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PREFACE In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. core, discipline specefic, generic elective, ability and skill enhancement for graduate students of all programmes at Honours level. This brings in the semester pattern, which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. I am happy to note that the university has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade "A". UGC (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for UGC 2020 programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English / Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisitioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor

Printed in accordance with the regulations of the Distance Education Bureau of the University Grants Commission. First Print : November, 2021 Netaji Subhas Open University Under Graduate Degree Programme Choice Based Credit System (CBCS) Subject : Honours in Geography (HGR) Course : Cartographic Techniques Lab & Thematic Mapping and Surveying Lab Course Code : CC-GR-01

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NSOU ??CC-GR-01 7 Unit-1 ? Scales and their Construction : Linear, Diagonal and Vernier Structure 1.0 Objectives 1.1 Introduction 1.2 Statement Scale 1.3 Ratio Scale 1.4 Graphical Scale 1.5 Construction of Graphical Scales 1.6 Comparative Scale 1.7 Vernier Scale 1.8 Construction of 'Single Positive Vernier Scale' 1.9 Summary 1.0 Objectives ? To know about the different tyhpes of scale ? To learn about the construction of scales 1.1 Introduction A map is a graphic representation of the features on the earth's surface. It is, therefore, a storehouse of spatial information. It is used to evaluate the topologic and metric properties of the geographic features, e.g., distance, direction, connectivity and proximity. These attributes enable us to identify the spatial patterns of association of the geographical features. Thus, a map conveys two fundamental properties- a. locations and b. attributes at locations Therefore, map is a very powerful tool for the spatial scientists, especially geographers. Essentially maps bear a definite relationship between what has been represented on it and what exists on the surface of the earth. This relationship forms the fundamental basis for the concept

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of a map scale. Map scale is defined as the ratio between a distance measured on the map,

or map distance (Dm) and the corresponding distance on the ground, or ground distance (Dg). Hence, a map. Scale = 1 : g m D D
8 NSOU ??CC-GR-01 Map scales are represented in three basic forms- 1. a statement (called, statement scale) 2. a numeric ratio (called, ratio scale or representative fraction or RF) 3. a graph (graphical scale). i) Statement Scale 1 cm to 10 km ii) Ratio Scale 1:1,000,000 iii) Graphical Scale 10 0 10 20 30 40 km Secondary Primary Division Division

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On maps it is customary to show a map scale in all the three forms for the sake of the convenience of the user. It is normally placed within a box. The location of the scale box depends on the page layout, the

best cartographic presentation being decided by-page border, location, size and shape of the outline map, available space, map index, key or legends. 1.2 Statement Scale It is a simple statement, in which the map distance is always expressed as a unit length. For example, 1 cm to 25 km or 1 inch to 50 miles. The value on the left- hand side of the statement indicates the map distance (cm/inch) and that on the right-hand side indicates the ground distance (km/mile). Despite its simplicity, the statement scale has two demerits. First, a layman, ignorant of the various scales of measurements, will not be able to read the map. Second, a reproduction of the original map by reduction or enlargement necessitates a determination of the scale all over again. 1.3 Ratio Scale It is a numeric ratio, in which the numerator is the map distance and the denominator is the corresponding ground distance, both being expressed in the same unit of measurement. Therefore, it is a dimensionless fraction.
NSOU ??CC-GR-01 9 For example, 1:100,000 (i.e., 1 unit of length on map is equivalent to 100,000 unit of length on ground). The greatest advantage of a numeric ratio scale is that a map with a given R.F. can be used universally. A statement scale or a graphical scale in any system of measurement can easily be computed from the R.F. and cartographically plotted as well. Thus, I: 100,000 may be written as: 1 cm to 100,000 cm (CGS system) or, 1 cm to (l00,000 ÷ 100,000) km or, 1 cm to 1 km Similarly, 1 : 100,000 may also be written as: 1 inch to 100,000 inch (FPS system) or, I inch to (100,000 ÷ 63,360) miles or, 1 inch to 1.58 miles Note: i. In R.F. conversion, both sides of the statement are expressed in the same unit of measurement. ii. The denominator of the R.F. should be rounded off to the nearest hundred or thousand or million as applicable. 1.4 Graphical Scale A map scale may also be cartographically represented by a line or a linear graph. This is known as a graphical scale. Primarily, a straight line is divided into a number of equal parts- known as the primary divisions. The left-most primary division is then subdivided into a number of equal parts, called secondary divisions. The value of one secondary division defines the precision of the map scale. A graphical scale can be constructed from either a statement scale or a numeric ratio scale. It can then be conveniently used by a layman to measure distances on a map. The graphical scale may take four different forms- 1. a plain scale, 2. a comparative scale,

10 NSOU ??CC-GR-01 3. a diagonal scale and 4. a vernier scale. 1.5 Construction of Graphical Scales Plain Scale This is the simplest form of a graphical scale and is shown as a linear graph. It is also called, linear scale. The primary or fundamental divisions (at least three) represent generally the ground distance in multiples of 1,5 or 10. The primary division on the extreme left is subdivided into a suitable number of secondary divisions. The length of each secondary division depends on the fractional length up to which precision in measurement is desired. The steps are: 1. As a construction principle, the map distance for each primary division is first evaluated from either a statement scale or R.F. 2. A straight line is drawn horizontally with a length suitable for the map (convenient class-room size being 6 inch or 15 cm). 3. With the help of a divider and a diagonal scale, primary divisions are cut off and perpendicular straight lines (of 0.5 cm or 0.3 inch) are drawn at each division point. However, primary divisions can also be mode graphically. 4. The first primary division from the left is then graphically subdivided into secondary divisions with the desired precision. The drawing is then properly labelled and bordered. Fig. 1 Scale–1 inch to a mile mile

NSOU ??CC-GR-01 11 Example: Q. Draw a Plain Linear Scale based on the statement, 1 inch to a mile. 1. Step - 1: Draw a horizontal straight line (5 inch). 2. Step - 2: Based on the statement, let the value of a 'primary division' be 1 mile. Therefore, number of 'primary divisions'= 5. 3. Step - 3: Divide the straight line graphically or by measurements into 5 eqal divisions. 4. Step - 4: Mark and label the 'primary divisions' taking 0 on the 2nd tick mark from the left. 5. Step - 5: Now, similarly divide the left-most 'primary division' into 10 equal divisions. 6. Step - 6: Mark and label the 'secondary divisions' properly (Fig. 1) Scale – 1:7,500 Fig. 2 Q. Draw a Plain Linear Scale based on the R.F. 1:7,500 Let the value of a 'primary division' = 100 m Therefore, 100 m on ground is represented by 1.33 cm on map Follow the given steps for drawing. 1. Step - 1: Draw a horizontal straight line.(1.33 × 4 cm) = 5.32 cm 2. Step - 2: Divide the straight line graphically into 4 equal divisions. 3. Step - 3: Mark and label the 'primary divisions' taking 0 on the 2 nd tick mark from the left. 100 0 100 200 300m

12 NSOU ??CC-GR-01 4. Step - 5: Now, similarly divide the left-most 'primary division' into 10 equal divisions (depending on the degree of precision intended). 5. Step - 6: Mark and label the 'secondary divisions' properly (Fig. 2) 1.6 Comparative Scale It is a composite linear scale in which two different linear scales representing different units of measurement, or time and distance, or pace and distance, or revolution and distance are superimposed for the sole purpose of comparison by keeping the 'O' mark same. They are respectively known as Unit Scale, Time Scale, Pace Scale and Revolution Scale. The Unit Comparative scale is the simplest one. It shows a comparison of distance measured in different but comparable units, e.g., kilometres-miles, metres-yards, etc. The two basic principles of construction are: 1) in both the scales, the ground distance equivalents of the pnmary and the secondary divisions are identical, and 2) the zero marks of both the scales coincide during superimposition. Example: Q. Draw a Comparative Scale based on the R.F. 1 : 66,000,000. Based on this R.F., let the value of a 'primary division' = 1000 km and 1000 miles The map value corresponding to 1000 km and 1000 miles should be found out first. CGS System 66,000,000 cm on ground is represented by 1 cm on map. Or, 66,000,000 100,000 km on ground is represented by 1 cm on map Or, 1000 km on ground rs represented by 100,000 1000 66,000,000 x cm on map = 1.51 cm FPS System 66,000,000 inch on ground is represented by 1 inch on map Or, 66,000,000 63360 miles on ground represented by 1 inch on map

NSOU ??CC-GR-01 13 Or, 1000 miles on ground is represented by 63360 1000 66,000,000 x inch on map = 0.96 inch 1. Step-1: Draw a 'plain linear scale' with measurements in CGS System 2. Step-2: Draw another 'plain linear scale' with measurements in FPS System just below the former, keeping 'O' mark at the same place (Fig. 3) Fig. 3 Scale – 1:66,000,000 Diagonal Scale In small and medium scale maps, accurate measurements can be obtained upto the smallest unit on the secondary division with a plain or comparative scale. However, on large scale or cadastral maps and plans (commonly used by surveyors, planners and geographers), measurements in decimal fraction are often desired, and here lies the importance and use of a diagonal scale. A diagonal scale has three types of divisions— 1) primary (on Main Scale), 2) secondary (on Main Scale) and 3) tertiary (on diagonal divisions). The principle is that the total value of all 'tertiary' divisions is equal to the value of 1 secondary division. Similarly, the total value of all 'secondary' divisions is exactly equal to the value of 1 primary division. The principle of construction is based on the properties of similar triangles explained below: 1000 1000 1000 1000 1000 3000 kilometers 2000 miles 0 0

14 NSOU ??CC-GR-01 Any reading which can be split into dimensionally related primary, secondary and tertiary divisions can be precisely measured with a diagonal scale. Concept of Diagonal Scale ? At end B of line AB, draw a perpendicular. ? Step-off ten equal divisions of any length along the perpendicular starting from B and ending at C. ? Number the division points 9,8,7, ... 1. ? Join A with C. ? Through the points 1, 2, 3, etc., draw lines parallel to AB and cutting AC at 1·, 2', 3', etc. ? Since the triangles are similar; 1'1 = 0.1 AB, 2·2 = 0.2AB, ... 9'9 = 0.9AB. ? Gives divisions of a given short line AB in multiples of 1/10 its length, e.g. O.lAB, 0.2AB, 0.3AB, etc. For example, 4.56 inch may be written as = 4.00 + 0.50 + 0.06 = (4 × 1.00) + (5 × 0.10) + (6 × 0.01) Here, 4, 5 and 6 are respectively the readings on the primary, secondary and tertiary divisions while their respective values are 1inch, 0.1 inch and 0.01 inch Readings with three related units are conveniently shown on a diagonal scale. For example, kilometre-metre-centimetre, mile-furlong-yard, furlong-yard-foot, yard-foot-inch, metre-decimetre-centimetre, decimetre-centimetre-millimetre, etc. The following steps are useful for the construction of a diagonal scale: 1) Step - 1: Break up the reading to fix the map distances for one primary, one secondary and one tertiary division. 2) Step - 2: Find the magnitudes of ground distance for one primary, one secondary and one tertiary division. 3) Step - 3: Accordingly, find the number of primary, secondary and tertiary divisions for the scale reading to be shown. 4) Step - 4: First, draw a plain scale with suitable numbers of primary and secondary divisions. Tertiary divisions are then drawn perpendicularly on the leftmost division of the main scale. 5) Step - 5: Horizontal lines parallel to the base of the main scale are drawn through each tertiary division points.

NSOU ??CC-GR-01 15 6) Step - 6: Secondary divisions are then marked off on the topmost horizontal line of the leftmost primary division. These are finally joined diagonally with those at the base of the left primary division. (Fig. 4) R.F. = 1:5000 Fig. 4 1.7 Vernier Scale The vernier is a device formulated by BP Vernier by which even the fractional parts of the smallest divisions of the main scale can be measured with the highest precision. It consists of a small auxiliary scale called the vernier which moves freely with its graduated edge along a long fixed scale called the main or primary scale. The vernier carries an index mark (Fig. 5) that forms the zero of the vernier divisions and is denoted by an arrow mark. The scale may be drawn as a straight linear graph or as an arc. The device is based upon the fact that it is easier to see the exact coincidence of two lines than to judge the distance between the two lines and is used in precision instruments like theodolite, sextant, barometer, planimeter, abney level, spherometer, screw gauge, slide callipers, etc. Verniers may be of two types-single and double-depending on its constrnction respectively on one or both sides of the index mark. However, from the point of view of principles of construction, verniers may be divided into two classes-direct or positive and retrograde or negative. Main Scale (inch) Vernier Scale Fig. 5 : 9 main scale divisions = 10 Vernier scale divisions
16 NSOU ??CC-GR-01 1.8 Construction of 'Single Positive Vernier Scale' In this the length of 'n' vernier divisions is equal to the length of (n – 1) main scale divisions. A vernier measurement can be decomposed into two parts as: 1) Main scale reading (MSR) and 2) Vernier reading (VR) The VR = Vernier Constant (VC) x No. of Vernier Division that coincides with a MS division. Vernier Constant, (VC) = The difference between the value of a main scale division and that of a vernier division = 1 n d, where n = number of vernier divisions and d = value of smallest division on the main scale. VC relates the vernier divisions with main scale division. Q. Draw a Vernier Scale to show 15.76 inch, given the value of 1 (One) smallest main scale division = 0.1 inch and 9 smallest main scale divisions are equal to 10 (ten) vernier divisions. Therefore, the smallest main scale division = 0.1 inch No. of vernier divisions = 10 Vernier Constant = 0.1 10 inch = 0.01 inch No. of vernier division that coincides with a main scale division = Measured Value Main scale division Vernier constant - = 15.76 15.70 0.01 - = 6 Its construction follows these steps: 1) Step - 1: Break up the reading to find the values of the main scale (15.70 inch) and the vernier component (0.06 inch)

NSOU ??CC-GR-01 17 2) Step - 2: Calculate the Vernier Constant (0.01 inch) from the given problem and find the number of Vernier division that concides with any of the main scale division). 3) Step - 3: First, draw a plain scale with a suitable number of primary and secondary divisions. 4) Step - 4: Based on the relations of the vernier and main scale, divide the 9 main scale division into 10 vernier scale divisions. 5) Step- 5: Take, on a screw-fitted divider, the length corresponding to the distance upto 6th division of Vernier scale. 6) Step - 6: Place one end of the divider on the main scale and slide it along the main scale until the other end coincides with a main scale division. 7) Step - 7: Now, mark the position of the left end of the divider on the main scale. 8) Step - 8: Starting from this point, draw vernier divisions (10) using a paper strip. 9) Step - 9: Mark and label the Vernier scale properly (Fig. 6) Fig. 6 Main Scale Vernier Constant–0.01 inch Vernier To show 15.76 inch 16 17 inch 15 6 1.9 Summary From this unit we have learnt about the different types of scales and their construction. A Storehouse of spatial information and the attributes enable us to identify the spatial patterns of association of the geographical features.

18 NSOU ??CC-GR-01 Map projection Coordinate system measurements Fig. 7 Unit-2 ? Projections and their construction: Polar Zenithal Stereographic, Simple Conic with one Standard Parallel, Bonne's, Cylindrical Equal Area and Mercator's Structure 2.0 Objectives 2.1 Introduction 2.2 Classification of Map Projections 2.3 Polar Zenithal Stereographic Projection 2.4 Simple Conical Projection with one Standard Parallel 2.5 Bonne's Projection 2.6 Cylindrical Equal-Area Projection 2.7 Construction 2.8 Mercator's Projection 2.9 Summary 2.0 Objectives ? To study about the different types of projection. ? To learn about the construction of the projections 2.1 Introduction Broadly speaking, map projection is defined as the systematic drawing of a network of parallels and meridians on a plain sheet of paper portraying a part or whole of the earth's surface. Naturally, it is scale-dependent and is done in accordance with a set of geometric and mathematical principles to satisfy certain objectives of the user. Thus, map projection is a device by which the curved surface of the earth is represented on a flat plane. The operational process essentially involves dimensional transformation, i.e., a 2-dimensional representation of the 3-dimensional figure of the earth.(Fig. 7) Principles of Map Projection

NSOU ??CC-GR-01 19 Maps are flat, but the Earth is not. Producing a perfect map is like peeling an orange and flattening the peel without distorting a map drawn on its surface. A map projection is a mathematical model of a set of rules or for transforming locations from the 3D Earth onto a 2D display (Fig. 8). This conversion necessarily distorts some aspect of the earth's surface, such as area, shape, distance, or direction. Hence, no flat representation of the earth can be completely accurate. Many different projections have been developed, each suited to a particular purpose. Map projections differ in the way they handle four properties: area, shape, distance and direction. Accordingly, they are called equal-area (authalic, homolographic or equivalent), orthomorphic (true-shape or conformal), equidistant, and azimuthal projections. Map projection follows certain rules. Rules : 1. No projection can preserve all four simultaneously, although some combinations can be preserved. 2. No projection can preserve both Area and Directions. However map maker must decide which property is most important and choose a projection based on that. Earth to Globe to Map Map Scale: Map Projection: Representative Fraction Scale Factor = Globe distance Earth distance = Mapdistance Globe distance (e.g. 1:24,000) (e.g. 0.9996) Fig. 8

20 NSOU ??CC-GR-01 2.2 Classification of Map Projections Map projections are fundamentally classified based on their extrinsic and intrinsic properties. The extrinsic properties include the exogenic parameters of transformation, i.e., the nature of datum surface, plane or surface of projection and the transformation process involved. The intrinsic properties include the specific property preserved, the geometric combination of parallels and meridians and the final shape of the graticules. Direct projection is when the projection is directly made from an oblate spheroid. Double projection is when the projection is made from a sphere originally transformed from an oblate spheroid. Based on developable surface, projections are of three types - planar (2D plane), conical (right circular cone), cylindrical (right circular cylinder) and polyhedral. Based on the tangency of projection plane, there are three types also - normal, transverse and oblique (Fig. 9). Based on the method of projection, the distinctive types are - perspective, non-perspective and conventional. Finally, based on properties the projections are of five types - 1. azimuthal (direction preserved), 2. equidistant (distance preserved), 3. equal area (area preserved: also called, equivalent or authalic or homolographic), 4. orthomorphic (shape preserved: also called, conformal) and 5. aphylactic (none). Families and Cases of Map Projection Fig. 9

NSOU ??CC-GR-01 21 2.3 Polar Zenithal Stereographic Projection Principle In this projection, a 2-dimensional plane of projection touches the generating globe at either of the poles. It is a perspective projection, with the source of light lying at the pole diametrically opposite to one at which the projection plane touches the generating globe(Fig.10) The parallels are projected as concentric circles of varying radius while the meridians are projected as straight lines radiating from the poles. Theory 1) Radius of the generating globe, R = Actual radius of the earth ÷ Denominator of R.F. Fig. 10 : Principles of Stereographic Projection 2) Radius of any parallel (ϕ), r = 2R tan ( ) 90 2 φ- Example Draw the graticule on Polar Zenithal Stereographic projection for the Southern Hemisphere upto 40°S at 10° interval on R.F.–l : 184,000,000

22 NSOU ??CC-GR-01 Computation 1. R = 640,000,000 184,000,000 cm = 3.48 cm 2. Radius of Parallels : φ 40°S 50°S 60°S 70°S 80°S 90°S ( ) 90 2 φ- 25 20 15 10 5 0 R(cm) 3.48 r = 2R tan ( ) 90 2 φ- cm 3.25 2.53 1.86 1.22 0.61 0 Construction 1) A pair of intersecting perpendicular straight lines is drawn at the centre of the paper. Fig. 11 Graticule on P. Z. Stereographic Projection

NSOU ??CC-GR-01 23 2) Concentric circles are drawn with centre at the point of intersection to represent the parallels. 3) With the help of a protractor, points are marked off at the given angular interval. 4) Straight lines are drawn joining these points with the centre to represent the meridians. 5) The graticule is then properly labelled with annotations. (Fig. 11) Properties 1) Parallels are represented by concentric circles of varying radius. 2) Inter-parallel distance gradually increases toward the equator. 3) Meridians are straight lines radiating from the pole at true azimuth apart. 4) The direction between any two points is preserved. 5) At any point, the radial scale is equal to the tangential scale. 6) It is an orthomorphic projection, i.e., the shape of a map is truly preserved. 7) It is commonly used for the map of the world in hemispheres. 2.4 Simple Conical Projection with One Standard Parallel Principle In this projection, a simple right circular cone touches the generating globe along a parallel. This is the parallel along which distortions of any kind is nil and is known as the standard parallel. It is a non-perspective projection. The standard parallel is drawn with a radius of R cotφ, where R is the radius of generating globe and φ is the standard parallel. Other parallels are concentric circles and meridians are radiating straight lines (Fig. 12)

24 NSOU ??CC-GR-01 Fig. 12 : Principles of Simple Conical Projection with I Standard Parallel Theory 1) The radius of the generating globe, R = Actual radius of the earth ÷ Denominator of the R.F. 2) The division of the central meridian for spacing the parallels at i o interval, put multiplication sign but not x. d CM = 180 Rπ ×(i) 3) The radius of the standard parallel, r = Rcot ϕ

NSOU ??CC-GR-01 25 4) The division on the standard parallel for spacing the meridians at i 0 interval, 1. 2 cos 360 Rπ φ ×(i) Example Draw the graticule on Simple Conial projection with I Standard Parallel for the extension 20°N – 60°S and 25°W – 95°W at 10° interval on R.F. 1 : 150,000,000 Computation 1. R = 640,000,000 150,000,000 cm = 4.266 cm 2. d CM = 180 Rπ ×(i) = 4.266 10 180 π× × = 0.744 cm 3. Standard Parallel between 20°N – 60°S is 20°S Therefore, r = Rcot ϕ = 4.266 cot20° = 11.72 cm 4. d = 2 cos 360 Rπ φ x(i) = 2 4.266 cos20 360 π× × × ×10 = 0.699 cm Construction 1) A straight line is drawn vertically through the centre of the paper to represent the central meridian.

26 NSOU ??CC-GR-01 2) It is then divided by d CM for spacing the parallels. 3) An arc of circle is then drawn through the standard parallel mark with radius and centre on the central meridian (produced if necessary). 4) Concentric arcs of circle are then drawn through each division on the central meridian to represent other parallels. 5) The standard parallel is divided by d on both sides of the central meridian for spacing the meridians. Fig. 13 : Graticule on Simple Conical Projecton with I Standard Parallel 6) Straight lines are drawn through each of these division points joining the centre of the arcs to represent the meridians. 7) The parallels and meridians are then properly labelled and annotated (Fig. 13) Properties 1) It is a non-perspective projection. The parallels are concentric arcs of circles truly spaced on the central meridian. 2) Poles are also represented by arcs in this projection. 3) Radial scale is true along all the meridians. 4) Meridians are straight lines truly spaced on the standard parallel and converging

NSOU ??CC-GR-01 27 at the vertex of the cone. 5) Tangential scale is true along the standard parallel only. 6) Deformation is positive towards the equator-and negative towards the pole. 7) It is an aphylactic projection, i.e., one that maintains neither area nor shape. 8) It is suitable for smaller countries of mid-latitude or temperate regions. 2.5 Bonne's Projection Principle In this projection, a simple right circular cone is supposed to touch the generating globe along the standard parallel. The radial scale is truly preserved along the central meridian and the tangential scale is preserved along all the parallels. Consequently, the parallels are represented as concentric arcs of circles but the meridians appear as smooth curves. This is the modification designed by R Bonne (a French cartographer) to the original Simple Conical Projection with I Standard Parallel(Fig. 14) Fig. 14 Theory 1) Radius of the generating globe, R = Actual radius of the earth ÷ Denominator of R.F. 2) The division of the central meridian for spacing the parallels at i 0 interval, d CM = 180 Rπ x(i)

28 NSOU ??CC-GR-01 3) The radius of the standard parallel, r = Rcot φp 4) The division on the standard parallel for spacing the meridians at i 0 interval, d = 2 cos 360 Rπ φ ×(i) Example Draw the graticule on Bonne's projection for the extension 8 o N – 40 o N and 66 o E – 98 o E at 4 o interval on R.F. 1:28,000,000 Computation 1. R = 640,000,000 28,000,000 cm = 22.85 cm 2. d CM = 180 Rπ ×(i) = 22.85 180 π× × 4 o = 1.59 cm 3. Standard Parallel between 80°N – 40°N is 24°N Therefore, r = Rcotφ = 22.85 Cot24° = 51.32cm 4. Division on Standard Parallel, d = 2 cos 360 Rπ φ × ×(i) φ 8°N 12°N 16°N 20°N 24°N 28°N 32°N 36°N 40°N R(cm) 22.85 d = 2 360 π φ Rcos ×i 1.57 1.56 1.53 1.49 1.45 1.40 1.35 1.29 1.22 Construction 1) A straight line is drawn vertically through the centre of the paper to represent the central meridian.

NSOU ??CC-GR-01 29 2) It is then divided by d for spacing the parallels. 3) An arc of circle is then drawn through the standard parallel mark with radius r and centre on the central meridian (produced if necessary). 4) Concentric arcs of circles are then drawn through each division on the central meridian to represent the remaining parallels. Fig. 15 Graticule on Bonne's Projection

30 NSOU ??CC-GR-01 5) Parallels are then divided with their corresponding division lengths on both sides of the central meridian. 6) Smooth free-hand curves are then drawn through the corresponding division points on the parallels to represent the meridians. 7) Lastly the graticule is poperly labelled and annotated (Fig. 15) Properties 1) Parallels are concentric arcs of circles, truly spaced on the central meridian. 2) Radial scale is true only along the central meridian. 3) The tangential scale is true along all the parallels. 4) Excepting the central meridian, all are regular curves concave towards the centre. 5) At any point the product of the two principal scales is unity. 6) It is an equal-area projection. 7) Since both parallels and meridians are curves, their intersection appears to be acute near the poles and obtuse near the lower latitudes. 8) For small and compact countries with nearly equal latitudinal and longitudinal extensions, angular deformation is relatively less, i.e., distortion in shape is less. 9) It is used for countries like France, Netherlands, Switzerland, Belgium, India, etc. 2.6 Cylindrical Equal-Area Projection Lambert developed this projection in which a simple right circular cylinder touches the globe along the equator. Parallels and meridians are both projected as straight lines intersecting one another at right angles. Tangential scale along all the parallels is kept equal to that along the equator. To maintain true area, radial scale along a meridian is made reciprocal to the tangential scale at that point. Hence, parallels lie at different heights above the equator. The interparallel spacing decreases rapidly towards the poles as parallels are all of same length as the equator(Fig. 16) 1) Radius of the generating globe, R = Actual radius of the earth + Denominator of R.F. 2) The division of the equator for spacing the meridians at i 0 interval, d E = 2 360 Rπ ×(i)
NSOU ??CC-GR-01 31 3) Height of a parallel from equator, y = RSinφ Example Draw the graticule on Cylindrical Equal Area projection for the whole globe at 30° interval on R.F. 1 : 295,000,000 Computation 1. R = 640,000,000 295,000,000 cm = 2.169 cm 2. d E = 2. . 360 Rπ × i = 2 2.169 360 π× × × 30 = 1.135 cm 3. Height / distance of a Parallel from Equator, y = RSinφ φ 30°N/s 60°N/s 90°N/s d E 1.135 y = RSinφ cm 1.084 1.878 2.169 2.7 Construction 1) A straight line is drawn horizontally through the centre of the paper to represent the equator. 2) It is then divided by d E for spacing the meridians. 3) Through each of these division points, straight lines are drawn perpendicular to the equator to represent the meridians. 4) On the central meridian, heights of different parallels from the equator are marked.
32 NSOU ??CC-GR-01 Fig. 16 : Principles of Cylindrical Equal Area Projection Fig. 17 Graticule on Cylindrical Equal Area Projection 5) Through each of these points, straight lines are drawn perpendicular to the central meridian to represent the parallels. 6) The graticule is then properly labelled. (Fig. 17)
NSOU ??CC-GR-01 33 Properties 1) Parallels are represented by a set of parallel straight lines. 2) Parallels are of same the length as the equator (2nR) 3) Parallels are variably spaced on the meridians. 4) Inter-parallel spacing decreases rapidly toward the pole. 5) The tangential scale rapidly increases poleward and is infinity at the poles. 6) Meridians are parallel straight lines truly spaced on the equator. 7) Meridians are of same length equal to the diameter of the globe (2R). 8) The inter-meridian spacing is uniform on all the parallels. 9) The pole is represented by a straight line of length 2nR. 10) At any point, the product of the two principal scales is unity. 11) It is an equal-area projection. 12) The shape is largely distorted near the poles. 2.8 Mercator's Projection Principle This is a cylindrical orthomorphic projection designed by Mercator and Wright. In this, a simple right circular cylinder touches the globe along the equator. All the parallels are of the same length equal to that of the equator and the meridians are equispaced on the parallels. Therefore, the tangential scale increases infinitely toward the pole. To maintain the property of orthomorphism, the radial scale is made equal to the tangential scale at any point. Hence, parallels are variably spaced on the meridians and the poles can never be represented. The parallels and meridians are represented by sets of straight lines intersecting at right angles. Theory 1) Radius of the generating globe, R = Actual radius of the earth ÷ Denominator of R.F. 2) The height of a parallel from the equator, y = 2.3026R log tan 90 2 ϕ+ ? ? ? ? ? ?
34 NSOU ??CC-GR-01 3) Divisions on the equator for spacing the meridians at i 0 interval, d E = 2 360 Rπ x(i) Example Draw the graticule on Mercator's projection for the whole globe from 80°N – 80°S at 20° internal on R.F. 1:295,000,000. Computation 1. R = 640,000,000 295,000,000 cm = 2.169 cm 2. d E = 2 360 Rπ ×(i) = 2 2.169 360 π× × ×20° = 0.757 cm 3 . Height / distance of a Parallel from Equator, y = 2.3026R log tan 90 2 ϕ+ ? ? ? ? ? ? φ 20°N/s 40°N/s 60°N/s 80°N/s 90 2 ϕ+ ? ? ? ? ? ? 55° 65° 75° 85° R(cm) 2.169 y = 2.3026R log tan 90 2 ϕ+ ? ? ? ? ? ? cm 0.772 1.655 2.856 5.284 Construction 1) A straight line is drawn horizontally through the centre of the paper to represent the equator. 2) It is then divided by d E for spacing the meridians. 3) Through each of these division points, straight lines are drawn perpendicular to the equator to represent the meridians.

NSOU ??CC-GR-01 35 4) On the central meridian, heights of different parallels from the equator are marked. 5) Through each of these points, straight lines are drawn perpendicular to the central meridian to represent the parallels. Fig.18 : Graticule on Mercator's Projection 6) The graticule is then properly labelled and annotated(Fig. 18) Properties 1) Parallels are represented by a set of parallel straight lines. 2) All parallels are of same length as the equator.

36 NSOU ??CC-GR-01 3) Parallels are variably spaced on a meridian and inter-parallel distance increases away from the equator. 4) The poles cannot be represented in this projection. 5) Meridians are represented by a set of parallel straight lines truly spaced on the equator only. 6) Meridians are equispaced on all the parallels and they are of equal dimension as well. 7) Parallels and meridians intersect each other at right angles. 8) On the map, the radial and the tangential scales are identical at all points. 9) It is an orthomorphic projection. 10) Direction being preserved in this net, any straight line drawn on this projection intersects the parallels at constant angles and thus represents a line of constant bearing on the globe forming a loxodrome or rhumbline. Therefore, the bearing from one point to another can easily be found by drawing a line between them and reading off the angle it makes with the meridians. Hence, it is very useful to sailors. 11) It is suitable for world maps showing wind circulation patterns, ocean circulation patterns, routes, drainage patterns, etc. 2.9 Summary

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Map projection is a way to flattten a globe's surface into a plane in order to make a map.

It

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is used to portray all or part of the round Earth on a flat surface.

Thus the it is a 2-dimensional representation of the 3-dimensional figure of the earth.

NSOU ??CC-GR-01 37 Unit 3 : Diagrammatic Representation of Data: Line and Bar Structure : 3.0 Objectives 3.1 Introduction 3.2 Line Graphs 3.3 Bar Diagrams 3.0 Objectives ? To study about the diagrammatic representation ? To learn about the tyhpes of graphs 3.1 Introduction The Diagrammatic representation of data can be done by line graphs and bar dragrams. 3.2 Line Graphs In these the points are plotted by means of rectangular coordinates with reference to a point of origin at which the x-axis (horizontal line) and y-axis (vertical line) intersect at right angles. The positive values are plotted to the right of the origin (zero) of the x-axis and above the origin (zero) of the y-axis, while the negative values are placed to the left of the origin (zero) of the x-axis and below the origin (zero) of the y-axis. Both the positive and negative values of the axes increase away from the origin. 1. Normally, period data, i.e., data on time frame and point data, i.e., spatial or vector data are represented in these graphs. 2. The chronological units are shown on the x - axis and the attributes of the variable on they - axis. 3. While plotting a curve, the vertical scale along the y - axis must be graduated from zero. However, scale-breaks can be used in demanding situations. 4. The curves must stand out clearly from the background. Therefore, it is mled more distinctively than the axes and guidelines. 5. When several curves are drawn on the same frame each should be clearly identified and distinguished by line, style or colour. 6. A line graph is normally a visual aid to understand the overall changes in value. As it rarely represents the true locus, points should be joined by a series of short straight lines. However, smoothening may be done by applying the statistical methods of curve fitting.

38 NSOU ??CC-GR-01 A simple line graph represents only a single series of values connected by a curve (Fig. 19 and 20). A polygraph is a mutliple line graph in which several sets of values are represented by distinctive lines for direct comparison (Fig. 21). A band graph is simply an aggregate or a compound line graph in which the trends of values in both the total and its constituents are shown by a series of lines on the same frame. The area between two successive lines is distinctively shaded for clarity. Fig. 19 : Simple Line Graph Fig. 20 : Simple Line Graph

NSOU ??CC-GR-01 39 Fig. 21 : Multiple Line Graphs Line graphs are normally drawn on an arithmetic scale, but when the range and dispersion of the data are very high, a logarithmic scale is taken. Such graphs are called log graphs. When logarithmic scales are taken along both the x - axis and the y - axis, the graphs are called log-log graphs(Fig. 22). When a logarithmic scale is taken along the y - axis and an arithmetic scale along the x - axis, they are called semi-log graphs(Fig. 23). These are particularly used when the variable is characterised by a very large range of values and a roughly constant ratio of increase. Fig. 22 : Log-log Line Graph (Rank-Size Distribution of Cities)

40 NSOU ??CC-GR-01 Fig. 23 : Semi-log Line Graph (Stream Order-Number relation) 3.3 Bar Diagrams These are 1-dimensional diagrams comprising a series of columns or bars proportional in length to the quantities they represent. Genetically bar diagrams are of three types— 1) simple bar diagrams, when the data with only one component is available and each bar represents a single value(Fig. 24). 2) compound bar diagrams, when the data comprises more than one component within a total and each bar is proportionately divided to show the constituents as well as the total; hence, these are more useful for comparison(Fig. 25) and 3) multiple bar diagrams, when different bars of proportionate lengths are drawn side by side to represent the constituents(Fig. 26).

NSOU ??CC-GR-01 41 Fig. 24 : Simple Bar Diagrams Fig. 25 : Compound Bar Diagrams

42 NSOU ??CC-GR-01 Fig. 26 : Multiple Vertical Bar Diagrams Based on the arrangements of the columns, bar diagrams are of three types: i) vertical bar diagrams(Fig. 26), when the bars are placed vertically above the abscissa, ii) horizontal bar diagrams(Fig. 27), when the bars are placed parallel to the abscissa and c) pyramidal bar diagrams or pyramid(Fig. 28 & 29) when the bars are arranged in the form of a pyramid. Fig. 27 : Horizontal Compound Bar Diagrams

NSOU ??CC-GR-01 43 Ago Fig. 28: Pyramid Diagrams Fig. 29 : Pyramid Diagrams Sometimes, percentage bar diagrams(Fig. 30), are drawn with the percentage values of the constituents. Such bars are of the same height representing 100% and are very useful for information about proportions. Again, to show the increase and decrease or profit and loss or surplus and deficit or positive and negative deviations, a two directional bar diagram or 'deviation bar diagram' is drawn(Fig. 31). Here, vertical bars are drawn above and below the horizontal zero line.

44 NSOU ??CC-GR-01 Fig. 30 : Percentage Bar Diagrams Fig. 31 : Deviation Bar Diagrams The basic principle of bar diagrams is that the length of a bar for an item is directly proportional to the quantity of the item it represents. Therefore, a suitable bar scale is first selected through visual inspection of data (1 cm represents 10,000 units). The general rule for its construction is— 1. Prepare a Worksheet (Table-1)

NSOU ??CC-GR-01 45 2. Select a Bar Scale 3. Compute the Bar Length 4. Draw the 'bar's with the computed lengths and annotate properly. Worksheet for Bar Diagrams District Population (P) Scale (s) Length of Bar P/10,000(cm) AA 54689 5.46 BB 86521 8.65 CC 9987 1 cm= 10,000 0.99 DD 24568 2.45 EE 19863 1.98 While choosing a bar scale, the ease of computation, construction and comprehensibility are of prime concern. Individual bars should be neither exceedingly short and wide nor very long and narrow. A worksheet must be drawn to show the computation in detail. An important point to remember is that the origin of the bar scale must be zero. However, space may be saved by using a scale break in some situations where there is a large range of values. Bars are separated by spaces not less than half the width of a bar or more than the width of a bar. Individual bars are essentially equal in width and uniformly spaced. However, in rainfall diagrams and in some special cases, no intervening spaces are left giving them the appearance of a battleship. Guide lines are helpful for understanding the diagram and may be extended throughout the diagram. Colours or shades may be applied for a better visual appeal.

46 NSOU ??CC-GR-01 Unit-4 ? Representation of Point Data: Isopleth Structure : 1.0 Objectives 4.1 Introduction 4.2 Isopleth Maps 4.3 Summary 4.0 Objectives ? To learn about the representation of point data. ? To study about isopleth maps. 4.1 Introduction These are quantitative areal maps where quantities are indicated by lines of equal value known by a multiplicity of such terms as isopleth (iso = equal, plethos = a multitude or crowd), isarithm, isoline, isometric lines, isontic lines and isogram. 4.2 Isopleth Maps Wright (1944) proposed that isograms be used for all lines of quantity with two subdivisions—isometric lines (metron meaning measurement) that represent a constant value or intensity pertaining to every point through which it passes and isopleths that represent a quantity or enumeration assumed to be constant, pertaining to certain areas through which it passes. An isopleth map (Fig. 32) is principally trend-surface map with three dimensions. The spatial trends are indicated by the spacing of isopleths. The closer the isopleths, the sharper the spatial variation and the steeper the horizontal gradient, and vice versa. Hence, regionalisation becomes easier based on the spatial geometry. However, the precision of drawing of isopleths along with the resultant geometric pattern depends on the selected value intervals, the size and shape of the units for which statistics are available, the situation of the plotting points and the actual method of interpolation (Mackay 1953, Porter 1958). Based on the overall range of quantities to be mapped, value intervals should be carefully selected. Intervals may be — (a) isarithmic, i.e., on a rhythmic interval basis (e.g., common intervals in arithmetic progression—2, 4, 6, 8 ...), (b) geometric (e.g., common factors in geometric progression—2, 4, 8, 16 ...) and (c) based on natural breaks in a frequency distribution.
NSOU ??CC-GR-01 47 The size of the enumeration unit determines the frequency and density of evaluated points from which the isopleths are interpolated and hence the precision. The shape of the areal units determines the location of the plotting points. Usually areal centres or centroids are at first carefully marked and then isopleths are interpolated in them. 1) The principle of interpolation is based on the assumption that between any two points there is an uniform rate of change of values. Hence, the isopleths are proportionally placed. 2) Isopleth maps are effectively drawn with both the absolute and the indexed values of any kind of information that involves spatial variation. 3) For better visual appeal inter-isopleth spaces may be filled in by graded shading and colour (Fig. 33). 4) In case of isometric lines, the maps are called chorisometer maps while in case of isopleths the maps are called chorisopleth maps (Wright 1944). 5) Isopleth maps, showing spatial distribution of an element, may be prepared on different time frames for an understanding of the changes in regional pattern. Fig. 32 : Isopleth Map
48 NSOU ??CC-GR-01 Fig. 33 : Isopleth Map 1.1 Summary Isopleth maps are very useful for geographical representation of data and used for sinplification of

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information about a region by showing areas with continuous distribution.

NSOU ??CC-GR-01 49 Unit-5 ? Representation of Area Data: Dots and Choropleth Structure 5.0 Objectives 5.1 Introduction 5.2 Qualitative Dot Map 5.3 Worksheet for Quanlitative Dot Map 5.4 Quantitative Dot Map 5.5 Choropleth Map 5.6 Summary 5.0 Objectives ? To study about the quantitative and qualitative maps. ? To study about the representation of these maps. 5.1 Introduction The representation of area data for shown through dots and choropleth. 5.2 Qualitative Dot Map These are maps in which dots are used to denote a position, the location of a feature, the intensity at a place, or a representative location for spatial summary data. Examples are a coordinate location, a radio tower, a spot height, the centroid of some distribution, or a conceptual volume at a place, such as the population of a settlement. Naturally, mapping is done with nominal data as well as ordinal data. Even though the marks (i.e., the dots drawn in these maps as circles of different sizes) may cover some map space, they are point symbols as they conceptually refer to a location(Fig. 34) The principles are: (a) dot size is subjectively scaled, directly varying with the ascending order of data values and (b) dots are positioned and centred exactly at the map locations. Visual variables of hue, orientation and shape can be applied to enhance the quality of map presentations as desired by the cartographer. 50 NSOU ??CC-GR-01 5.3 Worksheet for Quanlitative Dot Map Mouza Rural Population Scale Dot Size (d=mm) PP 345 Dia (mm) Range 4 QQ 678 4 >500 8 RR 875 8 500-1000 8 SS 1345 12 1000-1500 12 TT 456 4 Fig. 34 : A Qualitative Dot Map

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NSOU ??CC-GR-01 51 5.4 Quantitative Dot Map In this kind of distribution maps, quantities or values are represented by dots of uniform sizes, each dot having a specific value (Winterbotham 1934) (Fig. 35). Dot maps are especially useful when the values are unevenly and sporadically distributed. The dots are inserted within the particular administrative units for which data is available. The smaller the units, the more accurate is the map. While constructing a dot map the first step is to examine the range of quantities involved. From this, a value represented by each dot is selected. Basically, the success of a dot map depends absolutely on the choice of this value, called dot scale. It is chosen, keeping in mind the size of the administrative unit so that dots are neither numerous nor few. According to the principle, the number of dots corresponding to an administrative unit is directly proportional to the quantity. In other words, the statement, one dot represents k quantity forms the 'dot scale'. Hence, the number of dots for any administrative unit can be easily computed by dividing the quantity with the denominator of the scale. Worksheet for Quantitative Dot Map District Rural Population (P) Dot Scale (s) No. of Dot (P/s) AAA 12345 12 BBB 34567 35 CCC 9875 1 dot = 1000 10 DDD 17345 17 EEE 22456 22 While plotting, the dots should be placed evenly and uniformly within each unit. The boundaries of the units are often erased after the insertion of dots. Dots should never be placed in straight rows and columns; rather the vertices of a small equilateral triangle should be assumed and dots should be placed on these. The precision of a dot map can be enhanced by consulting a physical map showing negative areas. The size of the dots depends on the scale of the base map and on the number of dots to be inserted. To avoid the effects of coarseness or blurring and to obtain a finer visual tone, a nomograph may be consulted (Mackay 1949). Dot maps have three variants-percentage dot maps, mille dot maps and multiple dot maps. In the first two categories, the percentage values are mapped. In percentage
52 NSOU ??CC-GR-01 dot maps, each dot represents 1% while in mille dot maps each dot represents 0.1%. Such maps facilitate arithmetical comparisons and give ready information about the fractional distributions and proportions. In multiple dot maps, the distribution of several elements are normally shown using dots of differing colours and sizes. Fig. 35 : A Quantitative Dot Map 5.5 Choropleth Map Choropleth maps are technically quantitative areal maps that show the spatial distribution of the intensity or density of an element with the help of a system of graded shading or colour, drawn following the boundaries of the administrative units. The basic principle is that the intensity of shading is directly proportional to the density of elements. These density maps, related as they are to the administrative units, display only average distributions. Hence, the grouping of a number of units under one average value implies distributional uniformity. This may be far from the real world picture for the broad average may mask a vast range of local- variations. Obviously, the more expansive the areal units, the more sweeping the generalisation presented in the map form.
NSOU ??CC-GR-01 53 The construction of a choropleth map is a 3-step process as follows: 1. The first step is the drawing of a worksheet with four columns-name of the unit (column 1), absolute value of an element (column 2), area (column 3) and the density obtained by dividing the absolute value by the area (column 4) and rows equalling the count of the administrative units. 2. The second step is the construction of a choropleth table showing the columns of the density classes, administrative units, shading system and remarks. The choice of the scale of densities may be based on arithmetical progression with uniform class interval, or geometrical progression with rapid increasing intervals, or quartile deviation or mean deviation or standard deviation of the dataset or any other criteria chosen by the performer that seems to better suit the urpose. 3. The third step involves the meticulous drawing of shades (of either line or colour) following the administrative boundaries as per the choropleth table(Fig. 36) Worksheet – 1 for Computation of Population Density District Population (P) Area Density (A: sq km) (P/A: persons/sq km)

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A 1609172 3,149 511 B 3401173 6,227 546 C 2479155 3,387 732 D 2441794 3,140 778 E 1503178 2,219 677 F 3290468 3,733 881 G 5866569 5,324 1102 H 3015422 4,545 663 I 6895514 7,024 982 J 4604827 3,927 1173 K 8934286 4,094 2182

L 5041976 3,149 1601
54 NSOU ??CC-GR-01 Worksheet – 2 for Choropleth Mapping Density Class Districts Shading Systems Remarks 501 - 750 A,B,C,E,H Lightest Very Low 751 - 1000 D,F,I Light Low 1001 - 1500 G,J Medium Moderate 1501 -2000 L Deep High 2001 -2500 K Deepest Very High Choropleth maps are the basic tools of human geographers. The smaller the administrative unit, the more is the map precision. Intervals should be wisely chosen depending more on experience rather than on the theoretical character of distribution. Fig. 36 : A Choropleth Map

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NSOU ??CC-GR-01 55 5.6 Summary From this unit we have learnt about the different tyhpes of dot map and choropleth map and their representation. These maps show interval data as colour or shade.
56 NSOU ??CC-GR-01 Unit-6 ? Preparation of Thematic Maps: Proportional Squares, Proportional Pie Diagrams, Dots and Spheres Structure 6.0 Objectives 6.1 Introduction 6.2 Diagrammatic Maps 6.3 Proportional Squares Map 6.4 Proportional Pie Diagrams 6.5 Dots and Spheres 6.6 Summary 6.0 Objectives ? To study about the various schematic diagrams. 6.1 Introduction Various schematic diagrams such as proportional squares, proportional pie diagrams, dots and spares are used for preparation of thematic maps. 6.2 Diagrammatic Maps These maps, as the name suggests, show the representation of statistical data over the-map by means of suitable graphs and diagrams. These are also called thematic maps. The principles and procedures of such mapping are: i) the centres of circles and spheres must correspond to the exact site of the place or to the areal centres of the administrative units, ii) the base of any graph or of a bar, rectangle, square, triangle or cube should

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be placed at the exact centre of the region or at any point to be so selected that it may lie, as far as practicable, within the limits of the area concerned. For this

purpose the scale of representation should be thoughtfully chosen and iii) if, in spite of all considerations, diagrams of contiguous administrative units appear to overlap, they should be drawn sequentially for places in the ascending order of size. The smaller ones must be clearly visible while the larger ones may be allowed to be partly consumed or eclipsed. 6.3 Proportional Squares Map A proportional squares map comprises a series of squares proportional in size to the quantities they represent. Its construction is based on the principles that:
NSOU ??CC-GR-01 57 1. Area of a square (A) for an item is directly proportional to the quantity of the item (Q) it represents. 2. The area scale for the proportional squares is: a square of one unit area represents a quantity, q Area of square, A = x 2 (x = side of a square) The scale for the square diagrams should be chosen in such a way that individual squares are not too large or too small for the base map. A proportional scale is diagrammatically represented with at least three squares corresponding roughly to the largest, smallest and median values of the distribution. Side of a square is computed as: x = Q Worksheet for Proportional Square Map District Quantity (Q) x= Q Scale (s) Side of Square (d = x /s: cm) (cm) A 9579 97.87 1.96 B 9012 94.93 1.90 C 8901 94.35 1.89 D 7890 88.83 1.78 E 6789 82.40 1.65 F 5678 75.35 1.51 Proportional 5000 70.71 1.41 Scale 7500 86.60 1.73 10000 100.00 2.00 Square diagrams are of two types: i) simple square diagrams where data with only one component is available and each square represents a single value and 1 cm to 50
58 NSOU ??CC-GR-01 ii) compound square diagrams where the data comprise more for one component and each square is proportionately divided into rectangular segments to show its constituent parts. When maps are not available these are drawn on the same baseline with uniform intervening space. Colours or shades may be applied for visual appeal. In compound square diagrams, percentage values instead of absolute values may be evaluated and used to subdivide the squares. The squares afford ready information concerning proportions and facilitate arithmetic comparisons. The diagrammatic representation of the data mentioned in the worksheet has not been displayed. The Fig. 37 is a map for data set of Bankura District. The map prepared to show block-wise female population distribution of the district by proportional squares. A complete map should show the name of C.D. Blocks also. Fig. : Proportional Square Map
NSOU ??CC-GR-01 59 6.4 Proportional Pie Diagrams Pie diagrams are also called compound circle diagrams or wheel diagrams or pie charts. It is used when the data comprises more than one component within a circle and is proportionately divided into angular segments to show its constituent parts. Area of the circle is proportional to the total while its segments are proportional to the total angular value at the centre of the circle, i.e., 360°. Area of a circle, A = π × r 2 The construction of circle diagrams is based on the principle that the area of a circle (A) for a quantity to be represented (Q) is directly proportional to the total quantity it represents. Radius of a circle is computed as: r = Q π The angular segments (s) for the constituent items (i = 1, 2, 3, ...) are found by the formula: θ = 360 T ° × i Worksheet – 1 for Proportional Pic Diagrams District Quantity (Q) r = Q π Scale (s) Radii of Circle (r/s cm) A 9579 55.22 2.76 B 9012 53.56 2.68 C 8901 53.23 2.66 D 7890 50.11 2.51 E 6789 46.49 2.32 F 5678 42.51 2.13 Proportional 5000 39.89 1.99 Scale 7500 48.86 2.44 10000 56.42 2.82 1 cm to 15

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60 NSOU ??CC-GR-01 Worksheet – 2 for Proportional Pie Diagrams District Total Aus Aman Boro Production (Q) A 9579 1234 6543 1802 360° 46°23' 245°54' 67°43' B 9012 2112 5678 1222 360° 84°22' 226°49' 48°49' C 8901 998 6745 1158 360° 40°22' 272°48' 46°50' D 7890 1122 4425 2343 360° 51°12' 201°54' 106°54' E 6789 889 4321 1579 360° 47°08' 229°08' 83°44' F 5678 1008 3087 1583 360° 63°55' 195°43' 106°22' The scale for the circle diagrams is carefully selected so that individual circles are not too large or too small for the base map. A proportional scale must be diagrammatically represented with at least three circles corresponding roughly to the largest, smallest and median values of the distribution. A worksheet is drawn showing the computations in detail. Colours or shades may be applied for an effective visual toning. When maps are not available, they should be drawn touching the same baseline with uniform intervening spaces or they must be centred at the particular place or at the areal centre of the administrative unit. A separate worksheet is drawn to show the angular segments for each subdivision of the items and their total must be checked in a separate column. The drawing of the angular segments for each circle must start from a fixed line (either the radius drawn due west or north) and the respective order of drawing should be maintained throughout. A well planned legend of colours or shades must be drawn for the divisions of the main item. To afford ready information about proportions, percentage values corresponding to the angular segments, may be written on the outside or inside of its boundary as well.

NSOU ??CC-GR-01 61 The diagrammatic representation of the data mentioned in the worksheet has not been displayed. The Fig. 38 is a Map for data set of North 24 Parganas district. North 24 Parganas District, W.B. Fig. 38 : Proportional Pie Diagrams

62 NSOU ??CC-GR-01 6.5 Dots and Spheres Dot-and-Sphere map is used to show the distribution of both rural settlements and urban settlements of a region. The postulate is that rural settlements are distributed all over the region and is comfortably shown by 'quantitative dots' with a suitably chosen 'dot scale'(Fig. 39) As cities contain urban population, proportional spheres are used to show its huge volume. (Dot map has been discussed in the previous section in detail). Spheres are 3-dimensional diagrams comprising a series of spheres proportional in size to the quantities they represent. The construction of sphere diagrams is based on the principle that the volume of a sphere (V) for a quantity (Q) to be represented is directly proportional. Therefore, V = 4 3 πr 3 The statement, a sphere of one unit volume representl a quantity, q, forms the volume scale for the spheres. Therefore, radius of a sphere is given by: r = 3 3 4 V π Worksheet for Proportional Sphere Diagrams City Urban 3 3 4 V π Scale (s) Radii of Sphere Population, (d=r/s:cm) 2011 (V) A 99579 28.75 1.44 B 159012 33.61 1.68 C 589901 52.02 2.60 D 1017890 62.40 3.12 E 336789 43.16 2.16 F 55678 23.69 1.18 Proportional 50000 22.85 1.14 Scale 100000 28.79 1.44 1000000 62.03 3.10 1 cm to 20

NSOU ??CC-GR-01 63 The scale for the sphere diagrams should be carefully chosen so that individual spheres are not too small or too large for the base map. When maps are not available they should be drawn touching the same baseline with uniform intervening spaces; otherwise they must be centred at the particular place or at the areal centre of an administrative unit. A proportional scale must be diagrammatically represented with at least three spheres corresponding roughly to the largest, smallest and median values of the distribution. A worksheet must be neatly drawn to show the computations in detail. Graticule should be drawn or shading should be made carefully on the surface of the spheres to produce a 3-dimensional effects. Fig. 40 is an example of sphere effected by shading and Fig. 41 effected by the drawing of graticule. Fig. 39 : Quantitative Dot Map

64 NSOU ??CC-GR-01 Fig. 40 : Proportional Sphere Map Fig. 41 : Proportional Sphere Diagrams

NSOU ??CC-GR-01 65 6.6 Summary This unit gives a quick overview of the relative size of data without the use of scales. The are simple symbols used to represent data for location.

66 NSOU ??CC-GR-01 Unit - 7 ? Traverse Survey using Prismatic Compass Structure : 7.0 Objectives 7.1 Introduction 7.2 Prismatic Compass 7.3 Bearing of a Line 7.4 Local Attraction 7.5 Magnetic Declination 7.6 Whole Circle and Reduced Bearings 7.7 Fore and Back Bearings 7.8 Traverse Survey 7.9 Observations with Prismatic Compass 7.10 Traversing by a Prismatic Compass 7.11 Procedure 7.12 Correction of Bearings 7.13 Checks on Closed Traverse by Angles 7.14 Plotting the Traverse 7.15 Adjustment of Closing Error 7.16 Sources of Errors 7.17 Precautions 7.18 Summary 7.0 Objectives ? Learners will come to know about the travarse survey. ? To study about prismatic compass. 7.1 Introduction Surveying is needed for making accurate map of the earth's surface. It is defined as the art of taking such measurements as will determine the relative positions of points on the surface of the earth so that the size and shape of a portion of the

NSOU ??CC-GR-01 67 earth's surface may be ascertained and delineated on a map or plan. Obviously, it is a process of determining the positions of points on a horizontal plane. Contrary to this, the term levelling concerns the determination of the relative positions of points on a vertical plane. In a more comprehensive sense, surveying includes levelling. Fig. 42 7.2 Prismatic Compass It is the most commonly used compass (Fig. 42) to find the magnetic bearing of a line. It consists of a circular box (85-110 mm diameter) with a glass cover, in the 1. Needle 2. Pivot 3. Agate cap 4. Graduated disc 5. Slit metal frame 6. Horse hair 7. Mirror 8. Reflecting prism with cap 9. Eye vane 10. Focussing stud 11. Dark Sunglasses 12. Box 13. Glass cover 14. Litting pin 15. Light Spring 16. Brake pin or knob 17. Litting lever 18. Support to fit on tripod
68 NSOU ??CC-GR-01 centre of which a magnetic needle is

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balanced on a sharp pointed steel pivot with the help of an agate cap. The needle carries an aluminium ring with graduations in degrees and half degrees, which are written in an inverted style. The

object vane and the focussing stud for the prism are fitted at diametrically opposite points. The former consists of a hinged metal frame in the centre of which a horse hair or a fine wire is stretched. When it is folded on the lid, it presses the lifting pin separating it from the pin. The oscillation of the needle can be quickly checked by the inward pressing of the brake pin fitted at the base of the vane. A reflecting prism (right angled isosceles type) with a sighting slit at the top of the perpendicular side is fixed to the focussing stud. On the base, a prism cap is fitted with a turnable screw and dark glasses are sometimes provided to reduce the luminosity of the object. The object vane is sometimes provided with an adjustable mirror to sight the object more accurately. The prismatic compass is normally mounted on a light wooden tripod with a ball-socket joint. 7.3 Bearing of a Line It is the horizontal angle which the line makes with a reference direction or meridian, always measured clockwise from the line of reference. The bearing of a line (Fig. 43) may be: (i) true bearing or azimuth, if the reference line is a geographical meridian (i.e., the line passing through the given point and the geographical north and south poles), (ii) magnetic bearing, if the reference line is the magnetic meridian, passing through the given point and the magnetic north and south poles and (iii) arbitrary bearing, if the reference line is any line fixed and conceived on the ground during actual survey. 7.4 Local Attraction It refers to the deflection of a magnetic needle caused by external disturbances induced by the proximity of magnetic substances.
NSOU ??CC-GR-01 69 Fig. 43 7.5 Magnetic Declination The horizontal angle which the magnetic meridian through a place makes with the geographical meridian through the same place, is called the magnetic declination (Fig. 43). It depends upon the latitude of the place and undergoes diurnal, annual, secular and irregular variations. It is used to determine the true bearing of a line from the equation: True Bearing = Magnetic Bearing ± Magnetic Declination ('+' when the declination is East and '–' when the declination is West. Stations These are the ground points defined by the nodes of triangles or junctions of a traverse. 7.6 Whole Circle and Reduced Bearings Whole circle bearing (WCB) refers to the bearings expressed in whole circle system. In this, the bearing of a line is always measured clockwise from the north 70 NSOU ??CC-GR-01 line. The resultant amount may take any value between 0° and 360°. In contrast, the reduced bearing (RB) of a line refers to the bearings expressed in a quadrantal system in which it is measured as a horizontal angle from either the north or the south line (whichever is closer) towards either the east or the west line (whichever is closer). The magnitude of reduced bearing may take any value between 0° and 90°. In designating such bearings, quadrants are essentially mentioned. 7.7 Fore and Back Bearings The fore or forward bearing of a line (Fig. 44) refers to that which

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is measured in the direction of the progress of the survey, while the bearing

taken in the opposite direction is called back or backward bearing and are related by the equations: Back Bearing = Fore Bearing ±180° ('+' if FB >180° and '–', if FB <180° or, Back Bearing ~ Fore Bearing = 180° Fig. 44 7.8 Traverse Survey A traverse consists of a series of related points or stations which, when connected by angular and linear values, form a framework. Therefore, a traverse survey is one in which the points of the traverse frame are plotted from the measurements of the

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NSOU ??CC-GR-01 71 lengths and bearings (directions) of the series of connected lines. The lengths are usually measured with a tape while directions by a prismatic compass. The purpose is to control the subsequent details. The accuracy of the control survey must be superior to that of the subsidiary survey in general. A traverse may be of two types(Fig. 45) : 1) closed, when a complete circuit is made, i.e., the initial and final points coincide and 2) open, when the traverse framework does not form a closed polygon. Fig. 45 7.9 Observations with Prismatic Compass 1. Set up the prismatic compass over a station at your convenient height. 2. The instrument must be exactly overhead the ground station. To do this, a plumb bob is suspended from the bottom centre of the instrument to touch the head of the vertical ground pin. 3. Unfold the object vane and also the eye vane. 4. Level the instrument either

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by hand or by using a round pencil so that the

compass ring moves freely. 5. Rotate the instrument so

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that the line of sight (i.e., the line joining the centre of the eye piece and the horse hair) joins the station with the ranging rod held

vertically over another station.
72 NSOU ??CC-GR-01 6. Look through the eye piece

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and take the reading in degrees and minutes at the

intersection of the horse hair) ranging rod with the compass ring. Note: As the least count of the circular scale is 0° 30', readings are all in full degrees or may contain a term of 30 / only. 7.10 Traversing by a Prismatic Compass Loose needle traversing, as it is called, is mainly applied in reconnaissance or exploratory surveys. It is most advantageous because: (i) surveying is quick, (ii) each line is independent, (iii) the bearing of a line can be observed at any point along the line. However, lack of accuracy and vulnerability to local attractions lead to different sources of errors which are the common demerits of such surveys. The instruments and accessories required are: a prismatic compass, a tripod, a plumb bob, a tape, a set of pins and ranging rods. 7.11 Procedure i. Ranging rods are to be fixed at all the stations marked by pins with tags. ii. A rough sketch of the traverse is then drawn on the field book and the date, time, place and instrument number are recorded. iii. Distances of the lines are then measured with a tape and noted in the field book. iv. At each station, the prismatic compass is carefully centred and levelled. From each station, the bearings of the two connected lines are then observed and recorded in the appropriate columns as forward bearings (measured in the direction of survey) and backward bearings (measured in the opposite direction of survey) either in the form of reduced or whole circle bearings.

NSOU ??CC-GR-01 73 Field Book Closed Traverse Survey by Prismatic Compass Place: Date: Inst.No.: Time: Line Length Observed Bearing Difference Error Error/2 Corrected Bearing Remarks (ft) Fore Back (d) (d-180°) Fore Back AB 33.1 40°00' 219°00' 179° –1 o –0°30' 39°30' 219"30' i. all stations BC 35.3 95°30' 276°30' 1a1° +1 o +0°30' 96°00· 276°00' locally attracted. CD 36.4 208 o 30· 25°30' 183° +3 o +1°30' 207°00' 27°00' DA 42.2 282°30· 104°30' 178° –2 o –1°00' 2as 0 00· 103°30' ii. Survey done clockwise 7.12 Correction of Bearings The observed bearings are first corrected by adjusting the local attractions of the stations. The error can easily be detected from the difference of the fore and back bearings of a line. This difference should be exactly 180° and any deviation from this indicates local attraction at both ends of the line. The correction of bearings may be done as follows: When all the stations are locally attracted, difference between the bearings of none of the lines is 180°. Therefore, all the stations are affected by local attraction. Correction is made by equally distributing the error at both ends. The amount of error, therefore, may vary along the two lines from a single station. This is the demerit of this system in general. The general rules of correction are: 1) If e (or error) is negative, deduct 2 e from the smaller readings and add 2 e to the larger one. 2) If e is positive, deduct 2 e from the larger readings and add 2 e to the smaller one. 7.13 Checks on Closed Traverse by Angles For a closed polygon, the following checks may be applied: Sum of the internal angles = (2n – 4) × 90° (where n = number of sides in the polygon).

74 NSOU ??CC-GR-01 7.14 Plotting the Traverse The traverse is normally plotted by parallel meridian method. In this, distance and the corrected fore bearingf of each line are considered. At first, a map scale is selected and the ground distances are reduced. A small straight line is drawn vertically to represent the magnetic meridian. On it a point A is first marked and then the fore bearing of the first line (AB) is plotted with the help of a protractor and its length is marked off; thus the position of station B is fixed. Through B another line parallel to the magnetic meridian at A is drawn and the position of station C is similarly plotted with the help of the length and bearing of the line BC. The process is repeated at each station until all the lines are drawn(Fig. 46). Fig. 46 7.15 Adjustment of Closing Error After plotting the closed traverse data, there are often errors. The final point does not coincide with the initial point. This error is called closing error. To make

NSOU ??CC-GR-01 75 the traverse consistent, the closing error must be distributed by adjusting the lengths and bearings following either the Bowditch, Wilson or Smirnoff methods. Of these methods, the Bowditch method is more widely used because of its simplicity. It is based on the principle that the magnitude of error is proportional to the square root of distance. The closing error is distributed graphically by shifting each station by an amount proportional to the distance from the initial point parallel to the direction of the closing error. To do this, a straight line is drawn horizontally and the points are marked off with their reduced distances. At the closing point (A'), a perpendicular straight line is drawn and the amount of closing error (AA') is measured off. The top of this line is joined to the starting point (A) on the horizontal line and from each point on the horizontal line perpendiculars are drawn. These perpendicular segments (BB', CC', DD', etc.) are the proportionate closing errors to be distributed at the respective points. At each point on the plotted traverse, small straight lines parallel to the direction of closing error (error distribution line) are drawn. Then on each of these, respective closing errors are measured off and the corrected or adjusted points (B', C', D', etc.) are marked. These are then successively joined by straight lines to produce the corrected traverse in the form of a closed polygon (AB' C 'D' ... A). 7.16 Sources of Errors The common sources of errors in a prismatic compass traversing are instrumental, observational due to manipulation and sighting, and external influences. Instrumental errors may be of several types, such as, the needle is not perfectly straight or is sluggish with some lost magnetism, the needle may not be freely moving, the pivot is dull and bent, the plane of sight is not vertical, the line of sight is not passing through the centre of the graduated circle, the vertical hair is loose and thick, etc. Manipulation and sighting errors may be due to improper centering and levelling, imperfect bisection of the station with eye piece and horse hair, and carelessness in reading the graduated circle and recording the data properly in the field book. External influences like magnetic changes in the atmosphere, variations in magnetic declinations and local attractions due to the proximity of the magnetic substances may result in plottable errors in compass traversing.

76 NSOU ??CC-GR-01 7.17 Precautions Before setting, the instrument should be tested so that the instrumental errors can be eliminated at the outset. The instrument should be centred and levelled carefully. Before taking a reading, the compass should be precisely oriented so that the centre of the eye piece, the centre of the graduated circle, the horse hair and the ranging rod when held vertically over a station are all collinear and coplaner. The reading should be taken in the direction of increasing values only after the needle comes to a standstill. Magnetic substances of any sort should be avoided. 7.18 Summary Surveying is indeed the most important technique of determining the terrestrial or three-dimensional positions of points and the distances and angles between them. It has ben an element in the development of the human environment since the begining of recorded history.

NSOU ??CC-GR-01 77 Unit-8 ? Levelling and Contouring using Dumpy Level and Prismatic Compass Structure 8.0 Objectives 8.1 Introduction 8.2 Dumpy Level 8.3 Observations with Dumpy Level 8.4 Levelling Staff 8.5 Profile Levelling 8.6 Arithmetic Check 8.7 Contouring 8.8 Methods 8.9 Procedure 8.10 Computation 8.11 Interpolation of Contours 8.12 Sources of Errors 8.13 Precautions 8.14 Summarys 8.0 Objectives ? To learn about the levelling and contouring methods. ? To learn about the precautions while levelling and contouring. 8.1 Introduction Levelling concerns the determination of the relative positions of points on a vertical plane. In a more comprehensive sense, surveying includes levelling. 8.2 Dumpy Level Of the levelling instruments, it is the most simple, compact and stable one. The levelling head consists of a tribrach and a trivet with three arms each carrying a foot or a levelling screw. A telescope is rigidly fixed to its supports fitted to the spindles which are attached to the central hollow of the tribrach. The rotation of the telescope around the vertical axis is regulated by a clamp and a slow motion tangential screw. The telescope contains an eye piece, diaphragm, focussing screw, sighting knob and object glass. On its body, two level tubes (long and cross) are fixed in perpendicular directions(Fig. 47)

78 NSOU ??CC-GR-01 Fig. 47 8.3 Observations with Dumpy Level 1. Set the Dumpy level over a station. 2. Release the clamping screw and rotate the telescope to make it parallel to a line joining any two foot screws. 3. Rotate these two foot screws with both hands simultaneously either inward or outward until the bubble in the level tube is centred. 4. The telescope is then rotated to make it perpendicular to the line joining the previous two foot screws. Rotate this 3rd foot screw until the bubble in the level tube is centred.

NSOU ??CC-GR-01 79 5. The three foot-screws make an equilateral triangle. Step 2 to Step 4 is repeated twice separately for the remaining two sides of the triangle. This series of operations make the Dumpy level perfectly levelled at the given station. 6. Rotate the telescope until the line of collimation passes through a station with the staff held vertically over the station. Clamp the tangential screw and use slow motion tangential screw for precise sighting. 7. Look through the eye piece, adjust the focussing screw and take the required stadia reading on the staff. Note: All readings on a metre-staff contain figures with three places after the decimal point and those on a foot staff contain figures with two places after the decimal point. A metre is divided into 200 alternate black and white lines of uniform thickness and spacing of 0.005 m and a foot is divided into 100 alternate black and white lines of uniform thickness and spacing of 0.01 ft. A reading of 1.235 m = 1 is written in red on the right, = 2 is written in black on the left and there are 7 (0.035 = 0.005×7) black and white horizontal lines between the 1.200 m mark and the middle stadia. Similarly, a reading of 5.64 ft = 5 is written in red on the right, = 6 is written in black on the left and there are 4 (0.04 = 0.01×4) black and white horizontal lines between the 5.60 ft mark and the middle stadia. 8.4 Levelling Staff It is made of either wood or aluminium and may have graduations either in feet or in metres. The staff is normally 75 mm wide, 18 mm thick and 4 m long. It can be folded or may have sop with telescopic arrangements. There is a brass cap at each end of the staff. In a foot staff, each foot is divided into 100 equal divisions while in a metre-staff, each metre is divided into 200 equal divisions. On its silver white face, the graduations are numbered in red and black while the smallest divisions are coloured black and white(Fig. 48)

80 NSOU ??CC-GR-01 Fig. 48 8.5 Profile Levelling To draw a profile between two given points on the ground, Dumpy level is the most useful instrument. This is called profile levelling that gives a clear idea of the nature of irregularities of the ground along a chosen line in a particular direction. The following are the steps of doing this: 1. A line is laid on the ground between two points, A and B and stations are demarcated at a regular interval of distance on it (for distance measurement, commonly a measuring tape is used). Pins with Station Tags are placed at all the stations. 2. A Dumpy level is set up at a place from where all the stations are visible. The minimum distance of the closest station should be more than or equal to 5 m (it will help clear sighting of the Staff and taking measurements).

NSOU ??CC-GR-01 81 3. The instrument is then perfectly levelled using its three foot screws. 4. A staff is placed vertically over the first station. 5. The telescope is now turned to the staff with focussed eye-piece. The focussing screw on the telescope is rotated for clear visibility of the staff, when the line of sight intersects the staff. 6. Measurements on the staff at the intersection of the 'middle stedia' is then read accurately and recorded in the field book. 7. The first reading is recored as BSR (Back Sight Reading) and the last reading as FSR (Fore Sight Reading). All other readings are written as ISR (Intermediate Sight Readmg). 8. BM of the given station is noted to compute the 'height of collimation' and RL of a station is computed from it. The formulae are: Height of Collimation = BSR + BM RL of a station = Height of Collimation – ISR / FSR 9. The RLs are then plotted against the distances on a suitable scale by a line graph to find the nature of the ground(Fig. 49). The most important condition for this is that the vertical scale (VS) must be ten times that of the horizontal scale (HS). For example, if the horizontal scale is 1 inch to 10 ft, vertical scale will be 1 inch to 1 ft. Similarly, if HS is 1 cm to 5m, VS is 1cm to 0.5 m. To accommodate all the RLs, a datum is chosen nearest to the minimum RL value. Note: There are situations when all the stations may not be visible from a particular station. In such cases, the instrument is shifted to another place and the BSR for the second set-up is taken at the station with FSR in the previous set-up.
82 NSOU ??CC-GR-01 Field Book PROFILE LEVELLING BY DUMPY LEVEL Date: Instrument No. Time: Place: Instrument Station Distance BSR ISR(m) FSR Ht of RL Remarks at (m) (m) (m) Collimation A 0 1.235 26.560 25.325 1 10 1.350 25.210 X 2 20 1.785 24.775 3 30 1.810 24.750 4 40 2.010 24.550 5 50 1.750 1.560 26.750 25.000 BM,CP 6 60 1.955 24.795 y 7 70 1.985 24.765 8 80 2.220 24.530 B 90 2.255 24.495 Arithmetic Check 2.985 3.815 -0.830 -0.830 8.6 Arithmetic Check: Sum of BSR – Sum of FSR = Last RL – First RL = - 0.830 m
NSOU ? ? CC-GR-01 83 LONGITUDINAL PROFILE ALONG A LINE : AB BY DUMPY LEVEL Date: Instrument No. Time: Venue: Fig. 49
84 NSOU ??CC-GR-01 8.7 Contouring A contour is an imaginary line joining places with equal elevation above the sea level. Technically, it is defined as the line of intersection of a level surface with the surface of the ground. The vertical distance between two consecutive contours is called contour interval while the horizontal distance between the two is known as horizontal equivalent. Normally, the nature of the ground, the purpose and extent of the survey, the map scale and the amount of time and financial investment involved, together determine the contour interval. The smaller the map scale, the larger is the contour interval and the smaller the interval, the larger is the amount of field and office works. Contour maps are useful for engineering, hydrological and geomorphological studies. 8.8 Methods The preparation of a contour plan or map requires— 1) first, surveying and plotting the traverse: If the area to be contoured is not very extensive, a traverse may be so laid that it consists of a set of radial lines diverging from the apparently highest or lowest point of the area. The lengths and directions of each line may be fixed by prismatic compass survey. Stations may be taken at a regular distance apart on each line. 2) second, levelling survey to find the reduced levels of all the points on the traverse and 3) finally, the interpolation of the contours on the traverse plan. The equipment for levelling consists of a level (commonly a Dumpy level), a tripod, a levelling staff, a tape and a well laid out and neatly drawn field book for recording the staff readings, distances and field notes. 8.9 Procedure 1) The instrument is first set up at a convenient height and at a place from where a maximum number of stations can be sighted. 2) The instrument is then perfectly levelled with the help of foot screws and level tube.
NSOU ??CC-GR-01 85 3) The telescope is then directed towards the staff held vertically over the station (within or outside the traverse) with a known reduced level (Bench Mark). The eye piece and the object are focussed properly and the staff reading for the middle stadia is taken and the first reading is entered as a back sight reading (BS). 4) Similarly the staff readings for all the visible stations are taken successively. The last reading of the set up is entered as a fore sight reading (FS) while all others as intermediate sight readings (IS). 5) The instrument is then shifted to some other convenient position(s) from where the readings of the remaining stations (not covered in the first set up) can be taken. In this set up, the first reading is taken on the staff held at the last station of the former set up. It is certainly a back sight reading. This station is called a change point (CP). 6) Following the same procedure, staff readings are then taken on the remaining stations. 8.10 Computation The reduced levels of the stations can be calculated easily using collimation method. In this, the reduced levels are evaluated by subtracting the staff readings from the corresponding height of collimation. The common rules are: 1) HC = BS + RL of BM 2) RL of a Station = HC – IS or FS 3) For a new set up, i.e., at change points, new heights of collimation are evaluated as 4) HC of a CP =BS+ RL of the CP Arithmetical checks are done to avoid any ambiguity and confusion. The common checks are: ΣIBS – ΣFS = Last RL – First RL

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86 NSOU ??CC-GR-01 Field Book Determination of Reduced Levels by Dumpy Level Date: Time: Place : Inst. No. : Collimation Method Staff Reading (ft) Height of Reduced Stations Collimation Levels Remark BS IS FS (ft) (ft) A 09.87 34.87 025.00 BM B 04.56 030.31 C 02.32 032.55 D 08.76 1.23 42.40 033.64 CP E 06.18 036.22 F 03.57 038.83 G 11.65 1.94 52.11 040.46 CP H 05.83 046.28 I 1.57 050.54 Σ 30.28 22.46 4.74 333.83 Arithmetical Check : ΣBS − ΣFS = 30.28 − 4.74 = 25.54; RL 1 − RL A = 50.54 − 25.00 = 25.54 8.11 Interpolation of Contours 1) With the help of distance and bearing, the traverse or the radial lines are first plotted on a selected scale. 2) Stations are the marked on the lines. 3) Stations are then labelled with their RLs 4) From the range of RLs, contours are then selected at a suitable interval. Interpolation of contours between two RLs on a line may be done either by eye estimation or by arithmetical calculation. 5) Location of a desired contour depends on the amount of relief between the points with respect to the distance and the direction of rise or fall.

NSOU ??CC-GR-01 87 6) Through the interpolated points of identical elevation, freehand smooth lines are drawn to represent the desired contours(Fig. 50). CONTOUR PLAN BY DUMPY LEVEL SURVEY Fig. 50 8.12 Sources of Errors The common sources of errors in contouring are instrumental, observational and natural. (Sources of errors in compass traversing have already been discussed). However, in levelling operations, the instrumental elTors consist of a defective foot screw, a defective bubble tube, imperfect adjustment of the telescope and bubble, a faulty focussing tube, erroneous divisions on the staff and so on. Improper and careless levelling, parallax in sighting, non-verticality of the staff and mistakes in reading and recording the values in the field book are the common observational errors. The natural sources of en-ors are high wind, high sun, high temperature, curvature and refraction. 8.13 Precautions At every stage, surveying should be done very carefully. Special precautions should be taken while levelling the instrument, reading the staff, holding the staff

88 NSOU ??CC-GR-01 vertically over the stations, taking back sight reading at the last station of the former set up in case of change points, checking the office work in detail, etc. 8.14 Summary This unit gives the learners an overall idea about the levelling and contouring methods. levelling is a process of deternining the height of one level relative to another.

NSOU ??CC-GR-01 89 Glossary / Keywords 1. Scale 2. RF 3. Ratio Scale 4. Comparative Scale 5. Linear Scale 6. Vernier Scale 7. Primary Division 8. Secondary Division 9. Tertiary Division 10. Least Count 11. Vernier Constant 12. Main Scale 13. Vernier 14. Precision of Scale 15. Map Projection 16. Projection Plane 17. Generating Globe 18. Developable Surface 19. Standard Parallel 20. Latitude 21. Longitude 22. Parallels 23. Meridians 24. Great Circle

90 NSOU ??CC-GR-01 25. Constant of cone 26. Rhumb Line 27. Loxodrome 28. Orthodrome 29. Equidistant projection 30. Equal Area projection 31. Orthomorphic Projection 32. Azimuthal Projection 33. Aphylactic Projection 34. Planar Projection 35. Conical Projection 36. Cylindrical Projection 37. Polar Projection 38. Zenithal Projection 39. Radial Scale 40. Tangential Scale 41. Diagram 42. Line 43. Point 44. area 45. Volume 46. Line diagram 47. Multiple line diagram 48. Polygraph 49. Band graph 50. Log-log graph

NSOU ??CC-GR-01 91 51. Semi-log graph 52. Bar diagram 53. Multiple bar diagrams 54. Compound bar diagrams 55. Bar scale 56. Vertical bar diagrams 57. Horizontal bar diagrams 58. Pyramid 59. Percentage bar diagrams 60. Point data 61. Period data 62. Spatial data 63. Geographical data 64. Isarithm 65. Isoline 66. Isometric line 67. Isogram 68. Isontic line 69. Natural breaks 70. Isopleth map 71. Trend surface map 72. Area data 73. Dot map 74. Qualitative dot map 75. Quantitative dot map 76. Dot scale

92 NSOU ??CC-GR-01 77. Choropleth map 78. Graded shading 79. Thematic map 80. Diagrammatic map 81. Flowline map 82. Choroschematic map 83. Choropleth map 84. Chorochromatic map 85. Colour patch map 86. Proportional scale 87. Proportional square maps 88. Proportional pie diagrams 89. Proportional sphere maps 90. Area of a Square 91. Area of a Circle 92. Volume of a sphere 93. Surveying 94. Traverse 95. Closed traverse 96. Open Traverse 97. North line 98. Magnetic bearing 99. True bearing 100. Whole circle bearing 101. Reduced bearing 102. Closing error

NSOU ??CC-GR-01 93 103. Plan 104. Map 105. Prismatic compass 106. Ranging rod 107. Local attraction 108. Magnetic declination 109. Fore bearing 110. Back bearing 111. Levelling 112. Dumpy level 113. Collimation line 114. Axis of the telescope 115. Horizontal line 116. Vertical line 117. Plumb line 118. Level line 119. Level surface 120. Bench Mark 121. Reduced Level 122. BSR 123. ISR 124. FSR 125. CP 126. Contour 127. Interpolation

94 NSOU ??CC-GR-01 Reference and Further Readings 1. Anderssen R S Osborne M R (ed. 1970) : Data Representation, Queensland University Press 2. Balchin W G V and Lewis WV (1945): The Constrnction of Distribution Maps, Geography, 30(3), pp91 3. Bugayevskiy L Mand Synder P (1995): Map Projections - a reference manual, London: Taylor and Francis 4. Clark D (1963): Plane and Geodetic Surveying for Engineers, Vol. I & II, Constable, London 5. Cole J P and King CAM (1970): Quantitative Geography, John Wiley & Sons, NY 6. Cuff D J and Mattson MT (1982): Thematic Maps - their design and production, Methuen, London 7. Deetz CH and Adams OS (1934): Elements of Map Projection, USCGS Spl. Bull.68, pp117-136 1. Dent B D (1990): Cartography - thematic map design, William Brown Pub., Dubuque, IA 2. Garnier BJ (1963): Practical Works in Geography, Edward Arnold Pub., London 3. Hinks AR (1921): Map Projections, Cambridge University Press 4. Kanetkar T P and Kulkarni S V (1965): Surveying and Levelling, Part - I & II, AVG Prakashan, Pune 5. Keates JS (1973): Cartographic Design and Production, Longman, London 6. Kelllaway, G, P (1957): Map Projections, Methuen 7. Kraak M J and F Ormerling (1996): Cartography- visualisation of Spatial Data, Longman, Harlow 8. Mainwaring J (1960): An Introduction to the study of Map Projections, McMillan & Co., London 9. Maling DH (1973): Co-ordinate Systems and Map Projections, George Phillip & Sons Ltd., London
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96 NSOU ??CC-GR-01 QUESTIONS 1. Define Scale. 2. What are the different types of scale? 3. Compare ratio scale and statement scale. 4. Compare graphical scale and ratio scale. 5. What are the advantages of ratio scale? 6. What are the advantages of comparative scale? 7. What is linear scale? 8. What do you mean by 'precision of scale'? 9. What are 'primary divisions'? 10. What are 'secondary divisions'? 11. What is 'least count of scale'? 12. Define 'vernier constant'. 13. Why the 'diagonal' scale is so named? 14. What is vernier reading? 15. Define map projection. 16. What is a projection plane? 17. What is a generating globe? 18. What is a developable surface? 19. Define 'standard parallel'. 20. Define latitude of a place. 21. Define longitude of a place. 22. What are parallels of latitude? 23. What are 'meridians of longitude'? 24. Define a 'great circle'.
NSOU ??CC-GR-01 97 25. How many great circles can be drawn on a globe? 26. Define 'constant of a cone'. 27. Wha are Rhumb Lines? 28. What is meant by 'loxodrome'? 29. What are orthodromes? 30. What are equidistant projections 31. What are equal area projections? 32. What are orthomorphic projections? 33. What are azimuthal projections 34. What are aphylactic projections? 35. What are planar projections? 36. What are conical projections? 37. What are cylindrical projections? 38. What are polar projections? 39. What are zenithal projections? 40. Define radial scale 41. Define tangential scale 42. State the principles of PZ Stereographic Projection. 43. State the principles of Simple Conical Projection with I Standard Parallel. 44. State the principles of Bonne's Projection. 45. State the principles of Cylindrical Equal Area Projection. 46. State the principles of Mercator Projection. 47. State the properties of PZ Stereographic Projection. 48. State the properties of Simple Conical Projection with I Standard Parallel. 49. State the properties of Bonne's Projection. 50. State the properties of Cylindrical Equal Area Projection.
98 NSOU ??CC-GR-01 51. State the properties of Mercator Projection. 52. What are graphs? 53. What are diagrams? 54. What is a line graph? 55. What are polygraphs? 56. What are band graphs? 57. What is a log-log graph? 58. What is a semi-log graph? 59. What are bar diagrams? 60. What are multiple bar diagrams? 61. What are compound bar diagrams? 62. Define bar scale. 63. What are vertical bar diagrams? 64. What are horizontal bar diagrams? 65. What is a pyramid? 66. What are percentage bar diagrams? 67. Which data are suitable for line graphs? 68. Which data are suitable for polygraphs? 69. Which data are suitable for band graphs? 70. Which data are suitable for bar diagrams? 71. Which data are suitable for multiple bar diagrams? 72. Which data are suitable for compound bar diagrams? 73. Which data are suitable for pyramids? 74. What is 'point data'? 75. What is 'period data'? 76. What is 'spatial data'?

NSOU ??CC-GR-01 99 77. What is 'geographical data'? 78. Define isarithm. 79. Define isoline. 80. Define isometric line. 81. Define isogram. 82. Define isontic line. 83. What are natural breaks? 84. What are isopleth maps? 85. What are trend surface maps? 86. Which data are suitable for isopleth maps? 87. What are the advantages of isopleth maps? 88. What is meant by 'area data'? 89. What are 'dot maps'? 90. What are qualitative dot maps? 91. What are quantitative dot maps? 92. Define 'dot scale'. 93. State the principles of placing 'dot' on a map. 94. What are 'chorobleth maps'? 95. How does choropleth maps differ from chorochromatic and choroschematic maps? 96. What is meant by 'graded shading'? 97. What is 'area data'? 98. What are area symbols? 99. What are volume symbols? 100. Define a 'thematic map'. 101. What are diagrammatic maps'?

100 NSOU ??CC-GR-01 102. What are flowline maps? 103. What are choroschematic maps? 104. What are chorochromatic map? 105. What are colour patch maps? 106. What is meant by 'proportional scale'? 107. What are proportional square maps? 108. What are proportional pie diagrams? 109. What are proportional sphere maps 110. What is the area of a square? 111. Give the radius, circumference and area of a circle. 112. Give the radius, surface area and volume of a sphere. 113. Define surveying. 114. Define a traverse. 115. What is a closed traverse? 116. What is an open traverse? 117. Define 'North line'. 118. Define bearing of a line. 119. What is magnetic bearing? 120. What is true bearing? 121. What is whole circle bearing? 122. What is reduced bearing? 123. What is meant by 'closing error'? 124. Define a 'Plan' 125. Define a 'Map'. 126. Name the parts of a Prismatic compass. 127. What is a Ranging rod?

NSOU ??CC-GR-01 101 128. What is meant by 'local attraction'? 129. What is 'magnetic declination'? 130. What is Fore bearing of a line? 131. What is 'Back bearing of a line'? 132. How a traverse survey is done with a Prismatic compass? 133. How the local attraction is adjusted? 134. What is the check for bearings of a line? 135. What is the check for included angles of a traverse? 136. What are the precautions to be taken in a traverse survey by Prismatic compass? 137. Define levelling. 138. What are the parts of a Dumpy level? 139. How a Dumpy level is perfectly levelled? 140. Define collimation line. 141. What is 'axis of the telescope'? 142. Define horizontal line. 143. Define vertical line. 144. What is plumb line? 145. What is 'level line'? 146. What is 'level surface'? 147. What is Bench Mark (BM)? 148. What is Reduced Level (RL)? 149. What is BSR? 150. What is ISR? 151. What is FSR? 152. What is Change Point (CP)?

102 NSOU ??CC-GR-01 153. Define a contour. 154. What is meant by 'interpolation'? 155. What are instruments used for contour survey? 156. What are the sources of error in Dumpy level survey? 157. What are the precautions necessary in Dumpy level survey?

NSOU ??CC-GR-01 103 Notes

104 NSOU ??CC-GR-01 Notes

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of a map scale. Map scale is defined as the ratio between a distance measured on the map,

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On maps it is customary to show a map scale in all the three forms for the sake of the convenience of the user. It is normally placed within a box. The location of the scale box depends on the page layout, the

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Map projection is a way to flattten a globe's surface into a plane in order to make a map.

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is used to portray all or part of the round Earth on a flat surface.

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information about a region by showing areas with continuous distribution.

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be placed at the exact centre of the region or at any point to be so selected that it may lie, as far as practicable, within the limits of the area concerned. For this

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balanced on a sharp pointed steel pivot with the help of an agate cap. The needle carries an aluminium ring with graduations in degrees and half degrees, which are written in an inverted style. The

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is measured in the direction of the progress of the survey, while the bearing

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by hand or by using a round pencil so that the

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11/12	SUBMITTED TEXT	26 WORDS	44%	MATCHING TEXT	26 WORDS

that the line of sight (i.e., the line joining the centre of the eye piece and the horse hair) joins the station with the ranging rod held

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and take the reading in degrees and minutes at the

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PREFACE In a bid to standardise higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses: core, generic discipline specific elective, and ability/ skill enhancement for graduate students of all programmes at Elective/ Honours level. This brings in the semester pattern, which finds efficacy in tandem with credit system, credit transfer, comprehensive and continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry acquired credits. I am happy to note that the University has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade "A". UGC (Open and Distance Learning programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English. Eventually, these will be translated into Bengali too, for the benefit of learners. As always, we have requisitioned the services of the best academics in each domain for the preparation of new SLMs, and I am sure they will be of commendable academic support. We look forward to proactive feedback from all stake-holders who will participate in the teaching-learning of these study materials. It has been a very challenging task well executed, and 1 congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor

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Netaji Subhas Open University GEOMORPHOLOGY AND CLIMATOLOGY LABORATORY [CC-GR-02] Module 1 : Geotectonics and Geomorphology Laboratory Unit 1 Interpretation of Indian Topographical Sheets 9-45 Unit 2 Relative Relief map, Slope map (Wentworth) 46-53 Unit 3 Correlation between physical and cultural features from topographical map 54-97 Unit 4 Delineation of Drainage Basin and Construction of Hypsometric Curve 98-109 Unit 5 Megascopic Identification of Minerals and Rocks 110-135 Unit 6 Measurement of dip and strike using Clinometer 136-138 Unit 7 Preparation and Interpretation of Simple Geological Map 139-163 Module 2 : Climatology Laboratory Unit 1 Measurement of Weather Elements using Analogue Instruments: Mean daily temperature, Air pressure 167-180 Unit 2 Interpretation of a Daily Weather Map of India 181-209 Unit 3 Construction and Interpretation of Climograph 210-214 Unit 4 Construction and Interpretation of Wind Rose 215-216 Unit 5 Construction and Interpretation of Climatic Chart 217-221 Unit 6 Construction and Interpretation of Ombrothermic Chart 222-227 UG : Geography (HGR)
Module-1 Geotectonics and Geomorphology Laboratory Learning Objectives 1) To study the Indian topographical maps in detail. 2) To extract geomorphic information from Survey of India topographical maps. 3) Construction and interpretation of relief profiles (superimposed, projected and composite). 4) To calculate and draw the morphometric maps, like Relative Relief map, Slope map (Wentworth). 5) To correlate between physical and cultural features from topographical maps using transect chart. 6) To delineate a Drainage basin from topographical maps and find out its properties. 7) To construct a Hypsometric curve from topographical maps. 8) To identify the rocks and minerals by observing their salient features. 9) To learn the use of clinometers to measure dip and strike. 10) To study different geological maps and learn to interpret by understanding the Horizontal, Uniclinal and Simple Anticlinal & Synclinal Fold Structure.
8 CC-GR-02 NSOU
NSOU CC-GR-02 9 Unit-1 Interpretation of Indian Topographical Maps/ Sheets Structure 1. Interpretation of Indian Topographical Sheets 1.1 Concept 1.2 Introduction 1.3 Extraction and Interpretation of geomorphic information from topographical maps/survey of India maps— 1.3.1 Map reading 1.3.2 Numbering of Topographical maps of India 1.4

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Conventional Signs for Topographical maps of survey of India 1.4.1 Description 1.4.1.1 Villages,		

Buildings etc. 1.4.1.2 Water features 1.4.1.3 Telegraph lines 1.4.1.4 Railway and Bridges 1.4.1.5 Road and Bridges 1.4.1.6 Embankments 1.4.1.7 Boundaries, limits and Gardens 1.4.1.8 Ornamentation and Trees 1.4.1.9 High Mountain Features 1.4.1.10 Hill and Mountain Featues 1.4.1.11 Heights, Trigonometrical Symbols 1.4.1.12 Coastal Symbols 1.4.2 Scientific Study of Topographical Maps

10 CC-GR-02 NSOU 1.5 Key Features of Topographical Maps 1.5.1 Layout and Scale of Survey of India Topographical Sheets 1.5.1.1 Old Series Maps 1.5.1.2 Open Series Maps 1.5.2 Dimentions 1.6 Methods of Interpretation 1.6.1 Indentified Physical Features 1.6.2 (A) Miniature Map (B) Broad Physiographic Divisions 1.6.3 Longitudinal Profiles 1.6.4 Serial Profiles 1.6.5 Superimposed, Projected and Composite Profile 1.1 Concept Map interpretation is the systematic action of explaining the meaning, understanding, reading and execution of map. In it, a special attention given to the study of physical and cultural aspects potrayed on topographical maps or topo maps. It also gives emphasis on the relationship between the environmental setting and human activities, transportation, settlement and land use. The topographical map shows the surface of the earth in detail. It covers small area but shows much greater detail of natural features such as relief, drainage, vegetation etc. and man-made features such as roads, railways, villages, towns, canals etc. Thus, a topographical map is a multipurpose map and serves as a guide to geographers especially for studing the regional geography of the area depicted on the map. The topo-sheets or Topographical survey sheets are known storehouse of information. The study of any topographical sheet sharts with introduction of the marginal information which is generally given under the following heads.

NSOU CC-GR-02 11 i) The number of the sheet ii) Name of the state or district Given on the upper iii) The year of survey, publication of the map. margin of the sheet iv) Magnetic variation from true north and its annual variation v) Scale of the map vi) coutour interval Given in the lower vii) Index to sheets margin of the sheet viii) Administrative index ix) Grid reference x) Longitudinal extent xi) Latitudinal extent Given on the side xii) Height conversion table margins Thus, the name of the state or district mentioned in the topo-sheets not only provide information on the location of the area, but also lights on the geologic structure, past climatological as well as other physical information along with the evolution of that particular area. The account of a topographical map is generally written under the following headings: 1. Introduction 2. Relief feature 3. Drainage 4. Vegetation 5. Settlement 6. Transport and communication 7. Irrigation and Occupation 8. Other Features. → → →

12 CC-GR-02 NSOU ↓ ↓ ↓ < < < < < < < < ↓ ↓ ↓ ↓ ↓ ↓ ↓ < < < < < < < < < 1.2 Introduction Introduction of the map is given after physical and cultural elements are discussed and their possible interrelation is established. The information of topographic features from the map can be tabulated below: Topography Physical Elements Cultural Elements Relief Drainage Vegetation Settlement Irrigation Occupation Transport and Cummunication Rural Urban Compact Hamlet Ring Compact Agglomerated Dispersed Linear Other Tracks Roads Railway Waterway Powerline Airway Telephone line Metalled Unmetalled Relief is the actual configuration of land which includes its altitude and slope a on topo-sheet, the study of relief includes a description of mountains, plateaus, plains, slope of the land. All the other physical features are mostly influenced by the relief. The relief features can be identified with the help of contours which are drawn in brown colors on the topo-sheet. The mountains may be of different types, like Folded, Block, Dome, Volcanic, Erosional. The plateau may be of two types, Dissected and Volcanic. Moreover, the plateau may be further classified into six types, like— Diastrophic, Intermountanion, Border, Dome, Volcanic, Erosional. Thus, the plains may be of two types—Alluvial plains and Flood plains. Furthermore, the plains can be understood in a different way like,—(a) rolling, (b) alluvial, (c) dissected, (d) plains with knol, (e) plains with low hills of different shapes and sizes, (f) plains with plateau, (g) plains with plateau and hills, (h) plains with adjoining foot hills.

NSOU CC-GR-02 13 The entire area can make a general layout and the mountain, hills, valleys, plateaus, plains. After noting the broad features look carefully into the details of each one of them and mention the landforus like, peaks, ridges, hills, valleys, spars, waterfalls, cliffs, knolls, saddles, cols, escarpment, gorges, watersheds, cirques, morrainic deposits etc. A number of profiles along important line should be drawn to indicate the nature of relief to identify different types of landforms. The study and deep understanding of colours in the topo-sheets helps a lot to describe the physical features especially relief of the area. If there is sufficient number of contours, they follow irregular path and their value varies from 200 to 100 metres (600 to 3000 ft.), it is a plateau area. In such area we find waterfall, ridges, knolls, escarpments and undulating slope. Moreover, if however, the contours are larger in number, they are closer together, and their value exceeds 1000 metres (3000ft.), it is a mountain area. Such contour pattern shows steep slopes, v-shaped valleys, gorges, waterfalls, water divides etc. The drawing of relief features, either by drawing perpendiculars or by paper strip, the description of the landforms undergoes by its interpretation. Example: Fig:1 (A & B) Here, the formation of rounded and conical hills must be described and then interpretation of the relief features can be done. In this regard, the two dimensional features of the topo map can be visualized and represented by its three-dimensional view.

14 CC-GR-02 NSOU Fig.: 2 In this case, if you have a clear knowledge about geological as well as evolutionary history of the area, then in that case, probable cause for the formation of the 'gap' can be illustrated, though 'filled imagination' will give a much more precise information. 1.3Extraction and Interpretation of Geomorphic Information from Topographical Maps/Survey of India Maps 1.3.1 Map Reading:

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Map reading, in actuality, denotes the formation of a visual picture of the ground depicted on a map.

100%	MATCHING BLOCK 3/121	W

Undoubtedly a map is a good guide but it requires some art to follow the direction and information given by it.

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It is not always easy to grasp the general appearance of the land at the first glance over the map, because various details may be recorded by a complex set of conventional signs on it. It requires a good deal of practice, and only a well-trained mind in this art can visualise the correct picture of the country represented by it. In fact, all types of map do not present the same difficulties in their reading as the topographic survey map in which the topographic forms are very well expressed by different symbols or signs in a complex manner. The best way to be familiar with the topography of a region is to compare the survey map of the region at the spot in the field. But before proceeding to the actual field, the students must be trained in the laboratory in consulting the map. Moreover, it is not NSOU CC-GR-02 15 possible for a student even in his life-time to collect direct information from the field all over the earth; but one can easily manage to know of the different parts of the earth-surface from the topographical sheets thereof.

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Though a map is the tool of a geographer, it is consulted by other people also. A traveller may, simply need to know about the location of his destination and the route followed; while in military strategy one may require to detect all possible routes along which to march or, which may be followed by the enemy.

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Thus, there are two methods of approach to a map. Firstly, a simple approach with some particular end in view, and secondly, a scientific approach. The simple approach points out to the mere consultations of the map; whereas a scientific study of map requires a critical outlook; it requires, at first, the collection of facts, their systematic arrangements and then deduction of suitable inferences. The first type of study is simple and it may be made even by a layman, but the second method is more elaborate and requires a comprehensive knowledge of physical geography as well as of human responses to natural environment, without which erroneous conclusions may be drawn.

95%	MATCHING BLOCK 7/121	W

Obviously, this type of study is very useful to a student of geography in having a proper grasp of the regional geography of an area. A good practice in this type of practical work enables the student to write a systematic geographical account of any area. 1.3.2 Numbering of Topographical Maps of

India :

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The Survey of India was started over hundred years ago. Many great British surveyors received their training here.

94%	MATCHING BLOCK 9/121	W

Due to their great effort our country is mapped on scales of 1, 2, 4 miles to the inch. But the most important are 1 : 1,000,000 scale maps, published in two series— (i) India and Adjacent Countries Series and (ii) the International Series of La carte. International du Monde. The former also extends into the contiguous lands of Afghanistan, Tibet and China. These sheets

are of 4×4

93%	MATCHING BLOCK 10/121	W

degrees. The whole country is planned to be divided in 4×4 degree sheets, each being numbered as 39, 40, 41, etc. Sometimes the sheet is named after the most important town of the area covered by it. For instance, sheet Nos. 43 and 53 are also known as Srinagar and Delhi sheets respectively. In these sheets lettering is done in black, water in blue, contours in brown, and roads and town sites in red colours. These sheets have been published in two editions. (i) Political edition with 16

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72%	MATCHING BLOCK 11/121	W

boundaries in colour, and (ii) Layered edition with graduated layers of colours to show altitudes. The publication of the latter has been stopped and in its place maps of International Series are being published. These sheets

are

81%	MATCHING BLOCK 12/121	W

also known as 1/M sheets or one-in-million maps. The maps of International Series are being prepared according to the scheme adopted by the International Map Committee held in London in 1909, for

the whole world. In this Series

90%	MATCHING BLOCK 13/121	W

elevation is shown in metres. Besides, some maps as "Southern Asia Series" have also been published on 1:2,000,000 or 2M scale by reducing one-in-million maps to half the scale.

96%	MATCHING BLOCK 14/121	W

The colour scheme is the same as in 1/M maps. The one-in-million sheet has been further sub-divided into 16 equal sheets, each of one degree dimension as shown in Fig. 3. Each sheet is known as degree sheet as it represents only one degree extent. In Fig. 3 A, B, C, D, E, F, G, H, I, J, K, L, M, N, O and P are 16 degree sheets. They may be separately numbered as 63A, 63B, 63C etc., because they

are parts Fig.: 3
NSOU CC-GR-02 17 of the one-

94%	MATCHING BLOCK 15/121	W

in-million map No. 63. They are also sometimes called quarter inch maps as they show a scale of 4 miles to he inch. The contour interval is generally 250°. The degree sheets have been again sub-divided into 16 equal sheets, each representing an extent of 15 (See the square 63 K in Fig. 3). These smaller sheets

are

96%	MATCHING BLOCK 16/121	W

one inch maps as they show a scale of one inch to a mile. Sheets showing an extent of 30° are known as half inch maps because they represent a scale of half inch to one mile. One inch maps

are

95%	MATCHING BLOCK 17/121	W

numbered as 63 K/1, 63 K/2, 63 K/3, 63 K/4 etc., while the half inch maps

are

86%	MATCHING BLOCK 18/121	W

numbered as 63 K/NW. 63 K/NE, 63 K/SE, and 63 K/SW, because they in the corresponding directions from the centre of the 63 K degree sheet. In selecting sheets for study, in the beginning simple sheets should be taken in which contours are not complicated but instead, they may be easily marked. For instance, a sheet representing a plain or plateau with low hills and ranges and clear drainage pattern may be selected. The sheets No. 63 K/12 may provide such simple features; a coloured sheet may be preferred because on coloured

sheet

84%	MATCHING BLOCK 19/121	W

vegetation and other features are very distinctly marked. 1.4 Conventional Signs for Topographical Maps of Survey of India 1.4.1 Description 1.4.1.1 Villages, Buildings, etc. : (1) Village, as surveyed: (a) open (b) walled (2) Ruined village as surveyed. (3) Scattered buildings and huts: (a) permanently occupied, (b) temporarily occupied. (4) Deserted site. (5) Mounment (6) Sati (7) Factory Chimney (8) Cave (when not antiquity): (a) inhabited, (b) uninhabited (9) Piquet or Post (10) Church (11) Temple (12) Tomb (13) Pagoda (14) Mosque (15) Idgah (16) Fort: (

a) surveyed (the

100%	MATCHING BLOCK 20/121	W

thickness of line should be increased for large forts according to size

and

100%	MATCHING BLOCK 21/121	W

importance), (b) conventional (17) Watchtower (18) Chhatri or way side temple (19) Battlefield (with name and year) (20) (a) Burial ground, as surveyed. (

b)

85%	MATCHING BLOCK 22/121	W

Graves, (21) Oilwell (21A) Oil-tank (22) Mine-shaft (23) Boundary pillar: (a) Survgeyed, (b) not found at time of survey. (24) Rifle-range, (as surveyed) (25) Aerodrome: (a) as surveyed, (b) conventional (26) Landing ground: 18

CC-GR-02 NSOU (a)

100%	MATCHING BLOCK 23/121	W

as surveyed (b) conventional (27) Air bombing (or firing) range, as surveyed. (28) Air bombing target (29) Air firing target (30) Air mooring or Tall telegraph mast. (31A) Seaplane alighting area. (31B) Seaplane station. (31C) Trijunction pillars: (a) when village boundary

in

97%	MATCHING BLOCK 24/121	W

shown, (b) when village boundary is not shown. 1.4.1.2 Water Features : (32) Well: (a) lined or in rock, (b) unlined (33) Spring (34) Karez (with) depth of shaft in feet) (a) in use, (b) disused. (35) Pipe line: (a) water, (b) oil, (36) Swamp or marsh, with cultivation. (37) Reeds in perennial water. (38) Lake or tank, as surveyed: (a) with defined limit of perennial water, (b) with fluctuating, limit of pernnial water, (c) with

embankment under 10

63%	MATCHING BLOCK 25/121	W

ft. (d) with embankment 10ft or over, (e) with very steep embankment. (39) Excavated tank, as surveyed: (a) perennial, (b) non- perennial, (c) perennial with high embankment (40) Tank, conventional: (a) perennial, (b) non- perennial, (41) Quarry,

with

77%	MATCHING BLOCK 26/121	W

greatest depth, (42) Singleline stream: (a) perennial, (b) non-perennial, (c) approximate or undefined, (d) indicating change from non-perennial to perennial. (43) Stream bank, north bank shows continuous, unbroken, steep or precipitous bank from 1' to 100' or over, in height, and south bank shows the same, but broken, as surveyed, heights corresponding with those on the north bank: (a), (b) and (c) show treatment of side stream junctions in accordance with the extent to which the river-bank is broken, (d) breaks in banks that extend to river bed level, (e) small breaks that have not been eroded down to river bed level, (f), (g) and (h) types of gorges or narrow rivers with high banks. (44) Dry nala: (a) with broken ground along bank (as surveyed), (

b)

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100%	MATCHING BLOCK 27/121	W

ravines (as surveyed) (45) Double-line stream (width 1/20 inch or more on published sheet): (

a) perennial, with narrow showing direction of flow, (b) dry with sandy bed. (46)

87%	MATCHING BLOCK 28/121	W

Waterfall with height (perennial and non-perennial). (47) Rapids. (48) Sluice. (49) Perennial canal with distance stone: (a) single-line (thickness according to importance), (b) double-line according to width and with embankment shown

be

94%	MATCHING BLOCK 29/121	W

relative height. (50) Non-perennial canals with distance stone. (51) Disused canals. (52) Canal: (a) with navigation lock, (b) with lock or weir carrying— (i) road, (ii) foot-path, (c) aqueduct or (if printed in black or red) viaduct (53) Dam: (

a)

95%	MATCHING BLOCK 30/121	W

masonry, (b) earth work. (54) Weir (Anicut in Madras): on single-line and narrow double line streams, the sluice symbol should be used with the word 'Weir' typed alongside. (55) Canal tunnel, with or without cutting, surveyed. (56) Siphon in perennial canal (black in case of non-perennial canal).

NSOU CC-GR-02 19 Fig.: 4
20 CC-GR-02 NSOU 1.4.1.3

93%	MATCHING BLOCK 31/121	W

Telegraph lines : (57) Telegraph line. (58) Telephone line. (59) Electric Power line: (a) main transmission line (i) conventional on all scales, (ii) where spans vary largely the position of pylons should be as surveys when suitable to

the

92%	MATCHING BLOCK 32/121	W

scale, (b) local distribution line (conventional): for lines of intermediate importance the size of the large dots will be graduated between symbols (a) as surveyed, (b) conventional. 1.4.1.4 Railway and bridges: (Gauge, if other than 5'-6', should always be stated) (62) Railway, 5'-6' gauge double-line: (a) open

with sidings, mile stone and station with enclosure (

93%	MATCHING BLOCK 33/121	W

as surveyed), (b) under construction (63) Railway, 6'-6" gauge single-line: (a) open with sidings, and station and enclosure (conventional): (b) under construction. (64) Railway, other gauges double-line: (

a)

95%	MATCHING BLOCK 34/121	W

open with sidings, (b) under construction. (65) Railway, other gauges single-line: (a) open with sidings, (b) under construction, [In symbols (62) to (65) the sidings may be drawn narrower when space is limited]. (66) Mineral line or tramway. (67) Level crossing. (68) Road over railway. (69) Road (or railway) under railway. (70) Railway tunnel, with or without cutting, as surveyed. (71) Bridge carrying railway. (72) Bridge carrying: (a) railway over road, (b) road over railway (the descriptive wording should be omitted only where there is no room). (73) Bridge carrying road and railway of: (a) 5'-6" gauge, (b) other gauges. 1.4.1.5 Roads and bridges: (74) Roads of 1st importance: (a) metalled, and important bridge

with

76%	MATCHING BLOCK 35/121	W

piers over river (the normal distance between the piers should be 1/8" on scale of drawing, varying slightly to permit of equal spacing between piers), (b) unmetalled (75) Roads of 2nd importance: (a) metalled, (b) unmetalled (76) Other roads: (a) metalled, also mile stone, bridge and Irish bridge or causeway, and avenue of trees, (b) unmetalled (c) motor transport turning point on roads. (77) Cart-track with bridge. (78) Pack-track with bridge culvert. (79) Pack-track with pass and height. (80) Foot-path with bridge, culvert. In symbols (77 to 80) the heavier symbols

95%	MATCHING BLOCK 36/121	W

should be used in afforested or contoured areas, or where emphasis is required in open areas. Symbols may be still heavier if required to give emphasis in afforested or contoured sreas, (81) Road

NSOU CC-GR-02 21 Fig.: 5
22 CC-GR-02 NSOU

97%	MATCHING BLOCK 37/121	W

tunnel, with or without cutting, as surveyed. (82) Bridge or boats or pontoon bridge (explanatory words to be typed against the symbol). (83) Ferry or ford. (84) Track or path coincident with bed of stream: (a) for short distance, (b) long distance. (85) Track or path following notified boundary: (a) short distance, (b) long distance. (86) Roads in dry river bed: (a) with steep river banks, (b) with shelving river banks. (87) Unmetalled road along tank bund. (88) Forest fire-line, not in regular use as line of communication, race-course track and similar special cases (explanatory words to appear along the symbol but when in regular use as line of communication the appropriate road symbol is to be used. 1.4.1.6 Embankments: (89) Road or railway embankment: (a) 5ft to 9ft high, (b) 10ft high or over and steep with sharp edge at top. (90) Road or railway cutting: (a) 5 to 9 ft deep, (b) 10ft deep or more and steep, with sharp edge at top. (91) Protective embankment: (a) 5ft to 9ft high, (b) 10ft high or over steep, with sharp edge at top (92) Embankments, cuttings and bridges with narrow gauge railway (Sleepers omitted) (a) along single-line, (b) along double-line (Note: ("Single line" or "Double line" may be typed along the line, if necessary) 1.4.1.7 Boundaries, limits and Gardens: (93) International: (a) demarcated, (b) undemarcated. (94) Province or State: (a) demarcated, (b) undemarcated (95) District or Tribal (96) Sub-division, Township, Taluk, Tahsil, Zamindari or similar partition. (97) Pargana in U.P. (98) Reserved, Protected or State Forest (green riband

with

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88%	MATCHING BLOCK 38/121	W

appear along the external boundaries and along those between forests of different ownerships. (99) Village with trijunction pillar: In symbols 93 to 99 boundary pillars should be drawn first, fitting in the boundary symbol afterwards, even if the length of bars does not agree. (100) Boundaries along: (a) one side of road, track or path, (b) center of road, track or path (when it is recognised boundary), (c) one side of river, (d) centre of river (e) bed of river as surveyed. (101) Wooded area (a) not enclosed, (b) enclosed by wall or permanent fence. (102) Limits of cultivation, open and along stream or ravine. (103) Demarcated limits camping ground. (104) Salt pan. (105) Orchard garden: (a) not enclosed, (b) enclosed by a wall permanent fence. (106) Tea garden, as survey (107) Betel or vine on trellis. (108) Vegetable garden. NSOU CC-GR-02 23 1.4.1.8 Ornamentation and Trees: (109) Scattered trees. (110) Scrub and undergrowth. (111) Grass: high 112) Cane-brake (113) Pine, fir, etc. (114) Palm. (115) Palmayrs (116) Betelnut (117) Bamboo. (118) Aloes or cactus. (119) Other trees. (120) Plantain trees. Symbols (109) to (120) can be varied

slight by

87%	MATCHING BLOCK 39/121	W

size. Trees surveyed individually will appear in black, grass and all other tres will appear in green. Authorised symbols will be used where suitable,

a

91%	MATCHING BLOCK 40/121	W

wooded areas small circles and half circles representing tres of uncertain nature, and representing scrub, under-growth or tea bushes, may be mixed with actual symbols which should very with the character of the vegetation. Symbols should not be drawn with elaborate care except when isolated. (121) Stony waste, (122) Sand features: (a) sand hills and dunes, shape as surveyed, (b) shifting sand, (c) confused sand hills (conventional), (d) fla sandy areas, Loose free sand should be indicated by closer spacing of dots. (123) Sandy river bed showing: (a) perennial channels, (b) non-perennial channels. (124) River bed showing: (a) sheet rocks, (b) rounded rocks, (c) edged rocks, and (d) rock ribs. 1.4.1.9 High Mountain Features: (125) Snow, ice and rock forms: (a) Medial moraine, (b) Lateral moraine, (c) Terminal morain, (d) Hanging glacier, (e) Ice fall, (

f) Crevasses due to uneven bed, (g) Crevasses due to movement of ice stream, (h) Ice pinnacles, (i) Bergschrunds, (j) Permanent snow (ne ve), (k) Ice wall, (l) Glacie stream and lake, (m) Ice cave, (n) Ice couloir, (o) Rock couloir (p)

70%	MATCHING BLOCK 41/121	W

Scree (q) Rock fall (large rocks) (r) Recognised route over glacier, with pass, (s) Snow cornice. 1.4.1.10 Hill and Mountain Features (126) Contours, with form-lines showing sub-features and contour value. (127) Depressions or Devil's cauldrons. (128) Broken or rocky ground. (129) Sheet rock on mountain side,

with rock pinnacles. (130)

75%	MATCHING BLOCK 42/121	W

Scarp or cliff; high. (131) Scarp or cliff: medium (about 20' to 50'). (132) Scarp or cliff: low. (133) Earth or gravel slide. (134) Isolated rock masses (shape as surveyed). (135) Rock outcrops

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with and without scattered boulders. (136) Sheet rock. (137) Terraced scarps. (138) Rocky knobs. (140A) Mud Volcanoes, etc.: as surveyed— (a) Crater, (b) Pinnacles. (c) Mud vent, (d) Mud flow: conventional, (e) Pinnacles, (f) Crater.
24 CC-GR-02 NSOU Fig.: 6 (169)
NSOU CC-GR-02 25 Note : The rock forms depicted in symbols (125) and (128) to (138) are shown in their most usual surroundings; they are not, however, to be confined to the

42%	MATCHING BLOCK 43/121	W

type of country shown in the specimens but should be drawn illustrated whenever they occur. The list of feature is not exhaustive. 1.4.1.11 Heights, Trigonometrical Symbols (141) Heights: (a) Triangulation

station, (b) Triangulation interested point or permanent traverse station or intersected point, with ground level securately fixed or measured, (c) (vi), (d) approximate, (e) relative, (142) Bench-m ark, with height to the nearest foot: (a) geodetic, (b)

79%	MATCHING BLOCK 44/121	W

canal, (c) others. (143) Post Office. (144) Telegraph Office. (145) Combined post and telegraph office. (146) Police station. (147) Dak bungalow, (148) Rest-house. (149) Travellers bungalow. (150)Inspection bunglow (151) Circuit house. (152)

Camping-ground. (152) Buddhist kyaung. (153) Railway station. (154) Market or bazar with day. (155) Forest: (a) Reserved, (b) Protected, (e) State, (d) Zamindari. 1.4.1.12

100%	MATCHING BLOCK 45/121	W

Coastal Symbols: (156) Tidal water: (a) with limit in double line dry stream, (

b)

89%	MATCHING BLOCK 46/121	W

in double-line perennial stream (c) in single-line stream, (d) with definite bank

in the

87%	MATCHING BLOCK 47/121	W

junction with a double-line dry stream, (e) without definite bank at

the

46%	MATCHING BLOCK 48/121	W

junction. (157) Coast-line as surveyed, showing: (a) high water line, (b) low water line, (c) tidal flat with mud, (d) shingle and sand, (e) cliff, (

f) sheet rock, (g) rounded rocks with sand, (h) edged rocks (i) rock ribs, (j) single-line stream in foreshore. (158) Fathom-line. (160) Submerged sand. (161) Submerged rocks

100%	MATCHING BLOCK 49/121	W

with danger line. (162) Steamer service: (a) in double-line river, (

b)

91%	MATCHING BLOCK 50/121	W

in single-line river. (163) Mangrove swamp. (164) Lightship. (165) Light-house. (166) Buoy: (a)lighted, (b) unlighted. (167) Anchorage. (168) Pier or jetty (

masonry): (a) conventional, (

100%	MATCHING BLOCK 51/121	W

b) carrying railway as surveyed (169) Pier or jetty (open. framework or piles): (

a)

89%	MATCHING BLOCK 52/121	W

conventional, (b) carrying, road as surveyed, (c) carrying railway as surveyed. (170) Beacon, steamer signal, navigation mark, etc. of a fairly permanent character (with appropriate lettering typed against the symbol): (a) lighted, (b) unlighted. 26 CC-GR-02 NSOU 1.4.2 Scientific Study of Topographical Maps 1. Preliminary information: (a) Note the nature, number and scale of the sheet, (b) measure the area of the sheet into square miles by the scale; (c) find out the districts represented by the sheet and also the adjoining districts with reference to the index below the sheet; (d) note down the latitudinal and

98%	MATCHING BLOCK 53/121	W

longitudinal extent of the area depicted on the sheet. 2. Observation of the topography : Topography is the expression of the interaction of physical and cultural environments, and as such it includes physical as well as cultural (man-made) elements which are charted below. As already indicated in the foregoing, these features are marked over the sheet by some definite symbols—conventional signs and colours which are generally used to aid legibility in the map. Maps may be both coloured and uncoloured. Generally seven colours have been used in coloured maps. Hills are shown by brown contours or hachures and grey shades, water-courses are blue, forest are green, cultivated areas are yellow, railways are black and roads, towns and villages are red. These are shown on the "Characteristic sheet of the conventional signs and writing" used for British Ordinance Survey maps and some are also given on the margins of the map. Every country follows, more or less, the same conventional signs, with a few additions or a little alterations. In the topographical survey maps of India. British symbols have been adopted. In some maps more symbols are required, while in others only a few will do; for instance, in one inch maps less symbols are used than in cadastral maps, whereas quarter inch maps and 1/ m maps require less symbols than one inch maps. The student should, however, be familiar with these symbols

to

100%	MATCHING BLOCK 54/121	W

be able to identify various features on the map. For convenience the conventional signs are given earlier. 3. Picturing the sheet as a whole: Ignoring the details for the time, picture the map as a whole. Do not look too closely at the map but try to have an idea of the most outstanding features of the landscape depicted on it. In the first place you should identify whether the area exhibits one type of physical feature— plain or plateau or hill, etc. If it includes more than one type, try to divide the area into sub-regions so that appropriate and systematic description may be given. For this purpose observe carefully the main river valleys and main contours indicating high and low lands which will enable you to divide the area into different units. In this

NSOU CC-GR-02 27 connection it

94%	MATCHING BLOCK 55/121	W

may be noted that the nature of rocks is not legible on such maps, so only by the character of drainage it may merely be hinted whether it is a linestone region of any other region. 4. Observing the relief: After recognising the major units of relief, primary landforms—peaks, ridges, hills, spurs, escarpments, knolls, cols, etc. should be noted as identified. For this trace out important contours on a piece of paper and along suitable lines across them draw one or more profile sections which will give a clear conception of landforms. Drawing of sections to identify landforms is necessary only in the beginning. After a good deal of training and practice, the relief features can be marked only by eye-observation of the map. The profile sections will enable you to use appropriate adjectives to typical features, just as for ridge: long, narrow or board, steep-sided or with gentle slopes—closely spaced contours expressing steep slopes and widely spaced contours indicating gentle slopes; for hills: rounded. 28

CC-GR-02 NSOU 1.5 Key Features of Topographical Map A topographical map or a tipomap or a toposheet, as it is generally called, shows the surface features of the earth as it exists during the period of survey in as much detail as the scale allows by means of cartographic and conventional symbols. As it presents the ground in great detail, it is a storehouse of all information necessary to understand and comprehend both the physical and human geography of an area. Thus it forms the most important practical tool of a geographer. The ability to interpret a topographical map is fundamental to the understanding of the geography of an area. For this, it is necessary to study the map in detail through three distinct tasks—first, identifying the geographical features shown by conventional symbols (point, line, area, letter, colour); second, measuring their attributes and spatial patterns; and third, comprehending their occurrence and origin. Mapcraft is a special skill by which a mental picture of the ground is constructed from a map and is basic to map reading and interpretation. 1.5.1 Layout and Scale of Survey of Indian (SOI) Topographical Sheets The survey of India (SOI), the National Survey and Mapping Organisation of India under the Department of Science & Technology, is the oldest scientific department of the Government of India. With headquarters at Dehradun, Uttaranchal, it was set up in 1767 and has evolved rich traditions over the years. The tapestry of the Indian terrain was completed by the painstaking and pioneering efforts of a distinguished line of British surveyors led by Mr. Lambton and Sir George Everest. The then British surveyors mapped the area of land betwen (44°E, 4°N) and (104°E, 40°N) covering the whole of the then Indian subcontinent and a vast portion of Asia (Table-1). In this layout, the above area was first divided into 106 uniform rectangles of (4°×4°) dimension and were designated by numerals, 1–106 (Fig. 7) These were drawn on a 1 inch to 16 miles scale (1:1,000,000) and are known as million sheets or 1M Sheets. Each 1M sheet contains 16 degree sheets of (1°×1°) dimension drawn on a 1 inch to 4 miles scale (1:250,000) and are designated by alphabets A- P. A degree sheet is then further divided in two ways. Firstly, each such sheet contains 4 quadrant sheets of (30'×30') dimension drawn on a 1 inch to 2 miles scale and designated by NW, NE, SW and SE and secondly, each degree sheet contains 16 inch sheets of (15'×15') dimension drawn on a 1 inch to a mile scale and are designated by numerals 1–16.

NSOU CC-GR-02 29 1.5.1.1 Old Series Maps— Table 1: Layout of Indian Topographical Maps on the Old Scale Name Scale Extension Contour Reference No. Interval (ft.) (example) Million Sheet 1 inch to 4°×4° 500 72 or 1M Sheet 16 miles Degree Sheet 1 inch to 1°×1° 250 72F or Quarter-inch 4 miles Sheet Half-inch or 1 inch to 30'×30' 100 72 F/NE Half-degree or 2 miles Quadrant Sheet Inch Sheet or 1 inch to 15'×15' 50 72 F/10 15' Sheet 1 mile Fig 7: Layout of Million Sheets Conveing the Indian Subcontinent

30 CC-GR-02 NSOU In the late 1970s, topographical maps were redrawn on metric scales using updated information from both ground and aerial surveying (Table 2). More detailed maps were drawn on 1:25000 and referenced in two ways. Firstly, some of the 1:50000 sheets have been printed off on old layouts, i.e., each 1:50000 sheet contains six 1:25000 sheets on (7'30"×5') dimension and are designated by numerals 1–6 and secondly, each 1:50000 sheet contains four 1:25000 sheets of (7'30"×7'30") dimension, designated as NW, NE, SW and SE. Table 2: Layout of Indian Topographical Maps on a Metric Scale Name Scale Extension Contour Reference No. Interval (ft.) (example) Million Sheet 1:1000,000 4°×4° 500 72 or 1M Sheet Degree Sheet 1:250,000 1°×1° 100 72F or Quarter-inch Sheet Quadrant or 1:100,000 30'×30' 50 72 F/NE Half-degree or Half-inch Sheet 15' Sheet 1:50,000 15'×15' 20 72 F/10 Special Sheets 1:25,000 5'×7.30" 10 72 F/10/5@ 7.30'×7.30' 10 72 F/10NE# Note: @—Old Layout before 1990; #—New Layout since 1990. 1.5.1.2 Open Series Maps Table 3: Layout of OSMs (NMP 2005, Projection-UTM, Datum-WGS 84) Name Scale Extension Reference No. (example) Million Sheet 1:1000,000 6°×4° F45 Degree Sheet 1:250,000 1°×1° F45 D 15' Sheet 1:50,000 15'×15' F45 D 08 Quadrant Sheet 1:25,000 7.30'×7.30' F45 D 08 NW 3' Sheet 1:10,000 3'×3' F45 D 08 U LS Sheet 1:2,000 36'×36' F45 D 08 U 13 The scientific principles of surveying have since been enhanced by the latest technology (RS and GIS) to meet the multidisciplinary needs of national security,

NSOU CC-GR-02 31 1.5.2 Dimensions

32 CC-GR-02 NSOU sustainable national development, and new information markets. The SOI has taken a leadership role in providing the user focused, cost effective, reliable and quality geospatial data, information and quality geospatial data, information and intelligence by introducing a new national map policy (NMP) on 19 May 2005 that reshapes altogether trhe long existing frame of mapping layout, scheme of map referencing, scale and dimension of mapping, nature of map product and finally, their mode of access. The SOI promotes an active exchange of information, ideas and technological inovations among the data producers and users across the globe, who get access to such data of the highest possible resolution at an affordable cost in the real-time environment. It will produce two different series of maps, such as, Defence Series Maps (DSMs) and Open Series Maps (OSMs). The DSMs are topographical maps (on Everest/WGS-84 Datum and Polyconic/ UTM Projection) on various scales (with heights, contours and full content without dilution of accuracy) to cater only for defence and national security requirements. The OSMs, on the other hand, are primarily for supporting development activities in the country. These are drawn on UTM Projection on WGS-84 datum. Each of these OSMs (in both hard copy and digital form) with complete topographical database will become "unrestricted" after obtaining a one-time clearance from the Ministry of Defence. The SOI will ensure that no civil and military vulnerable areas and vulnerable points (Vas/ VPs) are shown on the OSMs. In this layout, India is covered by 32 UTM zones of (6°×4°) dimension (i.e, B46, C42, C43, C44, C46, D42, D43, D44, D46, E43, E44, E45, F42, F43, F44, F45,, F46, G42, G43, G44, G45, G46, G47, H42, H43, H44, H45, H46, H47, I43, I44, and J43). These are drawn on 1:1,000,000 scale and are called million sheets. Each million sheet contains 34 degree sheets on 1:250,000 scale and are designated by alphabets, A-X. Each degree sheet contains 16 sheets of (15'×15') dimension on 1:50,000 scale and are designated by numerals 01–16. A 15' sheet is then divided in two ways. Firstly, each sheet contains 4 quadrant sheets of dimension (7'30"×7'30") on 1:25,000 scale and are designated as NW, NE, SE and SW, Secondly, each sheet contains 25 sheets of dimension (3'×3') on 1:10000 scale and are designated again by alphabets, A–Y. Each 3' Sheet contains 25 sheets of (36"×36") dimension on 1:2000 scale and are designated again by numerals, 01–25. These are the largest scale maps published by the SOI (even larger than the existing cadastral maps on 1:4000) and are called LS sheets.

NSOU CC-GR-02 33 Fig 9: Open Scales Map: Dimension and Scale 1.6 Methods of Interpretation After the identity of the toposheet is established, its interpretation follows. It requires a careful study of the marginal information and the body of the map. A preconceived textbook knowledge about the characteristics origin, patterns and associated processes of the major map elements (i.e., geology, geomrophology, phytogeography, settlement geography, cultural geography, economic geography, etc.) as well as sound idea of the region portrayed in the map is required. Toposheet interpretation is a 3-step process by which features of the elements are first identified, followed by a recognition of the patterns produced by the features and finally an explanation of the patterns in terms of the processes involved (Table 4).

34 CC-GR-02 NSOU Table 4: Identification of Features on Topographical Sheets Elements Symbols/Criteria Features Relief Contour pattern, Hills of various elevation, shape and size; spacing and values valleys of various shape, size, length and gradiant; ridges of various geometric outline; basin; col; saddle; spur; cliff; escarpment; gorge; slope form; water divide; different types of pateaus and plains; etc. Conventional symbols Dune; etc. Letter symbols Rock outcrop; stony waste; rock; etc. Drainage Line symbols and Drainage patterns (dendritic, pinnate, associated pattern parallel, rectangular, radial, annular, angulate, barbed, deranged, contourted, etc); channel patterns (straight, sinuous, meandering, anabranching, braided, etc); perennial and non-perennial channels; dry bed; canal; abandoned channel; crevasse splay; meander scroll; cut off; etc. Conventional symbols Shoal; island; sand deposit; rocky bed; boulder bed; gully erosion; waterfall; swamp; etc. Letter symbols Barrage; reservoir; ford; ferry; seasonally indundated areas; etc. Understanding the Terrace; river capture; meander core; associated features paleo channel; Alluvial fan; hydrological aspects; etc. Vegetation Letter and conventional Reserve forest; protected forest; scrubland; symbols grassland; jungle type; specials type; species density; plantations; orchards and groves; horticulture; silviculture; etc. Understanding the Afforestation; deforestation; etc. associated features Settlement Conventional symbols Deserted village; fort; walled settlement; tribal settlement; etc. Spatial distributrion Hamlet; isolated pattern; dispersed pattern; clustered pattern; random pattern Geometry of shape Square; rectangular; circular; semi-
NSOU CC-GR-02 35 circular; liner; A, L, T, Y shaped settlement; amorphous; etc. Judging sites River bank; wet point; dry point; piedmont; confluence; forest fringe; gap; summit; leaves; etc. Judging symbols (letter Rural settlement; urban centre; planned and conventional) and town; agricultural, mining, industrial, associated features administrative, religious places or settlements; new settlement; colony; etc. Transport and Line-symbols Road (metalled, unmetalled and village), Communication highway (state and national); railway (narrow, broad or metre gauge, division, etc.); mineral line; telegraph line; power line; etc. Letter symbols Waterway; ford; ferry; etc. Conventional symbols Aerodrome or airport, bridge etc. 1.6.1 Identified Physical Feature Some mentionable physical features identified from the given topographical sheet no.73 A / 1 are: Conical Hill : A very common physical features is conical hills which can be easily identified by contours which are circular in pattern with high values towards the centres. These conical hills are associated with radial drainage pattern. A prominent example occurs in the eastern part in Grid near Betla Reserve Forest, the Palamou Pahar. Other examples are Banila Pahar, Chindal Pahar in B 2 Grid. These conical hills are fromed from elongated ridges after going through fluvial dissection and these hills are around 300mt in elevation. Ridge: Another prominent physical features is elongated ridge. Such elongated ridge can be found in the western part in A 2 grid near the protected part the Begh Pahari Region. It acts as a water divide. These ridges are well dissected and nearly above 400mt and are parabolic in nature with a number of ridges in between. Cliff: Dissection of river has produced some typical landform like cliffs eg. in the south-central part in B 3 grid. Falls: We can also find some falls in the map. There are many falls of average 10m height. This is a kind of geomorphic feature is found at the upper course of any river. Elements Symbols/Criteria Features 36 CC-GR-02 NSOU Identified Physical Feature [Related to the Activities of Rivers] Fig.: 10
NSOU CC-GR-02 37 1.6.2(A) Miniature map MINIATURE MAP BIHAR Fig.: 11 Map No: PALAMU DISTRICT 84° 24° 0′ 0′ 84° 15′ 24° 0′ 84° 15′ 0′ 23° 45′ 84° 23° 0′ ROUGH SKETCH, NOT TO SCALE
38 CC-GR-02 NSOU BROAD PHYSIOGRAPHIC DIVISIONS BROAD PHYSIOGRAPHIC DIVISION (BIHAR) Introduction : The sheet no of the topographical map is 73 A / 1 . It represents part of Palamu district of Bihar. The scale of the map is 1:50,000 that is 20m on the map represents 1 km on ground. The contour interval is 20m. The map is surveyed in 1979-1980. The region extends from 23°45′ N to 24′ and 84°E & 84°15′ E. Physiographic Divisions : The region is dissected plateau area by North Koel river and its tributaries with isolated ridges and conical hills. The ridges are elongated and flat toped. The elevation varies between 240m to 500m. Obevesing the flowing direction of the main river North Koel, it can be said that its general slope of the region is from south-west towards north. Map No: Palamu District Physiographic Divisions Dissected Plateau 300m Dissected Plain 84°E 24° N 84° 15′E 23° 45′ N

NSOU CC-GR-02 39 The region can be divided in two broad physiographic divisions. Dissected Plateau: The first physiographic division or zone is the dissected higher plateau region which is above 300 m. This zone can be seen in western, south-western and partly in eastern part of the map. The highest elevation is 500 m near Baduentani. Many Pahars are also around 500 m like Lahara Pahar (498 m), Ranimai Pahar (464 m), Budhubean Pahar (587 m) etc. The hills are seperated by valleys. The region is generally inaccessible occupied by the dense mixed jungle, reserved forest, mainly sal. Dissected plain: The second physiographic zone is dissected plain region with elevation below 300 mt. It is found in the rest part of the map along with the main river. Mainly norther, north-eastern and central part of the region and also in isolated patches in south-eastern part. The physiographic unit is confired along the large valley of North Koel river and Anunaga river and the interflares of Jungle, Khuli, Denis, Crobours Nala. We can also find a badland in extreme southern region. Slope of Physiographic Division: First Zone : The average slope is more than 15° and the relative relief of this zone varies between 150 m to above 200 m. Second Zone: The average slope varies between 5°-15°, where this zone borders the high dissected regions the slope angle relatively higher. The relative relief various between 50 m to 150 m. Third Zone: The last physiographic division has an elevation between 140 m to 200 m and this zone is observed adjoining the river and located on the south-eastern, northern, western part of the area. The lower part of the Khalkalia Nala, Champal Nadi and Karandi ghar fall in this physiographic divisions. This zone is having gently undulating almost flat terrain with relative relief below 50 m. The average slope is below 5°. This areas shows widely spaced contour and relatively large 3rd or 4th order streams. This area's probably flat undulating nature due to fluvial planation. Some typical physiographic feature were identified from the given topographical sheet. The most permanent occurance to steep sided escarp can be seen in the south- eastern corner of the area near Jal Reserved Forest, here the ridge gently assends form the northern part but desends towards the south with almost vertical fall. Similar ridges with lesser magnitude can be seen in number of other areas mostly in the north-western part of the region near Landakat Reserved Forest area. Such steep sided ridges are the characteristics of the rightly dissected elevated region, The ridges are mostly seen about above 300m.

40 CC-GR-02 NSOU Another very common physical features is the conical hill which can be easily identifed by the occurance of concentric contours with higher value to the centre. In this conical hill, radial drainage pattern is very prominent example occured in the W-N-W. Another such conical hill is located in the south-eastern corner of Angrid near Rampur Reserved Forest. However, it is observed that there are the elongated ridges have under gone fluvial dissection, they have remained as isolated conical hill which are more than 80-100m in elevation. The steep sides elongated ridges are located in the northern and eastern part of the region. These ridges are narrow created, highly dissected by large number of 1st order stream with very high slope and this act as water divide in between drainage basins. Isolated hills mostly conical are observed adjoining the river and mostly in the second physiographic zone. This is occur probably by the result of fluvial direction. The concave valley slope with clearly spaced contours at higher elevation and widely spaced contours at lower elevation are noted on the western part of the region. A cross section is drawn along line AB in the typical features clearly shows the nature of the slope. Such slope characters are seen in another part of the area where the steep ridges gradually dissend towards the meander rivers. The small tributaries joining the main stream shows a very steep profile in the upper part and a gently slope in the lower part as they join the main stream. In such plain-plateau margine, concave slope is a common pattern. 1.6.3 Representative Profile or Longitudinal Profile Representative profile is used to identity breaks in slopes, summit levels, general nature of the dissections and also to understand the fluvial morphology. In the topographical sheet no. 73A/1, a longitudinal profile / representative profile has been drawn on the line AB. It is in grid C3. The location of the point A is 23°45'4" N and 84' 10′ 38″ E and the location of point B is 25°48'26" N and 84°13'20". The highest elevation is 580 m and the lowest elevation is 240 m. Scale has been considered as vertical scale 1 cm ≅ 100 m and horizontal scale 1 cm ≅ 500 m.

NSOU CC-GR-02 41 Importance: 1) It is important to analyse the relief of the area. 2) It helps to construct a clear picture about the break of slope of an area. 3) It gives a overall view and idea of the local relief features. Procedure: This profile is drawn with the procedure mentioned below: 1) It is drawn with the help of highest and lowest altitude of the area. Therefore, a line is drawn joining the highest and lowest altitude of the area. 2) The entire cross section is based on this line. 3) Thereafter, the nature of slope, break of slope is to be identified with the help of such profile. Palamu District, Bihar N A E REPRESENTATIVE PROFILE OR LONGITUDINAL PROFILE Map No: A 73 1 Map No: B 23° 13′20″E 48′26″N 84° 45′4″ 84° 23°

42 CC-GR-02 NSOU 1.6.4 Serial Profiles Serial profile of any topographical map is done to get a view of the relief in a serial wise manner. It bring to us the sequital view on fall of altitude in an area in an orderly manner. By opting this method, we can study the phase of development of the relief in a given region. SERIAL PROFILES Map No: 73 A / 1

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NSOU CC-GR-02 43 In the given diagram, we get a glimpses of six serial profiles arranged in an orderly manner accounting to their altitude longitudinal and latitudinal variations. Generally a serial profile is viewed from the south to view the sequential increase in the height of an area. But the given topographical map number 73A/1 having a lower relief towards north. In profile number one, we see a low relief. Having proximity to the main river (North Koel river), this profile is relatively low having longitudinal extension from 84°0' E to 84°4'27" E and logitudinal value of 23°27' N. In the second profile, we see a comparatively higher relief than no one with the same longitudinal extension of 84°0' E to 84°4'27" E and longitudinaly value of 23°57'21" N. The following profiles are drawn in the same manner. We can observe the gradual increase of relief and altitude from profile one upto profile six. Profile no. three has the same longitudinal extension as one and two with the latitudinal value being 23°86'4" N. All the profile have the same longitudinal extension but they differ in their latitudinal values. Profile number 4—Latitude 23°54'22" N Profile number 5—Latitude 23°53'14" N Profile number 6—Latitude 28°51'50" N 1.6.5 Superimposed, Projected, Composite Profile: Concept: Superimposed Profile: Plotting of a set of serial profile covering on area on a single frame with common axes, gives the Superimposed Profile. It represents the true character of the landform. Projected Profile: From the Superimposition of many lines in a single frame consequently one after another starting from the first profile, a kind of panoromic sketch is produced, known as Projected Profile. It gives a panoramic effects of landforms. Composite Profile: Tracing only the supermost line from a diagram of super-

44 CC-GR-02 NSOU imposed or projected profile in the similar frame produces a Composite Profile. It represents the summit levels or skyline of landforms. Now we use the individual profiles from the serial profiles and draw them, one apart the other. This diagram is called Superimposed profile. It's a method of comparing the relative heights of subsequent reliefs. The lines of different colours represents six different profile, like— Brown solid line represents profile 1 Black solid line represents profile 2

NSOU CC-GR-02 45 Brown dotted line represents profile 3 Black dotted line represents profile 4 Red dotted line represents profile 5 Red solid line represents profile 6 The diagram of the Projected profile can be mentioned as a result of the prior one. We draw it by looking at the superimposed profile. Here lines donot cut each other. We only draw it with the estimation of how much the profiles could be seen one after the other. In case of the Composite profile, diagram, we only join the skyline of the earlier drawn profiles. It does not show all the profiles. In the composite profile diagram profile no. 4 could be seen maximum. So we can say that, it has the maximum relief of the region. The other profile which could be seen are profile no. 2, and 6. Profiles 1, 3 and 5 not seen because of their quite low height.

46 CC-GR-02 NSOU Unit 2 Relative Relief map, Slope map (Wentworth) Structure 2.1 Relative Relief 2.2 Average Slope 2.1 Relative Relief G. H. Smith in 1935, first used the term relative relief or local relief analysis. Smith used the method to make an analysis of the surface of Ohio state. In this method an area or map is divided into 2 cm by 2 cm grids. He calculated the difference of altitudes between the highest and lowest points of each square or the base map. Isopleths are drawn thereafter to indicate areas with same local relief value. The resulting map brings out areas of high relative relief and low relative relief. This map is also a type of slope map. Relief is the difference between the high and low heights of a given map area. It shows the physical out line of the land surface. Relative relief is also known as the amplitude of relief found in an area. To find the difference between map and main height of an area into topographical sheet, we divided the area into a grid and write it in the center of the grid and find the relief of each grid. The relief is drawn according to the convenience and then lines are interpoloted to make groups prominently. The difference of a relief groups are shaded and explained by the index in the margins. Formula: Highest altitude—Lowest altitude (per grid of 2 cm by 2 cm) CALCULATION TABLE FOR RELATIVE RELIEF [MAP NO. 73 C / 8]: Sl. No. Grid Number Maximum Minimum Relative Relief Height Height (mt.) (mt.) (mt.) 1. A 1 340 220 120 2. A 2 420 220 200 3. A 3 220 200 20 4. A 4 200 180 20

NSOU CC-GR-02 47 5. A 5 190 180 10 6. A 6 180 160 20 7. B 1 549 260 289 8. B 2 470 240 230 9. B 3 300 220 80 10. B 4 200 200 220 11. B 5 200 180 20 12. B 6 — — 20 13. C 1 520 240 280 14. C 2 440 240 200 15. C 3 240 220 20 16. C 4 220 200 20 17. C 5 301 180 121 18. C 6 180 80 120 19. D 1 420 240 180 20. D 2 400 240 160 21. D 3 220 200 20 22. D 4 220 200 20 23. D 5 180 140 40 24. D 6 420 400 20 25. E 1 400 300 100 26. E 2 220 140 60 27. E 3 200 130 70 28. E 4 220 140 60 29. E 5 200 180 20 30. E 6 180 180 20 Sl. No. Grid Number Maximum Minimum Relative Relief Height Height (mt.) (mt.) (mt.)

48 CC-GR-02 NSOU RELATIVE RELIEF MAP (AFTER SMITH) 50 250 250 150 50 100 50 50

NSOU CC-GR-02 49 Relief of the map 73 C / 8 : The given topographical map 73 C / 8 represents a part of Dhenkanal and Sambalpur district of Orissa. The scale of the map is 1:50,000 that is 2 cm on the map represents 1 km on the ground. The contour internal is 20 m. The map is surveyed in 1979- 1980. The region extends from 21°N to 21°50'N and form 84°15'E - 84°30'E. The region is a fluvially dissected plateau area with isolated ridge, small conical hills and escarpments. The ridges are enlarged and narrow sharp events are also visible at same locations. The elevation varies between 120m - 538m observing the direction of flow of the main river, it can be said that general slope of the area is predominently from north and south, but a secondary slope component is also seen in the north-eastern part of the region. The region can be devided into three broad physiographic divisions according to the physiographic section drawn by the highest to lowest elevation in the map, there it may be noted that the highest elevation in the map is located at the Sadophar (438). But the representative profile has been drawn from Panchudia Pahar (554m). This was taken because the features of Punehmedia Pahar more or less similar to that of sado, Pahar and the length of the profile was more managable. Interpretation of Relative Relief [Map No. 73 C / 8] The relative relief map has drawn with the help of absolute relief of the Topo Map No. 73 C / 8 . It represents four zones of relief with the value ranges >50 m, 50–150m, 150–250m and <250m in elevation. The highest value zones, i.e. hilly tract and plateau are in the northern part whereas the lower zones i.e. dissected plain is found in the southern portion in the relative relief map. An isolated hills (like monadnock) exists in the dissected plain area.

50 CC-GR-02 NSOU 90 60 30 INDEX RELATIVE RELIEF IN METER/KM 2 RELATIVE RELIEF MAP (AFTER SMITH) PALAMU DISTRICT, BIHAR Map No: 30 60 60 30 30 60 90 90 60 30 30

NSOU CC-GR-02 51 INTERPRETATION OF RELATIVE RELIEF (MAP NO. 73 A / 1) The topographical sheet having the no. 73 A / 1 covers part of Palamu district of Bihar state. The area is chosen to show the relative relief of particular portion of the map 73 A / 1 which represents both hilly tract and dissected plain. Latitudinally the selected area extends from 23°50' N to 23°53'16" N. Longitudinally the selected area extends from 84°0'E to 84°2'53"E. The selected area is about 30 sq. km of area. The highest elevation is found at Ranimal Pahar (464m). On the other hand lowest elevation is 280m. The region has low relative relief in the hilly and plateau. It means this is a plateau top area where relative relief remains low. Some portion of the area has high relative relief, althrough absolute altitude is lesser in these portion. It means towards with dissected plateau, plain exists where ups and down of relief is very high. 2.2 Average Slope: C. K. Wentworth, first used average slope. According to him, it is the gradient i.e. the ratio of vertical to horizontal equivalents which is expressed in British Units (F.P.S.). Formula: (1000 × 0.6366 = 636.6 is the constant value) [In case of maps with metric units where distance is expressed in km and the contour internal in metres on in topo sheet of R.F. 1:50,000] Procedure: In the drawing of average slope map of an area is in the initial stage by dividing the area into a number of square grids. Now the number of contour crossing is counted along the grid peremeter and the average number of contour crossing per unit distance is worked out which after manipulation with the contour interval provides this vertical interval. The horizontal equivalents is the linear, distance of 1 km, is converted to equivalents 1000 units. It is then multiplied by an constant 0.6366 which is the mean of all possible values of $\sin\theta$ where, θ is the horizontal angle between the contour interval and the grid line. Therefore, the single process of counting with core, the number of contour crossing timely represents the area under consideration. 1km × 1km = 1 Square km Two square—One straight and the other diagonal. The two values must be considered for getting average value. (Like : i) 8° & ii) 9°, average value = 8°30') This slope map is essential as it will determine the flow:— i) runoff ii) direction of stream iii) value will through light on—how the land can be utilized? etc. 52 CC-GR-02 NSOU CALCULATION FOR AVERAGE SLOPE (MAP NO. 73 A / 1) Sl. No. Grid Total Contour Contour Constant Average Number Contour Crossing Interval(s) (h) Slope Crossing Per sq. km(N) (in degree) 1. A 1 13 3.25 5°49'47.92" 2. A 2 5 1.25 2°14'56.09" 3. A 3 13 3.25 5°49'47.32" 4. A 4 23 5.75 10°14'23.59" 5. A 5 16 4 7°9'45.63" 6. A 6 8 2 3°45'43.39" 7. B 1 10 2.25 4°29'27.31" 8. B 2 11 2.75 4°56'16.41" 9. B 3 19 4.75 8°29'15.47" 10. B 4 23 5.75 10°14'23.59" 11. B 5 17 4.25 7°36'18'32" 12. B 6 6 1.50 4°29'27.31" 13. C 1 7 1.75 3°8'48.35" 14. C 2 24 6 20 mt 636.6 10°40'30.26" 15. C 3 15 3.75 6°43'3.25" 16. C 4 21 5.25 9°21'57.45" 17. C 5 17 4.25 7°36'18.32" 18. C 6 4 1.50 1°47'58.07" 19. D 1 15 1.75 6°43'09.23" 20. D 2 43 6 15°1'10" 21. D 3 17 3.75 7°36'13.32" 22. D 4 14 5.25 6°16'23-93" 23. D 5 17 4.25 7°36'13-32" 24. D 6 10 1 4°2'36.24" 25. E 1 21 3.75 9°21'57.48" 26. E 2 30 3.6 13°15'30.88" 27. E 3 30 4.25 13°15'30.88" 28. E 4 13 3.25 5°49'47.92" 29. E 5 13 3.23 5°49'47.92" 30. E 6 14 3.5 6°16'29.95"

NSOU CC-GR-02 53 INTERPRETATION OF AVERAGE SLOPE (MAP NO. 73 A / 1) The topographical sheet bearing the no. 73 A / 1 covers part of Palamu district of Bihar state. The area chosen to show the average slope of a particular portion of 73 A / 1 to represent both hilly tract and dissected plain. Latitudinaly the selected area extends from 23°50'N to 23°53'16"N and longitudinally the selected area extends from 84°0'E to 84°2'53"E. The selected area covers about 30 sq. km of area. The highest slope is about 13°15' and lowest slope is about 1°14'. In the average slope map three isolines have been drawn at 3° intervel. The value of the isolines are 3°,6°,9°. The whole part and the north-eastern and west- central part have highest slopes. The medium slope areas are found in central and north- eastern part. Towards south-east and north-west lower slopes are found. It has been found that the dessected plain area's slopes are lower, on the other hand, the plateau and hilly area's slopes are higher by value. 6 9 9 6 9 6 3 3 3 6 9 9 6 3 3 R.F. 1:50,000

54 CC-GR-02 NSOU Unit 3 Correlation between physical and cultural features from topographical map Structure 3.1 Drainage 3.2 Drainage Pattern 3.3 Drainage Density 3.4 Relative Relief, Stream Frequency and Drainage Density of a common area 3.5 Vegetation Map 3.7 Settlement and Communication Map 3.7 Transect Chart: Correlation between physical and cultural features 3.8 Interpretation of Topographical maps according to questions: 3.8.1 Example 1 3.8.2 Example 2 3.1 Drainage The streams in the region are all non-perennial and there is no single stream which dominates the region. Most of the major streams generally flow from North to South and North-West. It gives an idea about the regional slope of the area. One relatively large stream flow from west to north. This is the Chempal nala seen in the extreme north-eastern part of the map. The river shows a typical dendritic drainage pattern and meander have formed in it. In this region, the topography is relatively gentle and the relative relief is more than 40-60 mt. Hence the river covers conical hill, concave and convex slope, escarpment, spar, dome etc. In the lower portion, the river exibits formation of sand bars and havily silt, probably the material has been brought down from the surrounding plateau fringes. In the western part of the region, the drainage is dominated by the Khalkhalia nala and its tributaries. The Khalkhalia nala has a long course through the dissected plateau surface but it does not have the meander in its upper ridge. The main tributary of the river is Telkani nala which joins Khalkhalia nala in west of village. After this confluence the combined flow is known as Surbali jhar. Peculairly the Khalkhalia nala has no major left bank tributary but the tributaries in the right bank are the relatively longer. All the tributary show dendritic drainage pattern in their upper ridges, but if we consider the 1st order stream from radial drainage pattern in their ridges, briginating

NSOU CC-GR-02 55 from the steep sided conical hills which have formed after dissection of the plateau surface. The central part of the ridge region is dominated by the river karandi and its tributaries. This non-perennial river originates from the relatively high plateau summits near panchmurida pahar (554 mt). The river is initially join by 2nd or 3rd order streams after has formed more or less straight on sightly sinuous course. Just after the village Bijaypur, the river is joined by major left bank tributary. The Khanda Map No:

56 CC-GR-02 NSOU Jhar river is itself joined by two major tributary one from left band has long east to west course. The Khanda Jhar right bank tributary has formed well developed meandering bends to its south most point of the region. The whole river shows heavy silt deposition along its sediment depositions. This may be because both the Daineha nala and Khanda Jhar. The Daineha nala have long courses over the plateau surface and hence the most of the amount of eroded material must be substaintial. 3.2 Drainage Patterns Different drainage patterns, clearly indicate different or diverse geologic structure and the influence of slope, climate, soil, vegetation. Moreover, straight, irregular, sinuous and meander drainage patterns have diverse explanation. A drainage, especially channel pattern is called straight when there is no bends and it indicate, structural weak zone. An irregular pattern is bending river. A sinuous pattern has a symmetrical bends. The bends of a symmetrical drainage is meandering channel. A braided pattern resembling a braid with certain amount of widening of the channel, to accomodate the extra load of silt and water, develops when number of bifurcation of the flow occurs. IDENTIFIED DRAINAGE PATTERN The sheet number of the given topographical map is 73 A / 1 . It represents part of Plateau district of Bihar. The scale of the map is 1:50,000 that is 2 cm on the map represents 1 km on the ground. Here the contour interval is 20m. The region extend from 23°45'N to 24°N and from 84°E to 24°15'E. The region is a dissected plateau and formed by North Koel river and its tributaries with isolated ridge and conical hills. The varying underlying geological structure, surface, morphometry and stage of evolution together have given rise to a variety of drainage and channel patterns. The most common of these, is the dendritic pattern in which the alignments of the tributaries and subtributaries are along to the branching arrangement of a tree. The dendritic pattern assosiated with the areas of homogeneous lithologies, horizontal or very gentle dipping strata and extensive topographic surface having extremly low relief. Here in these map, there are numerous dendritic pattern like A 2 Grid near the Charhat settlement, B 2 grid near the Barichater etc and so on. However, locally rain areas with broadly identical slope conditions, the network

NSOU CC-GR-02 57 of tributaries have formed parallel pattern mainly in ridge area. It comprises numerous rivers, which are parallel to each other and follow the regional slope. This pattern is more frequently develop on uniformly sloping and dipping rock beds such as valley or changed coastal plain. Here in this map, there are numerous parallel drainage pattern. The another pattern comes as radial drainage pattern which is also know as centrifugal pattern. It is formed by the stream which diverge from a central higher point in all directions. It is dome surface, volcanies cones, batholiths and lacoliths residual hills, small table lands, messa and butte and isolated upland favoured the development of that radial pattern. In map, there are mumermors radial drainage pattern, near Talyahi pahar, A 3 grid near Tular RF, A 2 grid near Musmin Reserved forest etc. Lastly comes the water bodies which is very important for the settlements. If we go through the map, we can see that various settlement patterns are found near waterbodies which is used for agricultural purpose. Here we have found water bodies near Nagpur Noudhi settlement. 3.3 Drainage Density Drainage density is the average length of stream or channel per unit area. It is measured to learn about the structured lithologic relief and the climate of the area. Resistance rocks and area show erosion and have low density, erodable character will develop many stream and have a higher density. Horton in 1932 made a quantitative is calculated by expressing in the following manner— Σ L = Total Channel length of the basin. A = Total Area of the basin. D = Drainage Density 'D' is the drainage density in per square km area is calculated by the total length of channel within the area and divided by the total area of the basin. The total length of the stream of different orders in the catchment area is to the calculated and divided by total catchment area, where the catchment area is small. In a large catchment area with higher order the area is divided into grid of unit area, the length of stream and measurement and plotted at the centre. Lines of equal density are drawn at the selected values and that given the donation of density pattern.

58 CC-GR-02 NSOU Map No: 73 A / 1

NSOU CC-GR-02 59 The sheet number of the given topographical sheet map is 73 A / 1 . It represents part of Palamu district of the Bihar. The scale of the map is 1:50,000 that is 2 cm on the map represent 1 km on the ground. Here the contour interval is 20 metre. The region extends from 23°45'N and 84°E to 84°15'E. The regions is a fluvialy dissected plateau area by North Koel river and its tributaries with isolated ridges and conical hill. The underlying geological structure, surface morphometry and stages of evolution have given rise to a variety of physical features which are shown here are: V shaped river valley Flattened valley Gully erosion and badland topography Sand bank Point bar.

CALCULATION FOR DRAINAGE DENSITY, MAP NO 73 A / 1 Sl. No. Grid Number Length of Length of Drainage Density Drainage Drainage in (in km/km 2) in cm km 1. A 1 5 2.5 2.5 2. A 2 5 2.5 2.5 3. A 3 6 3 3 4. A 4 6 3 3 5. A 5 8 4 4 6. A 6 6 3 3 7. B 1 6 3 3 8. B 2 6 3 3 9. B 3 6 3 3 10. B 4 7 3.5 3.5 11. B 5 6.3 3.25 3.25 12. B 6 6.5 3.25 3.25 13. C 1 5 2.5 2.5 14. C 2 7 3.5 3.5 15. C 3 8 4.5 4 16. C 4 9 4.5 4.5 17. C 5 10 6 5 18. C 6 7 3.5 3.5

60 CC-GR-02 NSOU 19. D 1 4 2 2 20. D 2 7 3.5 3.5 21. D 3 8 4.5 4.5 22. D 4 10 5 5 23. D 5 8 4 4 24. D 6 9 4.5 4.5 25. E 1 6 3 3 26. E 2 8 4 4 27. E 3 8 4 4 28. E 4 9 4.5 4.5 29. E 5 6 3 3 30. E 6 4 2 2 DRAINAGE DENSITY MAP PALAMU DISTRICT, BIHAR 84°0′ E 23°30′ N 23°30′N 84°0′E 24°50′ N 84°2′ 53″E INDEX DRAINAGE DENSITY IN KM/Km 2 4.5 3.5 2.5 R.F. 1:50,000 MAP NO: 73 A / 1 84° 2′53′ 23°50′N

NSOU CC-GR-02 61 INTERPRETATION OF DRAINAGE DENSITY (MAP NO. 73 A / 1) Drainage density is the average length of stream or channel per unit area. It is measured to learn about the structured lithologic relief and the climate of the area. Resistance rocks and area show erosion and have low density, erodable character will develop many stream and have a higher density. Horton in 1932 made a quantitative is calculated by expressing in the following manner— Σ L = Channel length of the basin. A = Total Area of the basin. D = Drainage density The topographical sheet bearing the no 73 A / 1 covers part of Palamu district of Bihar state. The area chosen to show drainage density of particular portion of 73 A / 1 , represents both perennial and non-perennial river. Latuitionaly the selected area extends from 23°50'N to 23°53'16"N, longitidenally extends from 84°E to 86°2'53"E. The selected area covers about 30 sq. km of area. The highest drainage density 5 km/km 2 and lowest drainage density is about 2 km/km 2 . In the drainage density map three isolines have been drawn at 1 km/km 2 internal. The values of the isolines are 2.5 km/km 2 , 3.5 km/km 2 , 4.5 km/km 2 . As a whole the central and south-eastern part have higher drainage density. The medium drainage density areas are in eastern, partly central, sathern part. The lower density area are north and northwest part. The degree of drainage density depends on the rock structure, nature of precipitation, degree of vegetal cover and sunlight.

62 CC-GR-02 NSOU 3.4 Relative Relief, Stream Frequency and Drainage Density of a common area The Relative Relief, Stream Frequency and Drainage Density of a common area are calculated from the topo Map No. 72 K / 8 to represents the corelations of them— Calculation table for relative relief, stream frequency and drainage density Grid Highest Lowest Relative No. of Length of Length of No. Altitude(m) Altitude(m) Relief(m) Streams Drainage Drainage (cm) (km) 1. 360 200 160 9 9.5 4.75 2. 460 200 260 8 6.0 3.00 3. 440 200 240 8 5.0 2.50 4. 220 100 120 5 6.0 3.00 5. 140 100 40 5 5.5 2.75 6. 400 160 240 5 4.5 2.25 7. 480 220 260 7 4.5 2.25 8. 480 120 360 8 8.5 4.25 9. 180 100 80 5 5.0 2.50 10. 99 61 38 2 1.5 0.75 11. 440 180 260 7 4.5 2.25 12. 489 200 289 10 5.0 2.50 13. 380 100 280 6 6.5 3.25 14. 119 81 38 5 6.5 3.25 15. 100 80 20 2 5.0 2.50 16. 400 160 240 8 5.0 2.50 17. 420 140 280 8 5.5 2.75 18. 240 100 140 7 6.5 3.25 19. NA NA 120 3 7.0 3.50 20. 99 61 38 2 2.0 1.00 21. 300 120 180 4 4.0 2.00 22. 340 100 240 6 7.0 3.50 23. 240 100 140 4 2.5 1.25 24. 119 81 38 4 4.5 2.25 25. 119 81 38 2 3.5 1.75

NSOU CC-GR-02 63 RELATIVE RELIEF MAP Relative Relief table Relative Grid No. Shading Remarks Relief Range 5, 9, 10, 14, 0 – 100 15, 19, 20, Very Low 24, 25 1, 4, 18, 21 Moderately 100 – 200 23 Low 2, 3, 6, 7 Moderately 200 – 300 11, 12, 13 High 17, 16, 22 300 – 400 8 Very High Munger District, Bihar R.F.—1:50,000 Toposheet No. 72 K / 8 86°17′ 58″E 25° 2′ 43″ N 86° 15′E 25° 2′ 43″ N 25° 0′N 58″E 86°17′ 25° 0′N 86° 15′E

64 CC-GR-02 NSOU INTERPRETATION OF RELATIVE RELIEF MAP A relative relief map has been drawn for the extension 86°15'E and 86°17'58"E and 25°0'N and 25°2'43"N in the survey of India topographical map no. 72 K / 8 . The area has been divided into 25 square grid with 1 km/1km dimension. For each grid highest altitude and lowest altitude have been recorded or estimated. The difference between this gives the value of relative relief. The smaller the relative relief, the flatter the terrain and the higher the relative relief the more rugged the terrain is. The map shows that North-Eastern grid, the southern gird and extreme North-Western grid are comperatively more flat. The landscape presents and undulating topography. In the west central grid the tropography is the most rugged one, with value more than 300 metre. In the remaining grids the topography is moderately rough with moderate relative relief. Relative relief will increase if the land is rugged. The degree of ruggedness depends of the dissection of the land which is depend on stream frequency. There is a chain reaction or consequences of some morphometric techniques. Like : Stream Frequency → Drainage Density → Dissection Index → Ruggedness Index → Relative Relief → Average Slope.

NSOU CC-GR-02 65 STREAM FREQUENCY MAP Stream Frequency table Stream Grid No. Shading Remarks Frequency Range 10,15,19 1 – 3 20, 25 Very Low 4,5,6,9,13,14 Moderately 4 – 6 21,23,24 Low 1,2,3,7,8,11, Moderately 7 – 9 16,17,18 High 10 – 12 12 Very High R.F.—1:50,000 Munger District, Bihar Toposheet No. 72 K / 8

66 CC-GR-02 NSOU INTERPRETATION OF STREAM FREQUENCY MAP Stream frequency is the number of streams per sq. km area. It leads to drainage density. For the given grids, stream frequency map has been prepared to show the nature of drainage. The map has been divided into 25 sq. grids of equal dimension. In each grid, no. of channel have been counted and stream frequency has been calculated by dividing the no. of channel with the area. Stream frequency is very high in the central part of the northern half. It is very low in the southern part. In the remaining part stream frequency is found in the plateau region with more rainfall and high degree of slope. Lower frequency means relative plain land with lower slope.

NSOU CC-GR-02 67 DRAINAGE DENSITY MAP Drainage Density table Drainage Grid No. Shading Remarks Density Range 0 – 1 10, 20 Very Low 1 – 2 21,23,25 Low 2,3,4,5,6,7 2 – 3 9,11,12,15, Moderately 16,17,24 3 – 4 13,14,18,19,22 High 4 – 5 1,8 Very High R.F.—1:50,000 Munger District, Bihar Toposheet No. 72 K / 8 86°17′ 58″E 25° 2′ 43″ N 86° 15′E 25° 2′ 43″ N 25° 0′N 86° 15′E 86°17′ 58″E 25° 0′N

68 CC-GR-02 NSOU INTERPRETATION OF DRAINAGE DENSITY MAP A drainage density map has been drawn to show the distribution of length of drainage per sq. km. The map has been prepared by choropleth method. It shows that drainage density is very high in the north-western part and very low in the southern part. In the south eastern part drainage density is moderately high. In the remaining area, it is moderately low. More the length of drainage signifies, the more stream frequency and more the relief signifies, the more the preciptation, and more the slope. 3.5 Vegetation Map The sheet no. of the given topographical map is 73A/1. It represents part of Palamu district of Bihar. The scale of the map is 1:50,000 that is 2 cm on map represents 1 km on the ground. The region extends from 23°45'N to 24°0'N and from 84°0'E to 84°15'E. There are a number of reserved and protected forest in the region. The reserved forests of the region are Hutar Reserved Forest, Harilong Reserved Forest, Putuagarh RF, Betla Reserved Forest, Saidup Reserved Forest etc, and the Karma PF, Datam Protected Forest, Palpol Protected Forest, Barichatan PF etc. The main rivers are North Koel River and Auranga River. The area which is covered by forest is about 60% of the total map. Most of the forest area is covered by dense sal jungle. In the left bank of the North Koel River there are so many reserved and Protected forest like Harma PF, Musurmju PF, Huban RF, Hura PF, Chunga PF, Adan PF etc. Which are mostly dense mixed sal jungle. In the right bank of the North Koel River, there is Kewatirar Protected Forest. North part of the Auranga river is Palpal PF, which is mainly mixed jungle of eucaliputus. In the south part of Auranga river is Belta Reserved Forest which is mainly mixed jungle of bamboo. And the other forest are Mourwai PF, Dohara RF etc. which are in the south part of the map. It can be seen from the region that most of the highly dissected plateau surface, with elevation above 300m is covered by sal forest. Most of the area below 250m is mostly covered by different kinds of plantation and dense scrub.

NSOU CC-GR-02 69 VEGETATION MAP (Rough Sketch) PALAMU DISTRICT, BIHAR MAP NO : 73 A / 1 N

70 CC-GR-02 NSOU 3.6 Settlement and Communication Map The whole area is covered by mostly rural settlement with only one site showing development of when settlement at Rainalokal. The settlement pattern is clarely associated with topography and drainage of the region. The nature of settlement may be a rural due to rugged terrain and dissected topography. In area of high relief and dence forest, small clusters have developed at the forest clearing. These clusters are developed either by the side of unmetalled road or by side of small tributary streams. But mostly these are found on the plateau fringe area with relatively less slope. Few example can be given from the north-western part, like Bali, Haria, Bantalai, Sahaybahah, Khalo etc. Isolated settlement are notice in the south-eastern sector on the slopes of dissected plateau surface which is connected with other settlement clusters by footpath and cart track. Some nucleated settlement have development on the right bank of Champal Nadi. This area is relatively flat with elevation, not exceeding 250m. Only few conical hill with elevation above 300m can be noticed along the NH 4 metalled road, connecting Rairakhal with Deogarh. This area also has a few water tanks mostly man made and settlement have demarcated around this water and pond at Dioneha, Tandabria, Kathuria, Paikmat etc. Some other examples are of such water point Nuliation is found, in the south-western part of the region between the Kutunia Nala and NH 4 . Some examples are Kuli, Parabalanda, Helai etc. Such small clusters are seen to developed at the junction of small foot paths that diverge in all directions like the scapes of a wheel and the settlement occurance of the hub of the wheel. Linear settlement have developed mostly along the NH 12 and some other metalled roads which are off shoots from the NH. Such settlement are prominent near Bamur in the extreme south-east corner of the region. It can be noticed that those settlement are reletively larger. With few urban facilities like Post Office, market place and transport facility. Rainakhal the only large urban clustered is developed on both banks of Drineha Nala. However, its locational development can be mainly a tributary to the presence of the a number of metalled roads tributing NH. Though the settlement has developd on the side of river but the river being non-perennial and highly silled is not expected to play an important role in the development of Rainakhal at the junction of roads. It has hospital, post office, markets, revenue office, a few temples, P.W.D banglow, and even a vetenary hospital. The area is served by power line.

NSOU CC-GR-02 71 SETTLEMENT AND COMMUNICATION MAP PALAMU DISTRICT, BIHAR Map No: 73 A / 1 ROUGH SKETCH

72 CC-GR-02 NSOU 3.7 Transect Chart: Correlation between physical and cultural features The transect chart provides a useful and graphic means of sampling and summarising the various distribution of structural surface and human activities and of revealing their similarities and construsts. It was developed for use in presenting the result of intensive local survey which among other things, rainfall, vegetation and agriculture can be fully studies because in it relief, drainage, vegetation, transport and communication and settlements are represented. The transect chart is located in the B 2 grid. The transect chart is drawn on AB line. The location of A point to 84°5'27"E and 23°54'30"N and the location of point B is 84°7'41"E and 23°50'30"N. Through the transect chart, the interrelation among the physical and cultural features are shown. It has been seen that the height of the profile has been decreased from A to B i.e., from North-West part to South-East part where the altitude is higher number of streams are higher and most of them are non- perennial. On the other hand, the number of streams have decreased where altitude has decreased. Hence perennial river have taken the place of non-perennial river. In this profile we have seen that on the dissected plain, the perennial river North Koel is flown. More over, since it is flowing on the plain area, sand banks is developed due to despositional work of the river. In the case of vegetation cover, we can also establish to its relation with physiography and others. In this profile vegetation cover is seen at the both ends of the profile where the altitude is higher and ruggedness, exist, agriculture and settlement cannot be development easily. Communication system has also a deep relationship with the topography. In the areas near point A has more heights, more ruggedness, dense forest cover as a result communication system as well as settlement has not been developed.

NSOU CC-GR-02 73 TRANSECT CHART Showing The relationship between physical and cultural elements Settlement Communication Drainage Relief Height in mt. Vegetation A B Palamu District, Bihar No. 73 A / 1 400 300 200 100 0 SCALE VERTICAL SCALE : 1 cm ≅ 100 metre HORIZONTAL SCALE : 1 cm ≅ 500 metre 84° 5′27″E 23° 54′ 30″N 23° 50′30′ ′N 84° 7′41″E

74 CC-GR-02 NSOU 3.8 Interpretation of Topographical map according to questions 3.8.1 Example 1 [Question: Interpret the topographical map in the following heads— 1. Describe the physiography of the area. 2. Prepare a Average Slope map (10 cm × 12 cm grids). 3. Describe the vegetation cover of the area and establish the relationship between slope and vegetation cover. 4. Relate the slope with the settlement of the map. 5. Prepare a transect chart and interpret it. Answer Introduction: Map No. 73 C / 8 Geographical location: Latitude: 21°00'N to 22°15'N Longitude: 84°15'E to 84°30'E State: Orissa District: Dhenkanal and Sambalpur Map Scale: 2 cm to 1 km RF: 1:50,000 Survey: 1979-80 Published: 1980 Surveyer: Major General Keshari Lal Khosla, Serveyer General of India REPRESENTATIVE PROFILE Height in mts. Break of slope 200 mt 300 mt 500 mt Vertical Scale 1 cm = 200 mt Horizontal Scale 1 cm = 500 mt 600

NSOU CC-GR-02 75 BOARD PHYSIOGRAPHIC DIVISION MAP MAP NO. 73 C / 8 R.F. → 1:50,000 RIVER 300 200 200 300 300 (<300)

76 CC-GR-02 NSOU Interpretation: The board physiographic division showing the referred region into few division— 1. Hilly region: This region elevated from 400 - 600 mt where the natural vegetation is highly concentrated. There several reserved forest, protected forest, dense forest have been observered. 2. Plateau region: This region elevated from 200 - 400 mt. Some protected forests have been covered in this plateau region. 3. Erosional plain: Erosion plain ranged from 100 - 200mt. The main river flow from north-western part to south-western part of the map. Therefore, the plantation dissected by river and the area is mostly covered by vegetation. Table: Showing the guidwise Average slope in degree/km 2 Grid No. No. of contour crossing per grid Average Slope in degree/Km 2 A 1 10 4°29'27" A 2 11 4°56'16" A 3 11 4°56'16" A 4 5 2°14'56" A 5 4 1°47'58" A 6 2 0°53'59" B 1 8 3°35'43" B 2 14 6°16'29" B 3 8 3°35'43" B 4 6 2°41'53" B 5 6 2°41'53" B 6 0 0°0'0" C 1 16 7°9'45" C 2 22 9°48'12" C 3 23 10°14'23"

NSOU CC-GR-02 77 C 4 16 7°9'45" C 5 6 2°41'53" C 6 8 3°35'43" D 1 25 11°6'32" D 2 30 13°15'30" D 3 19 8°29'15" D 4 20 8°55'38" D 5 6 2°41'53" D 6 4 1°47'58" E 1 22 9°48'12" E 2 23 10°14'23" E 3 19 8°29'15" E 4 32 14°6'29" E 5 31 13°41'3" E 6 2 0°53'59" Interpretation: The average slope map is drawn through the Wentworth's method. Formula: Average Slope (θ) = tan −1 . It has extend to the latitude 21°0'N to 21°2'N and longitude 84°27'E to 84°30'E. The slope of the region is south-western to north-eastern direction. The steep slope is concentrated at the north-western portion which is indicated by dark colour and the gentle or low slope is observed at the western part of the region. Grid No. No. of contour crossing per grid Average Slope in degree/Km 2

78 CC-GR-02 NSOU AVERAGE SLOPE MAP (Wentworth's Method) Map No: 73 C — 8 R.F.→1:50,000 INDEX AVERAGE SLOPE IN DEGREE/km 2 10 5 1 84°27′E′E′E′E′E

NSOU CC-GR-02 79 AVERAGE SLOPE MAP (Wentworth's method) with VEGETATION COVER RF→1:50,000 Map No: 73 C 8 INDEX AVERAGE SLOPE IN DEGREE/KM 2 10 5 1 VEGETATION IN % / KM 2 >25 26-50 51-75 <75 84°30′E 21° 2′N 84°27′E 21° 2′N 21° 0′N 84°27′E 21° 0′N 84°30′E

80 CC-GR-02 NSOU Interpretation: The vegetation cover is more in highly elevated as well as steep slope area. The slope of the region is south towards north-east direction. The steep slope is concentrated in the north-eastern portion where the dense forest is also found. The gentle slope area is cover with less vegetation than the high angle of slope. Therefore the density of vegetation is proportional to the amount of average slope. The density of vegetation increasing with the slope and vice versa. Dense forest: Dense forest is located where the elevation of relief is high and characterised by closely placed contour. The high elevated region is covered by natural dense forest. In reffered topomap several dense forest have been seen at the northernwestern and easter part of the region. Moderate dense forest: It had been found on the plateau region with the range of 200 - 400mt height. Deforestation or scarce vegetation: In the river vally or lowland area is characterise by scarce vegetation due to settlement density which is more in this area. Dense forest Moderate Dense forest

NSOU CC-GR-02 81 Scattered Diagram: By the scatter diagram the relation of relief and vegetation is represented the vegetation density is showing on the vertical axis ranges from 0 - 100% and the average slope is showing on the horizontal axis range from steep to gentle (0 to 10 Degree). The example is showing the density of vegetation is increasing with the slope and vice versa. The relation is positive in north-east to south-west direction. Scatter Diagram

82 CC-GR-02 NSOU AVERAGE SLOPE MAP (Wentworth's method) with SETTLEMENT DENSITY RF→1:50,000 Map No: 73 C 8 INDEX AVERAGE SLOPE IN DEGREE/KM 2 10 5 1

NSOU CC-GR-02 83 Interpretation: The well developed settlement is developed over the gentle slope of the region. Due to gentle slope, the natural vegetation, the rugged topography, the settlement cannot developed properly in steep slope area. The slope of this region is south-west toward north-eastern direction. Therefore, the concentration of settlement is decrease towards the high slope area. The scatter diagram showing the relationship between the slope and settlement. The average slope is represent at the horizontal axis range from 0 - 10° and the settlement density is shown at the vertical axis ranges from 0 - 25. The example showing the density of settlement is decreasing with the slope and vice versa. Therefore, the relation of them is negative. Scatter Diagram

84 CC-GR-02 NSOU TRANSECT CHART Showing The relationship between physical and cultural elements Interpretation: The broad and unique way to represent the physical and cultural elements is transect chart. The transect chart has the latitude 21°2'N to 22°2'N and longitude 84°27'E to 84°29'E. (1) Relief: The relief of this region is elevated from 180 to 400m. The region is highly plateau region characterized by some conical hill.

NSOU CC-GR-02 85 (2) Drainage: The rivers are flowing north-easter to southern part following the slope. (3) Vegetation: The high elevated area is covered by natural and dense forest. The river valley is less covered by vegetation due to well density of settlement and transport. (4) Transport and Communication: The lower plateau is well developed of transport and communication. Due to rugged topography and natural vegetation the high land is less developed in communication. (5) Settlement: The plane or lowland area is characterised by compact or linear settlement. 3.8.2 Example 2: Question 1. Describe the physiography and vegetation cover of the given map. 2. Describe the geomorphic features and drainage pattern of the given map. 3. Establish the relationship of slope and drainage of the area using morphometric techniques (10 cm × 12 cm area). Use transect chart and scatter diagram to illustrate your answer. 4. Prepare a Average Slope map (10cm × 12cm area) from the given topo map. 5. Draw a transect chart and interpret it. Introduction: Map No. 73C/8 Geographical location: ΔΔΔΔΔ latitude: 21°0'N to 21°15'N ΔΔΔΔΔ longitude: 84°15'E to 84°30'E ΔΔΔΔΔ State: Orissa ΔΔΔΔΔ District: Dhenkanal and Sambalpur Map Scale: 2cm = 1km R.F: 1:50,000 Surveyed: 1979-80 Surveyer: Major General Kishari Lal Khosla, Surveyer General of India Published: 1980

86 CC-GR-02 NSOU BROAD PHYSIOGRAPHIC DIVISION MAP WITH VEGETATION COVER Map No: 73 C 8

NSOU CC-GR-02 87 Interpretation: The broad physiography division map with vegetation cover is drawn with the latitude of 21°0'N to 21°15'N and logitude of 84°15'E to 84°30'E in 12cm × 12cm grid. There are three division of this region— 1) Hilly region (<500m) 2) Plateau region (300–500m) 3) Erosional plain (>300m) Divisions Altitude ranges Geographical Landuse and in metre location Landcover Hilly region/ <500m At the north, Due to rugged plateau proper north-western, topography this area is and south-western less active for portion of agriculture. This area Sambalpur. is covered by natural dense forest due to high elevation. Due to rugged topography, unavailable groundwater, under developed transport system, settlements scatterly developed Plataeu/region 300 – 500m At the central and This area is partly lower plateau northern portion practice of aggri- of Sambalpur culture and the district region is covered with moderate vegetation settlements are develop dispersly. Erosional plan > 300 At the southern, Due to fertile land, north-eastern the area is use portion of agricultural practise. Sambalpur and The area is covered Dhenkanal only with plantation district due to urbanisation. The settlements are found more in the plain due to well developed transport and communication.

88 CC-GR-02 NSOU PHYSICAL FEATURES (Geomorphic) Conical hill : The conical hill have been seen in the C 3 grid. The higher elevation is 591m and the lower elevation is 180m. Flat-topped hill: The surface of the peak is flat. The elevation of flat topped hill ranges from 150m to 320m. It has been found in B 3 grid. Conical Hill Flat-Toped Hill

NSOU CC-GR-02 89 Ridge: There are four peak is found in this ridge. The higher element is 480m and the lower elevation is 230m. It is found in the A 2 grid. DRAINAGE PATTERN: Dendritic Drainage Pattern: There are several drainage networks adjacent to the main stream in all direction and in all magnitude. They resemblege it with root, banches of tree. It is developed where the rocks have resistance to erosion. Ridge Dendritic Drainage Pattern Height in mt

90 CC-GR-02 NSOU Parallel Drainage Pattern: Parallel drainage pattern network which are all parallel to each other. It is form where there is alternate hard and soft rock on the surface. Radial Drainage Pattern: Radial drainage pattern is an important drainage pattern. The drainage network diverted or radiate out from control higher point. Meandering Channel: Meandering Channel is controlled by structural rock. The flow is bend when the stream is facing hard rock on their path and there are heterogenic rock surface. Parallel Drainage Pattern Radial Drainage Pattern Meandering Drainage Channel 84°23′ 21° 14′ 84°21′ 21° 13′ 84°20′ 21° 11′ 21° 10′ 84°17′ 21° 12′ 84°28′ 84°30′ 21° 14′

NSOU CC-GR-02 91 AVERAGE SLOPE MAP (Wentworth's method) with DRAINAGE NETWORK Map No: 73 C 8 RF→1:50,000 84°27′ 21° 15′ 84°30′ 21° 15′ 21° 11′ 84°30′ 21° 11′ 84°27′

92 CC-GR-02 NSOU Interpretation: The average slope map with superimposed by the drainage network is drawn with the latitude 21°11'N to 21°15'N and the langitude of 84°27'E to 84°30'E to represent relief and drainage. The steep slope is found at northern portion which is deter-minated by first part ordering stream. The gentle slope of the relief is concentrated at the southern portion of this region where the no. of stream ordering is increasing. The river is flow from northern to southern part following the regional slope. TRANSECT CHART Showing The relationship between Relief and Drainage (MAP No. 73 C / 8) Interpretation: The transect chart is the very unique way to represent the relationship between physical and cultural element on a single frame. The transect chart is drawn along the section line AB with the latitude 21°19'N to 21°14'N and the longitude of 84°20'E to 84°28'E.

NSOU CC-GR-02 93 (1) Relief: The relief ranges from 200 – 400m. The relief is dissected by river. The higher elevation is seen at the northern part. (2) Drainage: The river is flowing from northern to southern direction following the slope. SCATTER DIAGRAM Showing The relationship between Relief and Drainage The scatter diagram represents the relationship between relative relief and drainage. The horizontal axis is determined by the relative relief range from 0 – 100m and the vertical axis is determined by the drainage density ranges from 0 – 50 km. km 2 . By the example, it is noted that with the increasing of the relief, the density of drainage is increase and vice versa. Therefore the relation of them is positive. Table: Showing the guidwise Average slope in degree/km 2 Grid No. No. of contour crossing per grid Average Slope in degree/km 2 A 1 41 17°50'59" A 2 34 14°57'5" A 3 14 6°16'29"

94 CC-GR-02 NSOU A 4 8 3°35'43" A 5 4 1°47'58" A 6 2 0°53'49" B 1 48 20°39'23" B 2 36 15°47'18" B 3 9 6°2'36" B 4 5 2°14'56" B 5 5 2°14'56" B 6 8 3°35'43" C 1 39 17°1'50" C 2 31 13°41'3" C 3 4 1°47'58" C 4 2 0°53'49" C 5 2 0°53'49" C 6 2 0°53'49" D 1 38 16°37'5" D 2 30 13°15'30" D 3 11 4°56'16" D 4 7 3°8'48" D 5 14 6°16'29" D 6 11 4°56'16" E 1 20 8°55'38" E 2 19 8°29'15" E 3 16 7°9'45" E 4 10 4°29'27" E 5 20 8°55'38" E 6 17 7°36'18" Grid No. No. of contour crossing per grid Average Slope in degree/km 2

NSOU CC-GR-02 95 AVERAGE SLOPE MAP (Wentworth's Method) Interpretation: The average slope map is drawn with the latitude of 21°11'N to 21°15'N and longitude of 84°27'E to 84°30'E of C 1 grid in 10cm × 12cm grid. The highest slopes (10°) is concentred at the north and north-western portion of Sambalpur district and the low or gentle slope ranges of 1° is concentrated at the southern-western portion of the area which is indicated by light colour. The slope is from southern toward northern direction. RF→1:50,000 Map No: 73 C 8 84°30′E 21° 15′N 21° 11′N 84°30′E 21° 11′N 84°27′E 84°27′E 21° 15′N

96 CC-GR-02 NSOU TRANSECT CHART Showing The relationship between physical and cultural elements.

NSOU CC-GR-02 97 Interpretation : The transect chart is a very unique and broadway to represent the relationship between physical and cultural elements. The transect chart is drawn along the section line AB with latitude of 21°11'N to 21°13'N and the longitude of 84°24'E to 84°26'E. (1) Relief: The highest elevation of the relief is 460m and the lowest elevation of the relief is 200m. The relief is a plateau region dissected by river. (2) Drainage: The higher elevated area is determined by first ordering stream and the no. of stream ordering an increasing near the low land area. (3) Vegetation: The hilly region is occupied by dense vegetation whereas the floodplain is characterised by plantation only. (4) Transport and Communication: The floodplain is well developed in transport and communication where due to natural vegetation cover and ruggedness, the transport network is not developed in upper plateau. (5) Settlement: In the upper plataeu the settlement developed dispersely or isolated whereas the floodplain is characterised by well developed settlement.

98 CC-GR-02 NSOU Unit 4 Delineation of Drainage Basin and Cons- truction of Hypsometric curve Structure 4.1 Delineation of Drainage Basin 4.1.1 Introduction 4.1.2 Other Terms 4.1.3 Importance 4.1.4 Delineation/measures of Drainage Basin 4.1.5 Properties of Drainage Basin 4.1.6 Base map of Drainage Basin 4.1.7 Distribution of Drainage Density 4.1.8 Distribution of Stream Density 4.2 Hypsometric Curve 4.2.1 Introduction 4.2.2 Significance 4.2.3 Types 4.2.4 Drawing of the Hypsometric Curve 4.2.5 Advantage 4.2.6 Drainage Basin for calculation and drawing of hypsometric curve 4.2.7 Hypsometric Curve [Drawing] 4.1 Delineation of Drainage Basin 4.1.1 Introduction: A drainage basin is an area where precipitation collects and drains off into a river, bay or other body of water. It includes all the surface run off water and ground water underneath the earth's surface.

NSOU CC-GR-02 99 4.1.2 Other Terms: (i) Catchment area, (ii) Catchment basin, (iii) Drainage area, (iv) River basin, (v) Water basin. 4.1.3 Importance: Drainage basin has tremendous importance due to its— (i) Geospatial or geopolitical Boundaries (ii) Hydrological Character (iii) Geomorphological Unit (iv) Ecological Character (v) Resource Management 4.1.4 Delineation / Measures of Drainage Basin: The significant landmark of the quantitative measure of drainage basin analysis, is the introduction of the R.E. Horton's (1934) empirical relationship of the linear, areal and relief properties of the drainage basin, further modified by A.N. Strahler (1952). This is followed in quick occassion by a other techniques by A.E. Scheidegger (1965), R.I. Shreve (1967), Woldenberg and many others. The drainage basin is supposed to be composed of both qualitative and quantitative variables which can be evaluated either in terms of the attributes and variates respectively. Qualitative Altributes Quantitative Variables 1. Geology A. Size and Shape 2. Structure a. Areal change 3. Soil types b. Shape Indices 4. Vegetation B. Relief 5. Landforms types a. Elevation 6. Drainage types b. Ruggedness c. Dissection d. Slope e. Distribution

100 CC-GR-02 NSOU C. Linear Network a. Texture b. Density c. Frequency and Pattern D. Hydrology a. Climatic variables b. Relief c. Discharge d. Velocity 4.1.5 Properties of Drainage Basin: The drainage basins are composed basically of four different properties— (1) Areal (2) Relief (3) Linear (4) Hydrological propereties. As the drainage basin is the area drained collectively by the network of a river along with its tributaries and subtributaries, it is demarcated by drawing a line along the network boundary or watershed. Its shape reflects the nature of the basin hydrology and can be measured by using the formula: (1) Form factor (index of form) = A/L 2 (2) Elongation Ratio = P/πL (3) Circularity Ratio = 4πA/P 2 (4) Lemniscate Ratio = πL 2 /4A (5) Index of shape = L / B (where, A = Basin Area, L = Maximum basin length, P = Basin Parameter, B = Basin width) The different drainage basin shapes are— (a) Narrow elongated (b) Bi-directional (c) Multi directional (d) Oval shaped (e) Circular form (f) Irregular shaped

NSOU CC-GR-02 101 In most commonly applied indices measuring the fluviometric properties of drainage basin or any grid area from topo map are: (1) Drainage Frequency (Df) = (2) Drainage Density (Dd) = Index

102 CC-GR-02 NSOU 4.1.6 Base Map of Drainage Basin Map No: 73 F 8

NSOU CC-GR-02 103 4.1.7 Distribution of Drainage Density DISTRIBUTION OF DRAINAGE DENSITY BY CHOROPLETH METHOD BAHADA DRAINAGE BASIN Map No: 73 F 8 > 2.0

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104 CC-GR-02 NSOU Table for Drainage Density and Stream Density Grid Length of Actual Area Drainage Number Area Stream No. stream on length drained Density of drained density map(cm) (km) (Full grid/ (km/km 2) Stream (full grid/ (No of a part) a part) stream km 2) A 5 1.5 0.75 0.19 3.45 2 0.19 10.5 A 6 3.5 1.75 0.92 1.9 3 0.92 3.26 A 7 9.5 4.75 0.83 5.72 7 0.83 8.43 A 8 3.5 1.75 0.72 2.43 6 0.72 8.33 A 9 2 1 0.13 7.69 2 0.13 15.39 B 3 1 .5 0.22 2.27 2 0.22 9.09 B 4 5 2.5 0.81 3.08 9 0.81 11.11 B 5 6 3 1 3 7 1 7 B 6 6 3 1 3 7 1 7 B 7 7 3.5 1 3.5 8 1 8 B 8 8.5 4.25 1 4.25 11 1 11 B 9 1 .5 0.21 2.38 2 0.21 9.52 C 1 5 2 0.81 2.46 7 0.81 8.64 C 2 5 2.5 0.98 2.55 5 0.98 5.10 C 3 5.5 2.75 0.93 2.95 6 0.93 6.45 C 4 7.0 3.5 31 3.5 7 1 7 C 5 .5 2.5 1 2.5 5 1 5 C 6 5.5 2.75 1 2.75 8 1 8 C 7 9 4.5 1 4.5 8 1 8 C 8 0.5 0.25 1 0.25 3 1 3 D 1 2.0 1 0.3 3.34 4 0.3 13.3 D 2 4.0 2 0.75 2.63 5 0.7 6.57 D 3 1.0 .5 1 5 9 1 9 D 4 4.0 2 1 2 4 1 4 D 5 5.0 2.5 1 2.5 6 1 6 D 6 4.5 2.25 1 2.25 6 1 6 D 7 4.5 0.6 0.88 2.25 6 0.88 6.82 E 3 1 0.5 0.22 2.27 2 0.22 9.09 E 4 0.5 0.25 0.24 1.04 2 0.24 8.33 E 5 2.0 1 0.85 1.17 4 0.85 4.07 E 6 6 3 1 3 5 1 5 E 7 1 0.5 0.87 0.57 1 0.87 1.15 F 6 0.5 0.25 0.24 1.04 2 0.24 8.33

NSOU CC-GR-02 105 4.1.8 Distribution of Stream Density DISTRIBUTION OF STREAM DENSITY BY CHOROPLETH METHOD BAHADA DRAINAGE BASIN Map No. 73 F / 8 12.1 - 15.0 9.1 - 12.0 6.1 - 9.0 3.1 - 6.0 0.1 - 3.0

106 CC-GR-02 NSOU STREAM DENSITY The morphological study of drainage basin has been done on the basis of Bahada drainage basin located in the State of Jharkhand. The stream is a tributary to the Kaina River. It is a non-perennial channel and the basin has a reasonable spread of stream network. Initially the basin boundary has been delineated along the ridge line. The maximum elevation marked in the basin in 868 mt., whereas the minimum is 340mt. contour near the confluence. The delineation of the basin has been done on the survey of India topographic sheet 73 F / 8 on 1:50,000 scale. The basin has been grided by horizontal and vertical grids at an interval of 2 cm on map, that is 1 km on ground. The grids have been numbered by alpha-numeric method. Altogether 33 grids square have covered the basin and in the marginal areas. Sometimes a part of a grid has been taken into a consideration for area and other values. Two different choropleth maps have been prepared from the generated deta of stream density and drainage density. Stream Density (S.D.) is obtained as number of streams/sq.km.: Drainage Density (D.D.) values have been obtained as length of stream in km/ sq. km. As per computed values of stream density it is 1.15 to 15.39. This range has been divided into a few discrete classes. Altogether 5 classes are obtained by screeining method. It has been followed to indicate the variation of classes. It is observed that the central part of a stream has minimum to a medium range of values where as the periferal sections with higher relief have obtained higher values. Small tributaries have given higher stream densities. In a stream density map, the maximum range obtained 0.25 – 14.6 k.m./sq. km. This range devided into 4 classes as a regular interval of 3.0. This the following classes are obtained (0.1 – 3.0 Ns/km 2 , 3.1 – 6.0 Ns/km 2 . 6.1 – 9.0 Ns/km 2 , 9.1 – 12.0 Ns/km 2 , 12.1 – 15.0 Ns/km 2) The drainage density is ranges from 0.25 to 7.69 km/km 2 . The range has been divided into four discreate classes, like >2, 2.1 to 4.0, 4.1 to 6.0, 6.1 to 8.0 km/km 2 . The northern and some central part of the basin has highest density value whereas the central to southern portion has the lower to medium density value.

NSOU CC-GR-02 107 4.2 Hypsometric Curve 4.2.1 Introduction : Hypsometry (hypsos = height; metron = measure) is the measurement of the relationship between area and altitude of any area by drawing curve. In the cartesian co-ordinates, area is plotted along the abcissa (x-axis) and altitude is plotted on the ordinate (y-axis). It is useful for the comprehension of area-altitude, distribution of any country, region or drainage basin. Longbein used such curve for the study of large watersheds whereas straliler and others for small drainage basins. 4.2.2 Significance : This curves are especially of treamendous significance for drainage basins as the areal distribution of the relief which is responsible for the development and alignment of drainage network, indicative of the stage of the erosional surface and slope pattern besides its significance of the potential energy of running water. 4.2.3 Types : This curve can be of three types as follows : 1. Absolute hypsometric curve 2. Percentage hypsometric curve 3. Relative hypsometric curve 4.2.4 Drawing of the Hypsometric Curve : The curve is used to show

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the proportion of the area of the surface at various elevation above or below a given datum.

It should be drawn for an area having physical homogeneity. The area between each pair of contours (a) is expressed as a percentage of the total area of the region (A). The altitudinal variations (h) between the corresponding pair of contours is expressed as a percentage of the total relative relief (H) of the region. The hypsometric curve is obtained by plotting the (h/H)% on y- axis with respect to (a/A)% on x-axis. The shape and orientation of this curve graphically indicates the stage of the ensuring erosion cycle and the number of cycles already elapsed. 4.2.5 Advantages : 1. Actual assessment of the relief zones and their corresponding areal coverage of any drainage basin. 2. Detection of plateaus or erosional surfaces. 3. Assessment of the stage of the topography. 4. Useful for compaing the altitudual distribution of different drainage basins.

108 CC-GR-02 NSOU 4.2.6 Drainage Basin for calculation and drawing of hypsometric curve CALCULATION SHEET FOR HYPSOMETRIC CURVE Altitude Area (a) Altitude/Height (h) a / A h / H Cumulatives Class (m) (km 2) (m) a / A h / H <400 0.48 60 0.06 0.25 0.06 0.25 300-400 0.41 100 0.05 0.42 0.11 0.67 >300 7.31 80 0.83 0.33 1.00 1.00 Σa or A = 8 . 20 Σh or H = 240 Relative relief / height of that area is (heighest contour – lowest contour value) GALESERA RIVER BASIN Map No. 73 B / 6

NSOU CC-GR-02 109 4.2.7 Hypsometric Curve [Drawing] HYPSOMETRIC CURVE OF GALESERA RIVER BASIN MAP NO. 73 B / 6 RF→1:50000

110 CC-GR-02 NSOU Unit 5 Megascopic Identification of Minerals and Rocks Structure 5.1 Mineral samples: Bauxite, Calcite, Chalcopyrite, Feldspar, Galena, Gypsum, Hematite, Magnetite, Mica, Quartz, Talc, Tourmaline 5.1.1 Introduction 5.1.2 Definition of Minerals 5.1.3 Physical Characteristics 5.1.4 Some Major Minerals and their Characteristics 5.2 Rock samples: Granite, Basalt, Dolerite, Laterite, Limestone, Shale, Sandstone, Coglomerate, Slate, Phyllite, Schist, Gneiss, Quartzite, Marble 5.2.1 Introduction of Rocks 5.2.2 Definition of different types of rocks 5.2.3 Types 5.3 Rocks and Minerals in Brief [Identification and Characteristics] 5.3.1 Igneous Rock 5.3.2 Sedimentary Rocks 5.3.3 Metamorphic Rocks 5.3.4 Minerals 5.3.5 Minerals in Tabular Forms 5.3.6 Minerals in different arrangement 5.3.7 Very Heavy Minerals (Sp. Gr. above 6) 5.3.8 Colour of Minerals 5.3.9 Rocks in Details 5.3.10 Rocks in tabular form

NSOU CC-GR-02 111 5.1 Mineral samples: Bauxite, Calcite, Chalcopyrite, Feldspar, Galena, Gypsum, Hematite, Magnetite, Mica, Quartz, Talc, Tourmaline 5.1.1 Introduction : The earth is composed of various kinds of elements and these elements are in solid form in the outer layer of the earth and in hot and molten form in the interior. About 98 per cent of the total crust of the earth is composed of eight elements like oxygen, silicon, aluminium, iron, calcium, sodium, potassium and magnesium (Table), and the rest is constituted by titanium, hydrogen, phosphorous, manganese, sulphur, carbon, nickel and other elements. Table : The Major Elements of the Earth's Crust Sl. No. Elements By Weight (%) 1. Oxygen 46.60 2. Silicon 27.72 3. Aluminium 8.13 4. Iron 5.00 5. Calcium 3.63 6. Sodium 2.83 7. Potassium 2.59 8. Magnesium 2.09 9. Others 1.41 The elements in the earth's crust are rarely found exclusively but are usually combined with other elements to make various substances. These substances are recognised as minerals. Thus a mineral is a naturally occurring inorganic substance, having an orderly atomic structure and a definite chemical composition and physical properties. A mineral is composed of two or more elements. But, sometimes single element minerals like sulphur, copper, silver, gold, graphite etc. are found. Though the number of elements making up the lithosphere are limited they are combined in many different ways to make up many varieties of minerals. There are at least 2,000 minerals that have been named and identified in the earth crust; but almost

112 CC-GR-02 NSOU all the commonly occurring ones are related to six major mineral groups that are known as major rock forming minerals. The basic source of all minerals is the hot magma in the interior of the earth. When magma cools, crystals of minerals appear and a systematic series of minerals are formed in sequence to solidify so as to form rocks. Minerals such as coal, petroleum and natural gas are organic substances found in solid, liquid and gaseous forms respectively. 5.1.2 Definition of Minerals: Mineral is an inorganic homogeneous substance usually crystalline with a define chemical composition. Therefore minerals are natural body without organic particles. Ex. Mica, Talc, Quartz, Feldspar, Gypsum, Hematite, Magnetite, Calcite, Chalcopyrite, Galena, Bauxite. 5.1.3 Physical Characteristics: (i) External crystal form—determined by internal arrangement of the molecules— cubes, octahedrons, hexagonal prisms, etc. (ii) Cleavage —tendency to break in given directions producing relatively plane surfaces—result of internal arrangement of the molecules—may cleave in one or more directions and at any angle to each other. (iii) Fracture—internal molecular arrangement so complex there are no planes of molecules; the crystal wil1 break in an irregular manner not along planes of cleavage. (iv) Lustre—appearance of a material without regard to colour; each mineral has a distinctive lustre like metallic, silky', glossy ctc' (v) Colour—some minerals have characteristic colour determined by their molecular structure —malachite, azurite, chalcopyrite etc. and some minerals are coloured by impurities. For example, because of impurities quartz may be white, green, red, yellow etc. (vi) Streak—colour of the ground powder of any mineral. It may be of the same colour as the mineral or may differ—malachite gives green streak, fluorite is purple or green but gives a white streak. (vii) Transparency—transparent; light rays pass through so that objects can be seen plainly; translucent—light rays pass through but will get diffused so that objects cannot be seen; opaque—light will not pass at all.
NSOU CC-GR-02 113 (viii) Structure—particular arrangement of the individual crystals; fine, medium or coarse grained; fibrous—seperable, divergent, radiating. (ix) Hardness—relative resistance of

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being scratched; ten minerals are selected to measure the degree of hardness from 1-10. They are: 1. talc; 2. gypsum; 3. calcite; 4. fluorite; 5. apatite; 6. feldspar; 7. quartz; 8. topaz; 9. corundum; 10. diamond.

Compared to this for example, a fingernall is 2.5 and glass or knife blade is 5.5. (x) Specific gravity—the ratio between the weight of a given object and the weight of an equal volume of water; object weighted in air and then weighted in water and divide weight in air by the difference of the two weights. 5.1.4 Some Major Minerals and their Characteristics Feldspar : Silicon and oxygen are common elements in all types of feldspar and sodium, potasium, calcium, aluminium etc. are found in specific feldspar variety. Half of the earth's crust is composed of feldspar. It has light cream to salmon pink colour. It is used in ceramics and glass making. Quartz : It is one of the most important components of sand and granite. It consists of silica. It is a hard mineral virtually insoluble in water. It is white or colourless and used in radio and radar. It is one of the most important components of granite. Pyroxene : Pyroxene consists of calcium, aluminum, magnesium, iron and silica. Pyroxene forms 10 per cent of the earth's crust. It is commonly found in meteorities. It is in green or black colour. Amphibole : Aluminium, calcium, silica, iron, magnesium are the major elements of amphiboles. They form 7 per cent of the earth's crust. It is in green or black colour and is used in asbestos industry. Hornblende is another form of amphiboles. Mica : It comprises of potassium, aluminium, magnesium, iron, silica etc. It forms 4 per cent of the earth's crust. It is commonly found in igneous and metamorphic rocks. It is used in electrical instruments. Olivine : Magnesium, iron and silica are major elements of olivine. It is used in jewellery. It is usually a greenish crystal, often found in basaltic rocks. Besides these main minerals, other minerals like chlorite, calcite, magnetite, haematite, bauxite and barite are also present in some quantities in the rocks. Metallic Minerals : These minerals contain metal and can be sub-divided into three types:

114 CC-GR-02 NSOU (i) Precious metals : gold, silver, platinum etc. (ii) Ferrous metals : iron and other metals often mixed with iron to form various kinds of steel. (iii) Non-ferrous metals : include metals like copper, lead, zinc, tin, aluminium etc. Non-Metallic Minerals : These minerals do not contain metal, Sulphur, phosphates and nitrates are examples of non-metallic minerals. Cement is a mixture of non-metallic minerals. 5.2 Rock samples: Granite, Basalt, Dolerite, Laterite, Limestone, Shale, Sandstone, Coglomerate, Slate, Phyllite, Schist, Gneiss, Quartzite, Marble 5.2.1 Introduction of Rocks : The earth's crust is composed of rocks. A rock is an aggregate of one or more minerals. Rock may be hard or soft and in varied colours. For example, granite is hard, soapstone is soft. Gabbro is black and quartzite can be milky white. Rocks do not have definite composition of mineral constituents. Feldspar and quartz are the most common minerals found is rocks. 5.2.2 Definition of different types of rocks : Definition or Rocks : Rock can be defined as a material made of mineral particles bonded together. Rock is a hard and clastic substance. Therefore, rocks are aggregate of minerals. Rocks are classified according to their origin— (a) Igneous Rock : The Latin word 'Ignis' means fire. Igneous rocks are actually of fiery origin. They are made by the cooling and solidification of hot molten, material either magma within the earth's crust or the earth's surface. Ex. Granite, Basalt, Dolerite. Igneous rocks are of two types— i) Extrusive rock ii) Intrusive rock. (b) Sedimentary Rock : The Latrin word 'Sedere' means 'Setting down'. Deposition of eroded materials of pre-existing rocks by natural agents like river glacier, wind at distant places below the river, lake, sea or oceans under water in layers and solidification of these sediments (deposited particles) in layers from sedimentary rocks. Ex. Coal, Shale, Sandstone, Limestone, Conglomerate, Laterite. Sedimentary rocks are either of classic or non-classic origin.

NSOU CC-GR-02 115 (c) Metamorphic Rock : The Greek word 'meta' means 'altered' and 'morpho' means form. Due to temperature or pressure a pre-existing either igneous or sedimentary rock changes into a new form of rock which is called metamorphic rock. Ex. Slate, Phyllite, Quartzite, Gneiss, Marble. Schist, metamorphic rock can be either foliated or non-foliated. 5.2.3 Types : There are many different kinds of rocks which are grouped under three families on the basis of their mode of formation. They are: (i) Igneous Rocks—solidified from magma and lava; (ii) Sedimentary Rocks—the result of deposition of fragments of rocks by exogenous processes; (iii) Metamorphic Rocks—formed out of existing rocks undergoing recrystallisation. Igneous Rocks : As igneous rocks form out of magma and lava from the interior of the earth, they are known as primary rocks. The igneous rocks (Ignis—in Latin means 'Fire') are formed when magma cools and solidifies. When magma in its upward movement cools and turns into solid form it is called igneous rock. The process of cooling and solidification can happen in the earth's crust or on the surface of the earth. Igneous rocks are classified based on texture. Texture depends upon size and arrangement of grains or other physical conditions of the materials. If molten material is cooked slowly at great depths, mineral grains may be very large. Sudden cooling (at the surface) results in small and smooth grains. Intermediate conditions of cooling would result in intermediate sizes of grains making up igneous rocks. Granite, gabbro,m pegmatite, basalt, volcanic breccia and tuff are some of the examples of igneous rocks. Sedimentary Rocks : The word 'sedimentary' is derived from the Latin word sedimentum, which means settling. Rocks (igneous, sedimentary and metamorphic) of the earth's surface are exposed to denudational agents, and are broken up into various sizes of fragments. Such fragments are transported by different exogenous agencies and deposited. These deposits through compaction turn into rocks. This process is called lithification. In many sedimentary rocks, the layers of deposits retain their characteristics even after lithiflcation. Hence, we see a number of layers of varying thickness in sedimentary rocks like sandstone, shale etc.

116 CC-GR-02 NSOU Depending upon the mode of formation, sedimentary rocks are classified into three major grops: (i) mechanically formed—sandstone, conglomerate, limestone, shale, loess etc. are examples; (ii) organically formed —geyserite, chalk, limestone, coal etc. are some examples; (iii) chemically formed—chert, limestone, halite, potash etc. are some examples. Metamorphic Rocks : The word metamorphic means 'change of form'. These rocks form under the action of pressure, volume and temperature (PVT) changes. Metamorphism occurs when rocks are forced down to lower levels by tectonic processes or when molten magma rising through the crust comes in contact with the crustal rocks or the underlying rocks are subjected to great amounts of pressure by overlying rocks. Metamorphism is a process by which already consolidated rocks undergo recrystallisation and reorganisation of materials within original rocks. Mechanical disruption and reorganisation of the original minerals within rocks due to breaking and crushing without any appreciable chemical changes is called dynamic metamorphism. The materials of rocks chemically alter and recrystallise due to thermal metamorphism. There are two types of thermal metamorphism — contact metamorphism and regional metamorphism. In contact metamorphism the rocks come in contact with hot intruding magma and lava and the rock materials recrystallise under high temperatures. Quite often new materials form out of magma or lava are added to the rocks. In regional metamorphism, rocks undergo recrystallisation due to deformation caused by tectonic shearing together with high temperature or pressure or both. In the process of metamorphism in some rocks grains or minerals get arranged in layers or lines. Such an arrangement of minerals or grains in metamorphic rocks is called foliation or lineation. Sometimes minerals or materials of different groups are arranged into alternating thin to thick layers appearing in light and dark shades. Such a structure in metamorphic rocks is called banding and rocks displaying banding are called banded rocks. Types of metamorphic rocks depend upon original rocks that were subjected to metamorphism. Metamorphic rocks are classified into two major groups—foliated rocks and non-foliated rocks. Gneissoid, granite, syenite, slate, schist, marble, quartzite etc. are some examples of metamorphic rocks. 2.2.4 Rock Cycle : Rocks do not remain in their original form for long but may undergo transformation. Rock cycle is a continuous process through which old rocks are transformed into new ones. Igneous rocks are primary rocks and other rocks (sedimentary and metamorphic)

NSOU CC-GR-02 117 form from these primary rocks. Igneous rocks can be changed into metamorphic rocks. The fragments derived out of igneous and metamorphic rocks form into sedimentary rocks. Sedimentary rocks themselves can turn into fragments and the fragments can be a source for formation of sedimentary rocks. The crustal rocks (igneous, metamorphic and sedimentary) once formed may be carried down into the mantle (interior of the earth) through subduction process (parts or whole of crustal plates going down under another plate in zones of plate convergence) and the same melt down due to increase in temperature in the interior and turn into molten magma, the original source for igneous rocks. 5.3 Rocks and Minerals in Brief [Identification and Characteristics]: Identifying Characteristics : In case of Rocks : 1. Colour, grain size, specific gravity 2. Mineral composition, special character. In case of minerals : 1. Colour, Luster, Specific gravity 2. Hardness, special characteristics. Testing Instruments Lustr a) Glass a) Vitreous—Broken glass b) Streak plate b) Pearly—Lustre of a pearl c) Magnet c) Earthy—soil like d) Knife (steel) d) Silky—smooth e) Acid (HCl) e) Metallic—metal like f) Magnifying glass Hardness Special Character a) Nail—0 > 2.5 a) Reaction with HCl b) Steel Knife—5.5 b) Magnetic attraction c) Iron knife—5.0 c) Streak plate d) Glass plate—6.0 d) Smell Power e) Feel Power

118 CC-GR-02 NSOU IGNEOUS AND SEDIMENTARY ROCKS 5.3.1 Igneous Rock Granite: i) Light coloured with spots of white, pink and black. Moderate to coarse grained, moderate to high specific gravity. ii) Composed of quartz, feldspar, mica. It is a hard, compact, massive. Basalt: i) Dark black/grayish black, very fine grained, moderate to high specific gravity. ii) Composed of pyroxene, biotite. It is hard massive and compact. Dolerite: i) Dark coloured, moderate grained, moderate to high specific gravity. ii) Composed of pyroxene, feldspar. It is hard, massive and compact have interfingering texture.

NSOU CC-GR-02 119 SEDIMENTARY AND METAMORPHIC ROCKS

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NSOU CC-GR-02 121 5.3.2 Sedimentary Rocks Shale: i) Yellowish green/Grey/Brown/Greenish brown. Very fine grain size, moderate specific gravity. ii) Composed of clay minerals, gives smell of clay when water is applied, it is non clastic rock. Sandstone: i) White, light yellowish white, mixture, reddish brown medium to fine grain, moderate specific gravity. ii) Composed of sand and quartz, clastic surface, rough surface. Limestone: i) Black/Grey/Greyish white/Mixture/Reddish Brown, medium to fine grain, moderate specific gravity. ii) Composed of calcite, non clastic and reacts with HCl, can be scratched by knife. Conglomerate: i) Yellowish brown/White/Pinkish white, coarse grain, moderate specific gravity. ii) Composed of pebbles, sand/quartz, clastic texture. Laterite: i) Brown, orange, reddish brown, red, medium grained, moderate to high specific gravity. ii) Composed of bauxite, limestone, quartz, vesicular structure with spots of nodules, clastic rock, very rough surface. 5.3.3 Metamorphic Rocks Slate: i) Greenish black/Grey, fine grained, moderate specific gravity. ii) Composed of clay, prominent foliation, gives metallic sound under Hammer blow.
122 CC-GR-02 NSOU Phyllite: i) Greenish grey/Grey/Green, moderate specific gravity. ii) Composed of chlorite and mica, foliated rock, fine to medium grain size. Quartzite: i) White/Ash/Grey/Brownish grey, low to medium grained, low to moderate specific gravity. ii) Composed of sand, quartz sharp edge, non foliated. Gneiss: i) Alternate band of light and dark colored, medium grained, moderate specific gravity. ii) Composed of mica, quartz and feldspar, non foliated. Marble: i) White/Pink, orangish white, fine to medium grained, low to moderate specific gravity. ii) Composed of lime stone, react with HCl, non foliated. Schist: i) Silver/White/Black/Green, medium grained, low to moderate specific gravity. ii) Composed of muscovite biotite chlorite, foliated rock, crystalline, quartz, foldspar. 5.3.4 Minerals Talc: i) White/Whitish grey/Grey, silky luster, low specific gravity. ii) Less than 2.5, soapy feeling Mica: a) Muscovite — i) Colour white, silver, pearly luster, very low specific gravity. ii) Hardness > 2.5, transparent and translucent mineral. b) Biotite — i) Black coloured, pearly luster, very low specific gravity. ii) Hardness > 2.5, transparent and translucent mineral.
NSOU CC-GR-02 123 Gypsum: i) White/Grey colored, sub-pearly luster, low specific gravity. ii) Hardness > 2.5, translucent mineral. Quartz: i) White/Greyish white, vitreous lustre. ii) Hardness 6, crystalline mineral. Feldspar: a) Albite/Plagioclase — i) White/Grey, sub pearly luster, high to moderate specific gravity. ii) Hardness < 5, 2D Clevage. b) Orthoclase —i) Reddish white/Pink color, sub pearly lustre, high to moderate specific gravity. ii) Hardness < 5, 2D (Cleavage Hematite: i) Reddish brown (outer surface), Black inner surface, sub metallic luster, very high specific gravity. ii) Hardness 5.5 to 6.5, very low magnetism, gives cherry red streak. Magnetite: i) Iron black colored, submetallic to earthy luster, high specific gravity. ii) Hardness 5.5 to 6.5, highly magnetism, gives black streak. Calcite: i) White colored, vitreous luster, low to moderate specific gravity. ii) 3D Cleavage, react with HCl. Bauxite: i) Creamy/Whitish cream/Grey/Earthy lustre, low to moderate specific gravity. ii) Non crystalline mineral, Pisolitic masses.
124 CC-GR-02 NSOU
NSOU CC-GR-02 125 Chalcopyrite: i) Golden yellow/yellow/Green, metallic luster, high specific gravity. ii) Hardness < 3.5 to 4, Greenish black streak, gives smell when HCl is applied. Galena: i) Steel black/Iron black colored, metallic luster, very high specific gravity. ii) Hardness < 5.5, lead grey streak. Tourmaline: i) Silver or greenish black coloured, metallic lustre moderate specific gravity. ii) Hardness < 6, prismatic crystalls with rounded shape. Igneous or Sedimentary Rocks Metamorphic Rocks Shale — Slate Sandstone — Quartzite Granite — Gneiss Limestone — Marble Coal — Graphite
126 CC-GR-02 NSOU 5.3.5 Minerals in Tabular Forms MINERAL TYPE COLOUR LUSTRE SPECIFIC HARDNESS SPECIAL GRAVITY CHARACTER 1. Mica Biotite Silvery Pearly very low less than 2.5 transparent, black translucent 2 set cleavage Muscovite Silvery white 2. Quartz Greyish white, white (variable) 3. Feldspar Orthoclase Pink Pearly Moderate 5-6 2 set cleavage Plagioclase White (Variable) 4. Galena Silvery Metalic Very High 5-6 Greyish Black grey Streak, Smell of Gun Powder 5. Talc Off Silky Low to Less than 2.5 Soapy feel moderate
NSOU CC-GR-02 127 white, moderate white, Greyish white (variable) 6. Gypsum Silvery Pearly Low to Below 2.5 Waxy, white, moderate transparent, Silver translucent grey (variable) 7. Haematite Cherry Metallic Very high 5-6 Cherry red red/brown (Outer streak, surface), very low lead black Magnetised (inner surface) 8. Magnetite Black, Metallic/ Very high 5-6 Lead black greyish sub- streak, gets black metallic attracted by (variable) magnet 9. Bauxite Red, Pink, Earthy Moderate 5-6 Nodular, Reddish to high pisolitic brown structure (variable) 10. Chalcopyrite Greenish Matallic Moderate 5-6 Greenish black, grey black streeak golden (variable) 11. Calcite White, Pearly Moderate 2.5 to 5 3 set of greyish to low cleavage, white Rhombohedral (variable) shape, reacts with HCl 12. Tourmalin Silvery Metallic Moderate More than 6 Prismatic Black, Crystalls with Greenish rounded black shape

128 CC-GR-02 NSOU 5.3.6 Minerals in different arrangement Mineral Sp. Gr. Mineral Sp. Gr. Olivine 3.2–4.3 (6-7) Hornblende 3.3–4.7 (5-6) Topaz 3.5–3.6 (8) Realgar 3.56 (1.5-2) Kyanite 3.5–3.7 (4-7) Strontianite 3.6–3.7 (3.5-4) Limonite 3.6–4 (5-5.5) Staurolite 3.7 (7-7.5) Azurite 3.7–3.8 (3.5-4) Siderite 3.7–3.9 (3.5-4.5) Psilomelane 3.7–4.7 (5-6) Malachite 3.9–4 (3.5-4) Corundum 3.9–4.1 (9) Sphalerite 3.9–4.2 (3.5-4) Garner 3.9–4.2 (6.5-7.5) Smithsonite 4–4.5 (5.5) Chalcohpyrite 4.1–4.3 (3.5-4) Barite 4.5 (3-3.5) Stibnite 4.5–4.6 (2)

63%	MATCHING BLOCK 58/121	W

Chromite 4.5–4.8 (5.5) Zircon 4.7 (7.5) Molybdnite 4.7–4.8 (1-1.5) Pyrolusite 4.8 (2-2.5) Pyrite 4.8–5.1 (6-6.5) Haematite 4.9–5.3 (5.5-6.5) Magnetite 5.18 (5.5-6.5) Zincite 5.4-5.7 (4-4.5) Cuprite 5.8–6.15 (3.5-4) Arsenopyrite 5.9–6.2 (5.5-6) 5.3.7 Very Heavy Minerals (Sp. Gr. above 6) Cuprite 5.8–6.15 (3.5-4) Wolframite 7.1–7.9 (5-5.5)

Aresenopyrite 5.9–6.2 (5.5-6) Cobalite 6–6.3 (5.5) Bismuthinite 6.4–6.5 (2) Cerussite 6.55 (3-3.5) Classiterite 6.8-7.1 (6-7) Argentite 7.19–7.36 (2-2.25) Niccolite 7.3–7.6 (5-5.5) Galena 7.4-7.6 (2.5) Cinnabar 8.09 (2-2.5) Native Copper 8.8 (2.5-3) 5.3.8 Colour of Minerals

97%	MATCHING BLOCK 59/121	W

The minerals can also be arranged according to their common colours. The arrangement followed here is a modification of Warner's scheme.

I. Metallic Colour: i) Copper red—native copper. ii) Brass yellow—chalcopyrite. iii) Silver white—arsenopyrite. iv) Tin white—cobalite.
NSOU CC-GR-02 129 v) Lead gray—galena, molybdenite. II. Non-Metallic Colours A. White i) Reddish, yellowish or grayish white—calcite, quartz. ii) Greenish white—talc. iii)

80%	MATCHING BLOCK 60/121	W

Milk-white—slightly Bluish—some chalcedomy. B. Gray i) Green gray—talc. C. Black i) Velvet black—black tourmaline. ii) Greenish black—augite. iii) Bluish black—black cobalt. D. Blue i) Blackish blue—

azurite. ii)

79%	MATCHING BLOCK 61/121	W

Azure blue—a clear shade of bright blue-azurite. iii) Violet blue—blue mixed with red-fluorite. iv) Prussian blue—pure, blue—Kyanite. v) Smalt blue—some gypsum. vi) Indigo blue—blue with black and green tourmaline. E. Green i) Verdigris green—green, inclining to bluesome feldspar. ii) Celandine green—green, white blue and gray—talc and beryl. iii) Mountain green—green, with much blue—beryl. iv) Grass green—green, with more yellow-green diallage. v) Pistacho green—light green with some brown epidote. vi) Asparagus greeen—yellowish green-apatite. vii) Blakish green—serpentine. viii) Oil green—olive oil colour—beryl. F. Yellow i) Sulphur yellow—

sulphur. ii)

88%	MATCHING BLOCK 62/121	W

Straw yellow—pale yellow—topaz iii) Wax-yellow—brownish gray yellow—sphalerite, opal.

iv)

78%	MATCHING BLOCK 63/121	W

Honey—yellow, with shads of brown and red—calcite. v) Lemon yellow—sulphur, orpiment. 130

CC-GR-02 NSOU vi)

92%	MATCHING BLOCK 64/121	W

Ochre—yellow—brownish—yellow—yellow ochre. vii) Wine-yellow—topaz and flourite. viii) Cream yellow—kaolinite. ix) Orange yellow—orpiment. G. Red i) Aurora red—red with much yellow—some realgar. ii) Hyacinth red—red with shades of brown and yellow—garnet. iii) Scarlet red—red with a tinge of yellow—cinnabar. iv) Blood—red—garnet. v) Rose—red—rose quartz. vi) Brownish red—limonite.

H.

100%	MATCHING BLOCK 65/121	W

Brown i) Reddish brown—garnet, zircon. ii) Wood-brown—some asbestos. 5.3.9 Rocks

in Details Rocks are the units of the

93%	MATCHING BLOCK 66/121	W

earth's crust and are composed of minerals. A rock may be formed of only one mineral or it may be composed of several minerals. In popular conception the term rock is associated with something hard and heavy but in cientific usage a soft clay is as much a rock as the hard granite. Genetically the rocks may be classified into three major groups. viz. (i) Igneous, (ii) Sedimentary and (

iii) Metamorphic. i) Igneous Granite : These are mostly

81%	MATCHING BLOCK 67/121	W

commonly massive rocks without showing any tendency of foliation and banding. When metamorphosed they are banded or foliated and

are

100%	MATCHING BLOCK 68/121	W

more properly called granite-gneiss. The granites are a completely crystalline rock without any glassy matter and the texture varies from fine to coarse. Mineralogically they are composed chiefly of quartz, feldspars, and accessories like biotite muscovite, hornblende, other ferromagnesian minerals and iron oxides. These rocks are named according to the most prominent accessories as biotite-granite,

hornblende-granite,

95%	MATCHING BLOCK 69/121	W

etc. In hand specimen the quartz, feldspar and the chief accessories can be distinguished with the help of a pocket lens. In colour the granites are commonly of shade of gray but pink or red varieties also occur frequently. The colour of the rock depends on the

proportion of

93%	MATCHING BLOCK 70/121	W

the feldspars to the ferromagnesian minerals and also the colour of the feldspar itself. The specific gravity of the rock varies from 2.63

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to 2.75 according to the proportion of the light and heavy minerals. In case of a graphic granite a beautiful inter growth is seen between quartz and feldspars. Pegmatite: These occur as dykes or veins in the plutonic rock masses or as marginal segments to such

92%	MATCHING BLOCK 71/121	W

plutonic mass but are characterized by the presence of large crystals of, say, quartz, fedspars, mica, etc. They also contain minerals which require volatile matter in their formation. e.g., tourmaline, fluorite, topaz, etc. and compounds of rare minerals like lepidolite, beryl, etc. Syenite: It is completely crystalline rock and resembles granite in appearance but it contains very little or no. quartz. In colour it varies from nearly white to light or deep gray, but pink syenites are also not uncommon. The rock is massive and evenly granular. Banding

of

94%	MATCHING BLOCK 72/121	W

foliation may be caused due to metamorphism. Mineralogically the typical rock is composed of alkali feldspars, hornblende, with accessories of plagioclase, apatite, magnetite and a little or no quartz. In mica-syenite the hornblende is replaced by biotite and in augite-syenite, augite is the chief ferreomagnesian mineral. In nepheline-syenite nepheline is present along with feldspars. The specific gravity of the rock varies from 2.6 to 2.8 depending on the kind and proportion of minerals. Diorite: It is completely crystalline even to coarse granuled rock. It is generally massive but may be foliated due to metamorphism. The constituent minerals are chiefly plagioclase, with little or no quartz and hornblende along with other ferromagenesian minerals as accessories. Sometimes one of these accessories like augite or biotite might occur in large quantities.

The

98%	MATCHING BLOCK 73/121	W

colour of the rock varies from shades of dark green to almost black. Since the proportion of ferromagnesian minerals is higher than in case of granite or syenite the rock has a darker colour and a heavier specific gravity varying from 2.85 to 3.0. Gabbro: These are massive even granular rocks typically made up of some of the plagioclases and pyroxenes. Some of these show original banded structure which might get pronounced by metamorphism. The colour vgaries from dark gray, greenish to black but

amorthosites are

Ouriginal by Turnitin

92% **MATCHING BLOCK 74/121** W

sometimes white or light coloured. Their specific gravity is a little higher than diorities varying from 2.9 to 3.2. Peridotite: These rocks

are

100% **MATCHING BLOCK 75/121** W

without feldspar and are made up entirely of ferromagnesian minerals. They

are

88% **MATCHING BLOCK 76/121** W

crystalline, massive and sometimes show a mottled appearance (due to poikilitic texture). They

are

89% **MATCHING BLOCK 77/121** W

generally dark coloured varying from some shades of green (dunite) to complete black. They

are

70% **MATCHING BLOCK 78/121** W

heavier than gabbros and the specific gravity varies from 3 to 3.3. 132 CC-GR-02 NSOU Dolerite: It is dark, heavy, finely crystalline dyke rock. Typically it is composed of labradorite, augite and iron oxides, sp. gr. 2.64 to 3.12. Basalts: The basalts are very common volcanic rocks and the term covers many varieties. These

are

89%	MATCHING BLOCK 79/121	W

basic lavas in which plagioclase feldspars and the ferromagnesian minerals occur in almost equal proportions. There may be a little quartz and alkali feldspar also. The ferromagnesian mineral is either augite or olivine and iron oxide. Sometimes hornblende or biotite also occur. In colour the basalts vary from gray black to black and rather dull in appearance. Gellular and amygdaloidal structures are common and less fewquently the rock is porphyritic showing large crystals of plagioclase in a fine ground mass. The specific gravity is high varying from 2.9 to 3.1. Rhyolete: It is the volcanic equivalent of granite. The texture is generally prophyritic, i.e., large crystals of quartz and orthoclase embedded in a partly crystalline or glassy ground mass. Obsidian is the pure glassy variety with a bright vitreous lustre. It is jet black to red colour and has conchoidal fracture. Many pitchstones have a rhyolitic composition and show homogeneous glassy mass with a dull or resinous lustre. The colour varies from black to red brown or green. The specific gravity varies from 2.30 to 2.70. Pumice: It is an extremely porous and cellular glassy rock. The colour is generally white or gray but darker varieties also occur. Title: These rocks have been formed by the denudation of pre-existing rocks and the deposition and consolidation of the denuded material in water or air. The sedimentary rocks are characterized by startification. ii) Sandstone: It is a rock made up of sand grains held together by some cementing materials like silica, iron oxide or lime. Some sandstones contain little cementing substance and their tenacity is due to the presure during the time of consolidation. Apart from sand the minor constituents are feldspar, mica, garnet, magnetite, etc. The size of the grains varies very widely. In the fine grained types the sand particles are generally anugular but in the coarser varieties the sand particles are well rounded. Bedded or cross-bedded structures are well marked. The colour varies widely from gray, white buff, brown to red depending primarily on the colour of the cementing material. Shale: These are finely startified rocks and are compacted muds, clays or silts. Sometimes the shales are so finely startified that each laminate is no thicker than a

NSOU CC-GR-02 133

100%	MATCHING BLOCK 80/121	W

sheet of paper. Apart from clay which is chiefly kaolin the shales contain varying proportions of sand and also calcareous matter and with the increase in the proportion of sand degrade into fine grained sandstone and with increase of calcareous matter they pass into limestone. Most shales are soft and disintegrate into small fragments. These occur in various shades of colour—gray, buff, yellow, red, brown, purple, green or black. Limestone: It is a widely distributed rock and is chiefly composed of calcite with varying proportions of silica or clay as impurities. In grain size it varies from a finely granular rock to a rock composed of coarse fragments of shells and corals. The rock shows a wide range of colours. It is white when pure and impure varieties vary from gray to black. The rock can be easily scratched with a knife and it effervesces

in cold dilute hydrochloric

93%	MATCHING BLOCK 81/121	W

acid. The specific gravity of the rock varies from 2.5 to 2.8. Breccia: A rock composed of cemented stone fragments. The fragments are angular and typically do not show any stratification. These fragments may be of any kind of rock. The colour of the rock varies widely depending on the constituents. Conglomerate: This rock is entirely of an aqueous origin. It consists of rounded water-worn pebbles cemented together. The size of the pebbles varies widely. The pebbles may be entirely of one rock but more commonly they are fragments from different rocks. The colour and texture present a heterogeneous appearance. iii) Metamorphic: These rocks were originally sedimentary or igenous and their present state is due to a change brought about by intense heat and/or pressure. Quartzite: These are chiefly formed by the metamorphism of standstone. It is fine to coarse grained rock and is hard and compact. The colour varies widely—white, gray, yellowish, greenish or reddish. Broken surfaces show vitreous

88%	MATCHING BLOCK 82/121	W

lustre and conchoidal fracture. Slate: It is a fine grained hard and dense rock derived chiefly from the metamorphism of shales. The rock is cleavable into very thin laminae. The cleavage surface may be lustrous or dull, smooth or complicated but sometimes

are

85%	MATCHING BLOCK 83/121	W

also knotty due to graines of pyrite or magnetite. The colour is generally gray to black but red, purple of green slates also occur. The specific gravity is about 2.75. Marble: It is a metamorphic form of limestone. The rock is massive and has generally an even-grained texture. The endless varieties of coloured marble are due to the presence of impurities in the original rock. Black marbles are produced from 134 CC-GR-02 NSOU bituminuous limestone. The red, brown and yellow varieties are due to disseminated iron compounds. Gneiss: It is compact, completely crystalline, coarsely foliated rock. The darker bands are composed of ferromagnesian minerals and the light bands are commonly a mixture of quatz and feldspar. These bands may be regular or curved and contorted. The lines may be continuous or short and penticular. The colour varies from white through shades of gray, red, brown, green to nearly black. The rocks are named either according to chief ferromagnesian mineral as hornblende-gneiss, biotite-gneiss, augite- gneiss, etc., or after the parent rock as granite-gneiss. syen.te-geniss. etc. Schists:

There are

96%	MATCHING BLOCK 84/121	W

characterised by marked foliation along which they split readily. The rocks are completely crystalline and individual minerals are large enough to be visible, but sometimes the grain size is very fine. The colour varies widely according to the ferromagnesian minerals: mica-schists-may be gray to brown, chlorite-schists— shades of green, hornblede-schists—from green to black; talc-shists—light white to pale green or gray. Phyllite: These also show a slaty cleavage but are characterised by the presence of mica and the latter gives the rock a silvery appearance. Sometimes the cleavage face is knotted by crystals of garnet, quartz, pyrite. etc. 5.3.10

Rocks in tabular form : A. Grained, constituent grains recognized—Mostly instrusive (a) Feldspathic rocks, usually light (

90%	MATCHING BLOCK 85/121	W

b) Ferromagnesian rock, generally dark in colour to black in colour with quartz without quartz with subordinate feldspar, without feldspar Non- Granite Syenite Diorite Peridotite

Porphyrtitic (a) Aplite (a) Syenite Gabbro- Pyrozenite (b) Nepweline Dolerite Hornblendite syenite (c) Anorthosite Porphyry Granite Syenite Diorite Porphyry Porphyry Porphyry
NSOU CC-GR-02 135

73%	MATCHING BLOCK 86/121	W

B. Dense, constituents nearly or wholly unrecognizeable— Instrusive and Extrusive (a) Light, colour, usually Feldspathic (b) Dark coloured to black, usually ferromagensian Non- Felsite Basalt Porphyritic Porphyritic Felsiteprophyry Basalt-porphyry C. Rocks composed wholly or in part of glass—Extrusive Non-porphyritic obsidian, pitchstone, perlites, pumice, etc. Porphyriotic vitrophyre (obsidian and pitchstone porphyry) Fragmental Igneous material—Extrusive Tuffs, Breceias (volcanic ashes, etc.) 136

Unit 6 Measurement of dip and strike using Clinometer Structure 6.1 Introduction 6.2 Measurement 6.3 Method 6.4 Example 6.1 Introduction The clinometer is an optical device for measuring elevation, angles above horizontal. With the help of this instrument, we can easily measure the dip and strike of any rock. This is mostly used to determine the dip and strike of the rock or rock structure to prepare geological or geomorphological maps. 6.2 Measurement The dip and strike of any rock strata can be easing measured with the help of a compass (for measuring direction of dip & strike) and a clinometer (for reading angle of dip). These two are usually combined in a compass clinometer. Dip: The inclination of a bedding plane with respect to the horizontal plane is called dip. Strike: The direction perpendicular to the direction of true dip is called a strike and a line drawn in this direction is called. a strike line. 6.3 Method The measurement of dip and strike using clinometer needs to follow the following steps— a) Set the clinometer so that 90° and 270° on the dial are lined up with the markers on the clinometer and the inner scale reads 0° when the instrument is horizontal. b) Then, place the clinometer on the bedding plane and move it around until a reading of 0° is obtained. c) Draw a soft pencil line on the bedding plane to mark where the base of the clinometer rests on the rock. Since this line is horizontal, it will show the direction of dip.
137 Clinometer Clinometer
138 d) Draw a another line on the rock so that it is a right angle to the direction of strike and points directly down the sloping bedding plane. This line marks the director of dip. e) Using a compass measure the direction of strike and the direction of dip, as shown by the lines drawn on the rock. f) Record the grid reference of the location, the strike direction in degrees and the dip direction in degrees. 6.4 Example

96%	MATCHING BLOCK 87/121	W

The slope of land in degrees can be fdound with the help of a clinometer. As already explained, if the slope is 1° a Vertical Interval (V.I.) of 1 foot corresponds to a Horizontal Interval (H.I.) of 57.3 feet, or about 20 yards, so that we get the relation: Where D = degree of slope. If a land with uniform slope of 5° is to be contoured at vertical intervals of 10 feet then the H.I. will be = yards. That is the contour lines are to be drawn 40 yards apart. In other words the land rises 10 feet vertically in a horizontal distance of 40 yards. To minimise calculation a scale can be prepared for a given V.I. to show H.I. corresponding to different degrees of slope. Supposing a hillock is to be contoured at 10 feet interval with a clinometer. First, one contour line is established round the eminence a little below the summit at a distance less than 10 feet. To level a line round the hill marking the position of the first contour a piece of cloth is tied round a ranging rod at a height equal to the height of the eye of the observer with the clinometer. The ranging rod is moved about and with the clinometer at zero a number of positions are fixed by noting the cloth mark on the rod.

Unit 7: Preparation and Interpretation of Simple Geological Maps
139 Unit 7 Preparation and Interpretation of Simple Geological Maps Structure 7.1 Concept 7.2 Related Concepts 7.3 Formula 7.4 Geological Time Scale 7.5 Information Displayed by Geological Maps 7.6 Use of Geological Maps 7.7 Criterias for Interpretation of Geological Maps (Horizontal, Uniclinal and Simple Anticlinal and Synclinal Fold Structure) 7.8 Interpretation of Geological Maps A) Example 1 B) Example 2 C) Example 3 D) Example 4 E) Example 5 F) Example 6 G) Example 7 H) Example 8 I) Example 9 J) Example 10 K) Example 11

140 7.1 Concept The map which show the geographical/geological pattern of the composition of the earth's surface by means of lithology, structure and succession of geological formations. It represents the outcrop of the different rock strata of a particular region. 7.2 Related concepts 1) Lithology: It shows the precise location and extend of the different outcrops or underline rock beds. 2) Succession: The chronological sequence of rockbads is called succession. 3) Unconformity: It denotes the discontinuity in the succession. 4) Structure: It denotes the altitude of the rock beds which represents the relation between outcrop pattern and contour layout. 5) Outcrop: The intersection of a rock body with the topography is called outcrop. 6) Bedding plane: It is the plane that separates two successive rock beds or strata or layers. It may be upper and or lower bedding plane. 7) Dip: The inclination of a bedding plane with respect to the horizontal plane is called dip. It is two types— (a) True dip: It is measured along the direction of maximum inclination/slope of an inclined plane. (b) Apparent dip: It is measured in any direction other than the direction of maximum slope. [True dip is always equal or greater than apparent dip.] 8) Strike: The direction perpendicular to the direction of true dip is called the strike and line drawn in this direction is called a strike line. (It is also known as 'stratum contours' or 'structure contours') 9) Dip direction: It is the geographical direction in which the beds dip is called the dip direction.

141 10) Thickness: It is the differences of upper and lower surface of a bed. It is two types— (a) Vertical thickness: The vertical distance between upper and lower surface of the bed. (b) True thickness: It is the perpendicular distance between the upper and lower surfaces of the bed. 11) Horizontal structure: In it the bedding planes run parallel to the contours [No strike line and dip become zero] 12) Uniclinal structure: This structure is formed when all the beds in a series dip uniformly in a particular direction. 13) Folded structure: In it repetition of outcrops and reversal and variation of dip signified syncline or anticline or a combination of two— (a) Syncline: The two limbs dip towards the axial plane. (b) Anticline: The two limbs dip away from the axial plane. 7.3 Formula: 1) True dip (θ) = tan −1 2) Apparent dip (α) = tan −1 3) Vertical thickness (V t) = Measure vertical distance between bedding planes by scale. (w.tanθ) 4) True thickness (Tt) = vertical thickness (Vt) . cosθ

142 7.4 GEOLOGICAL TIME SCALE (In case of geological map interpretation, the geological time scale is necessary)

143 7.5 Information displayed by Geological maps Geological map is a two-dimensional representation of patterns of lithological boundaries in relation to topography and structure. It is the one which shows the occurance and distribution of rocks as ground surface. Geological maps are produced at various scales and may show different types of informations like folds, faults. Others are designed for economic purposes and give specialised informations on mineral deposit. They display the following information. a) The distribution of rock and position of the boundaries them. b) The key usually gives the stratigraphical position and name of the rock. c) Thickness of beds. d) The various structural elements features such as the dips of the strata, position of faults and their throw may be shown accordingly in the map. e) Informations may be given on some map on particular some fossils banks and localities of some features of economic importance for eg. the outcrop of mineral veins and coal seems. 7.6 Use of Geological Maps Geological maps are used to interprete the structure, stratigraphy, mineralogy, paleontology and historical records of the earths crust. It is used to locate source of groundwater, mineral sources and energy resource. Also geological maps are used to describe and identify certain potential mineral hazards such as Mercury, Randon etc. Geological map constitute a fundamental objective, scientific foundation on which water use and resource use decisions are made and based. It is the best science product to display the information that decision makers used to identify and protect valuable resources avoid risks from natural hazards and make wise use of our land. They are used to identify potential geological hazards such as landslides, earthquakes, and areas susceptible to Tsunamis. Geological maps are used by landuse planners to identify and determine the areas which are suitable for agriculture and urban development.

144 7.7 Criterias for Interpretation of Geological Maps Visual Identification of structures: Unconfirmity: (a) Bedding plants of the older series appear to end abruptly covered by the beds of younger beds/series. (b) Strike was on two sides intersect and beds have different altitudes. Horizontal structure: Contours run parallel to the bedding planes. Vertical structure: Bedding planes cut across the contours such that the inner strike distance in zero (usually denoted by a cross). Uniclinal structure: Contours and outcrop intersect one another. Folded structure: a) Outcrops repeat on eithers side of the core beds. b) The outcrops combine to form either X or H pattern. c) If younger beds form core, it is a syncline, and if older beds form a core it is an anticline. Faulted structure: a) A fault in indicated by a thicker line on the either side of which bedding planes are displaced. b) A straight fault trace indicates a vertical fault and curved fault trace indicates inclined fault. Fold: a)

80% **MATCHING BLOCK 88/121** **W**

Rock strata may be bent or folded into a series of troughs or downfolds or arches or upfold due to horizontal compressional forces.

b)

87% **MATCHING BLOCK 89/121** **W**

The imaginary surface about which folding occurs is axial plane of fold.

c) The line along which the change in direction of dip occurs is called the age is of folding. d)

48% **MATCHING BLOCK 90/121** **W**

The beds on either side of fold is called limbs. e) The fold in which limb dip towards the axial plane is a syncline. f) The fold in which limbs dip

outrward or away from the axial plane is an anticline. g) The fold is symmetrical where limbs equally dip and vice versa. Fault: a)

76% **MATCHING BLOCK 91/121** **W**

A rock series may be broken or fractured due to stresses setup in the Earth's crust by the tectonic forces and they are accompanied by dislocation or relative movement of strata on either side, the rocks are said to be faulted, fracture called fault and surface

called fault plane. The angle of fault is called heave and displacement is called throw. There are upthrown and downthrown sides of a fault.
145 7.8 Interpretation of Geological Maps Example 1 : Y X Scale: 1″ = 1000 feet Uncomformity
146 INTERPRETATION Introduction: A section line XY is drawn through the central part of the map running in west to east direction and the map has H.S.—1" = 1000 feet and V.S.— 1" = 1000 feet. This is a three series map. a) Succession of rock beds: The sequence of rock beds is called succession of rock beds. The map consists of three series. The oldest bed of older series is lower D and after that the other beds are deposited in seavencial order. The oldest beds of older series are lower D, E, F, G, O, P. The youngest beds of younger series are upper T. S. P, O. Name of Symbol Age of Thickness (feet) Remarks rock beds Deposition True Vertical upper T Youngest 98 199 Younger upper S 049 50 lower p 49 50 lower O 98 100 lower G 148 150 lower F 248 250 lower E 248 250 lower D Oldest 693 700 Older b) Geological Structure: The upper part of the map is horizontal structure and the beds are upper T and S. There is a unconformity line between upper S and lower P. The middle part of the map is anticline fold above which a valley is exist and its related beds are lower P, O, S and F. It's core bed is lower D and it's oldest bed of older series. It's right dip angle is 26°33' towards west and left dip angle is 12°31' towards east. The lower part of the map also is syncline fold and its core bed is lower < Unconformity Unconformity

147 G, above which a ridge is exist. Its left dip angle is 12°31' towards west and left dip angle is also 12°31' towards east. Name of Symbol Age of Dip (degree) Remarks rock beds Deposition Apparent True upper T Youngest 0°0' 0°0' Horizontal upper S ,, ,, Structure lower p 26°33' 33°41' lower O ,, ,, Anticlinal Valley lower G 12°31' 14°2' lower F Oldest ,, ,, Synclinal ridge lower E ,, ,, lower D ,, ,, c) Topography and its relation with structure: The map area reaches its highest altitude of 1100 feet towards the left and right margin of the map section and the lowest altitude of the areas is 500 feet. The lower altitude is find in the central part of the map. The relative or altitudinal variation in the region is almost 600 feet. The general slope of the map is from west to central and east to central part of the map. Fluvial action has been affecting the topography leads to a river valley where the rivers have formed and the rivers flowing from three direction from the higher to lower altitude teading to a centripetal drainage pattern. Moreover here, consequent, subsequent, strike, dip and anti-dip streams form a trellis drainage pattern. It indicates that there is no structural control over topography. However, due to such drainage pattern a typical topographic features called inversion of relief topography with a hillocks near the western part. Therefore, it signifies a folded topography of both anticlinal and synclinal by nature. Unconformity Unconformity

148 d) Geological History: The geological sequences are— 1) All the rock beds are of sedimentary origin, so all of them develop in marine condition. 2) Here the oldest bed in D which was first deposited, the subsequently E, F, G beds were deposited in the same series. 3) After that, in a seperate series O and P beds are deposited. 4) After the deposition they were uplefted and tilted and due to tectonic movement, folded topography is formed. 5) Finally, S and T beds are deposited and due to tectonic movement, they formed folded topography and then they are subjected to erosional deposition. 6) Different drainage network constantly evolute the region and Inversion of topography is formed.

149 B) Example 2 :

150 INTERPRETATION Geological Map is a systematic representation of structure layout of different geological beds within the limits of contour aligement of a particular area on a certain scale. The section is drawn on the basis of the given map (example 2) which is located (xy) southwest to northeast. The nature of contour and topographical pattern indicates a plateau region. Succession of Geological beds: Thickness (feet) Beds V. T. T. T. Remarks Upper scale < 50 150.82 Youngest Upper Sandstone 200 201.10 Mudstone 200 201.10 Lower Sandstone 350 351.92 Lower Shale > 500 301.45 Oldest V.T. → Vertical thickness T.T. → True thickness. The sequence of beds is given. From the table we can see that upper shale is the youngest bed while lower shale forms the oldest bed. From this, we also use get the sequence of super position of beds. It is a single series formation. Structure: Dip Amount Beds T.D. A.D. Remarks Upper Shale 6°0' 5°42' Upper Sandstone ,, ,, Uniclinal Mudstone ,, ,, Lower Sandstone ,, ,, Lower Shale ,, ,, T.D. → True Dip A.D. → Apparent Dip The structure is an uniclinal structure with an angle of Dip as 6°0' (True dip) and 5°42' (Apparent dip). The sedimentary series being of the same series are conformable to each other. < Structure

151 Topography: The Region is of a plateau terrain. The maximum height of 800 feet is in the eastern part of the section while the lowest height of 200 feet is in the western side of the section thus covering a relative relief of 600 feet. Two consequent streams are flowing from N to S. Topography in relation with structure: The topographical dip and structural dip is inversely related thus they are negatively related. Thus erosion varies in this region. On the western side, strike valley or antidip valley is formed. Geological History: Sedimentary beds are formed under marin conditions in the order lower shale, lower sandstone, mudstone, upper sandstone, upper shale order. Deposition is taken place by upliftment and then lifting of rock strata and their subaerial erosion and denudation.

152 1 C) Example 3 : Geological map and cross sectional profile

153 D) Example 4 :

154 A) Example 5 : Geological Cross Section Along the Line PQ Horizontal Scale 1″ = 1000 feet Vertical Scale 1″ = 1000 feet Scale: 1″ = 1000 feet A P X Q Y B A B

155 F) Example 6 :

156 G) Example 7 : SCALE : 1 inch = 1000 feet

157 H) Example 8 :

158 I) Example 9 :

159 J) Example 10 :

160 K) Example 11 :

161 Summary/Learning Outcomes: The learning outcomes of the blocks are : 1) The study of Indian topographical map helps to understand different physical and cultural elements. 2) The correlation between different physical and cultural elements of topographical map can easily understood by gaining the knowledge to topographical sheets. 3) By gaining knowledge one can delineate the drainage basin from the given topographical map. 4) Students can construct the hypsometric curve from the topographical map. 5) The identification of different rocks and minerals can be done by the learners by acquiring the knowledge about such rocks and minerals. 6) The knowledge of the study of geological maps enhanced the skills, helps to understand and interpretation of different types and structures of such maps. 7) The learners of geography discipline can describe and prepare particular assignment and solve problems related to the topics of the blocks after studied minutely. 8) The practical experience of solving geomorphological problems in this block will definately enhanced the skills of the learners in this discipline and strengthen the theoritical base of geomorphology and geotectonics. Questions: 1. Draw a Broad Physiographic Division map of the given topographical map. 2. Draw Longitudinal Profiles, Serial Profiles, Superimposed Profile, Projected Profile Composite Profile and state their importance. 3. Draw a Relative Relief map and interpret it. 4. Draw a Average Slope map and interpret it. 5. Draw the Drainage Patterns of the map and interpret them. 6. Draw a Drainage Density map and interpret it. 7. Establish the correlations of Relative Relief, Stream Frequency and Drainage Density of a common area of the given topographical map

162 8. Draw a Vegetation Map and interpret it. 9. Draw a Settlement and Communication Map and interpret it. 10. Draw a Transect Chart to represent thecorrelation between physical and cultural features of the given topographical map. 11. Delineate a Drainage Basin the given topographical map and state its properties. 12. Draw a Drainage Density map by demarketing any Drainage Basin from the given topographical map and interpret it. 13. Draw a Stream Density map by demarketing any Drainage Basin from the given topographical map and interpret it. 14. Draw a Hypsometric Curve and state its significance. 15. Identify the given samples of minerals and state their three identifying features: Bauxite, Calcite, Chalcopyrite, Feldspar, Galena, Gypsum, Hematite, Magnetite, Mica, Quartz, Talc, Tourmaline. 16. Identify the given samples of rocks and state their three identifying features: Granite, Basalt, Dolerite, Laterite, Limestone, Shale, Sandstone, Conglomerate, Slate, Phyllite, Schist, Gneiss, Quartzite, Marble. 17. Measure the dip and strike by using clinometers. 18. Draw profiles along a cross section of the given Geological Map and interpret it. (Horizontal structure). 19. Draw profiles along a cross section of the given Geological Map with Uniclinal structure and interpret it. 20. Draw profiles along a cross section of the given Geological Map with Simple Anticlinal and Synclinal Fold Structure and interpret the map. 21. What are the major criteria to identify and interpret a geological map. 22. State about the succession, structure, topography, relation between structure and topography and geological history of geological maps. References: Dury, G.H. (1971): Map Interpretation, Pitman Publishing. Hammond, R. and Macullagh, P.S. (1974): Quantitative Methods in Geography, Clarendon Press, Oxford.

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Block-II Climatology Laboratory Learning Objectives: 1) To learn the uses of analogue instrument for the measurement of different weather elements. 2) To study the daily weather map of India and learn to interpret it. 3) To construct and interpret Climograph to identify the climatic conditions. 4) To study different climatic conditions and construct Wind Rose diagram 5) To construct Climatic Chart and learn to interpret it by underswtanding the related weather features. 6) To construct the Ombrothermic Chart and learn to interpret it using the weather conditions.

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167 Unit 1 Measurement of Weather Elements using Analogue Instruments: Mean daily temperature, Air pressure Structure 1.1 Concepts of Weather and Climate 1.2 Measurement of Weather Elements 1.2.1 Temperature Measurement by Six's Maximum and Minimum Thermometer 1.2.2 Temperature Measurement by Rutherford's Maximum and Minimum Thermometer 1.2.3 Temperature Measurement by Sterenson's Screen 1.2.4 Air pressure Measurement 1.3 Case Study : Weather Element Measurement by Analogue Instrument 1.3.1 Barometer 1.3.1.1 Introduction 1.3.1.2 Measurement of Reading 1.3.1.3 Example 1.3.2 Six's Maximum and Minimum Thermometer 1.3.2.1 Introduction 1.3.2.2 Measurement of Reading 1.1 Concept of Weather and Climate Concept of Weather: Temperature, sunshine, wind direction, wind velocity, precipitation, etc., are hardly stable at a place. They change rather quickly as time passes and their values may vary from place to place at a particular time. Weather is the state of the atmosphere at a place at a particular time, or for a short spell of time, with reference to temperature, atmospheric pressure, wind direction, wind velocity, sunshine, cloudiness, precipitation, etc. The spell of time may be as short as an hour or so or as long as a day. Elements such as temperature, atmospheric

168 pressure, wind direction, clouds, precipitation, etc., which form weather of a place, are called weather elements. Concept of Climate: The average condition of the weather elements of a place over a long period of time is far less variable than the ever changing state of weather elements. The knowledge of changes taking place quickly in the weather condition is useful but that of the average weather condition over a long period of time say a few years, being nearly the same every year, is easily definable and reckonable and thus more useful. Climate is defined as the average weather condition of a place over a long period of time which should be at least 30 years. 1.2 Measurement of weather elements The measurement of weather elements is basic to the study of the weather and climate of a place. We shall study the following weather elements: 1. Temperature, 2. Atmospheric pressure, 3. Wind direction, 4. Wind velocity, 5. Humidity and Rainfall, 6. Cloud amount. 1.2.1 Temperature Measurement by Six’s Maximum and Minimum Thermometer: Temperature is the degree of hotness and coldness of an object as measured with a thermometer. Heat being basic to life on earth, knowledge of temperature of different places is obviously useful. In India the Centigrade scale, internationally known as Celsius scale since 1948 afdter the name of its inventor A. Celsius (1701-44), is used for measuring temperature. According to this scale, water boils at 100° and freezes at 0° at sea-level and these figures are written as 100°C and 0°C. The thermometer calibrated according to Centigrade scale is called Centigrade thermometer (having a hundred degrees). Before the introduction of metric system of measurements, the Fahrenheit scale was used for measuring temperature. In some countries, this scale is still being used. According to this scale water boils at 212° and freezes at 32° and these figures are written as 212°F and 32°F. The thermometer calibrated according to the Fahrenheit scale is called Fahrenheit thermometer after name of its inventor G.D. Fahrenheit (1686-1736). The formula for converting a Celsius temperature to a Fahrenheit temperature is

169 The formula for converting a Fahrenheit temperature to a Celsius temperature is The temperature of a place is in fact the temperature of air near the ground under shade. It is minimum at about 4 A.M. and maximum at about 2 P.M. Six’s Maximum and Minimum Thermometer: Introduction: This thermometer is used to measure the minimum and maximum temperatures of a day. Description: It consists of a U- shaped tube having a narrow uniform bore. Both the ends of the tube are drawn into bulbs. The bulb (A) on the left side is completely full of alcohol; the bulb (D) on the right side is conical and is partially filled with alcohol. The U-shaped portion of the tube contains mercury (Fig.2.1). Above the mercury columns there are two steel indices E and F. These indices do not move up or down by themselves and remain in position unless pushed upwards by the rising mercury. Steel springs are attached to the steel indices. They are strong enough to press the indices against the wall of the bore of the tube and thus keep the indices in position. The movement of mercury is controlled by the alcohol in the bulb A. Alcohol expands about 6 times as much as a mercury. When temperature rises, alcohol in the bulb A expands. Being a very thin liquid it passes through the space between the steel S.I.=Steel index H.M.=Horse-shoe magnet Fig. 2.1

170 index (E) and the wall of the bore of the tube and pushes the mercury column in the tube AB downwards. Obviously, the mercury column in the tube CD will rise. The rising column of mercury will push the steel index F upwards. It will continue pushing the steel index F upwards until temperature stops rising. The lower end of the steel index F will indicate the maximum temperature. When temperature begins to fall, the alcohol in the bulb A contracts. The contracting alcohol drags mercury behind it. Thus on the contraction of alcohol in the bulb A, the mercury column in the tube AB rises. The rising column of mercury pushes the steel index E upwards until temperature stops falling. The lower end of the steel index E indicates minimum temperature. Thus, the figures indicating temperature on the tube CD increase in value upwards and the figures indicating temperature on the tube AB decrease in value upwards. Alcohol in the bulb D does not play any part in the movement of mercury; its main function is to exert a little pressure on the mercury column and this stop it from breaking. Every Six's Maximum and Minimum Thermometer is accompanied with a small horse-shoe magnet. This magnet is used to bring the steel indices in contact with mercury. The magnet is placed on a steel index and dragged towards mercury until the index touches mercury. The steel indices are brought in contact with mercury. The steel indices are brought in contact with mercury columns every day at 5-30 P.M. Next day we note down the minimum temperature at 8-30 A.M. and the maximum temperature at 5-30 P.M. Thus, we get minimum temperature and maximum temperature of a day and of all days of a month. It may, however, he noted that in the meteorological observatories, two separate thermometers (i) Rutherford's Maximum Thermometer and (ii) Rutherford's Minimum Thermometer are used for recording maximum and minimum temperatures instead of a Six's Maximum and Minimum Thermometer. 1.2.2 Temperature Measurement by Rutherford's Maximum and Minimum Thermometer: (i) Rutherford's Maximum Thermometer: It is a mercury thermometer and it has a steel index (Fig.2.2). It is mounted on a wooden board and is hung horizontally in Stevenson's Screen. A horse-shoe magnet is used to bring the steel index in contact with mercury. When temperature rises, mercry expands and the expanding mercury
171 pushes the index forward; and when the temperature falls, mercry contracts and recedes without disturbing the index. The end of the index facing the mercury thread, indicates the maximum temperature. (ii) Rutherford's Minimum Thermometer: This thermometer has alcohol instead of mercury (Fig.2.3). It has a glass index instead of a steel index. The thermometer is mounted on a wooden board and is hung horizonally in Stevenson's Screen. The glass index is always immersed in alcohol. The thermometer is titled slightly to allow the glass index to take a position in which its outer end of the index facing the empty end of the thermometer) touches the concave surface of alcohol. When the temperature falls, alcohol contracts and recedes. The concave surface of the receding alcohol drags the glass index towards the bulb of the thermometer. The outer end of the glass index indiceates the minimum temperature. When temperature increases, alcohol expands and it being a very thin liquid flows through the space between the bore of the thermometer and the glass index without disturbing the latter. 1.2.3 Temperature Measurement by Stevenson's Screen: For measuring temperature of air thermometers are kept under from buildings. A specially designed wooden box supported by four wooden legs is thermometers. This box is called Stevenson's Screen. The length, breadth and height of the structure of the box are 57.2 cm, 31.4 cm. and 41.6 cm. respectively. The box is painted white, it has louvered sides for excluding sun and rain but for admitting air, and double top and double bottom. The bottom of the box is 1.066 metres above the the ground. Fig. 2.2 Fig. 2.3

172 The upper layer of the roof projects for 5.1 cm. beyond the sides of the box and is sloping. Stevenson's Screen is fixed in the open area away from buildings and trees. It is fixed in such a way that its door faces north. Rutherford's Maximum Thermometer, Rutherford's Minimum Thermometer, horse-shoe magnet, and wet and dry-bulb thermometers are placed inside Stevenson's Screen. (i) True daily mean temperature: In some observatories, temperature is recorded every hour. The sum of hourly temperatures recorded during the 24-hour day divided by 24 gives the true daily mean temperature. True Daily mean temperature = (ii) Daily mean temperature: There are very few observatories where temperature is recorded every hour. In most of the observatories only the maximum temperature and the minimum temperature are recorded during the 24-hour day. The daily mean temperature is obtained by dividing the sum of the maximum temperature and the minimum temperature recorded during the 24-hour day by 2. Daily mean temperature = It is from the daily mean temperature that we calculate other temperature values namely the mean monthly temperature, the annual range of temperature. Thus, daily mean temperature is a basic temperature value. (iii) Daily range of temperature: It is obtained by subtracting the minimum temperature from the maximm temperature of the 24-hour day. (iv) Mean monthly temperature: We get the mean monthly temperature of a month by adding the daily mean temperatrure for all the days of the month and dividing this sum by the number of the days of the month. (v) Daily normal temperature: It is the mean daily temperature of the same day of the past at least 30 years. Example I. Temperatures recorded hourly at a station during the 24-hour day are given below. Fig. 2.3

173 Hours Temperature Hours Temperature (0°C) (0°C) 0100 7.5 1300 22.5 0200 6.8 1400 23.8 0300 5.9 1500 23.2 0400 5.4 1600 22.0 0500 6.3 1700 20.1 0600 7.8 1800 18.6 0700 9.2 1900 16.8 0800 11.2 2000 15.2 0900 14.8 2100 13.5 1000 16.5 2200 11.2 1100 18.6 2300 10.4 1200 21.2 2400 8.9 Find out (i) the true daily mean temperature, (ii) the mean daily temperature and (iii) the daily range of temperature. Solution: (i) True daily mean temperature = = = 14.06°C. (ii) Daily mean temperature = = = 14.6°C.

174 (iii)Daily range of temperature = 23.8 – 5.4 = 18.4°C. Example 2. On 1.8.1975, the maximum temperature was 35°C and minimum temperature 26°C. Find out (i) the daily mean temperature and (ii) the daily range of temperature on 1.8.1975. Solution: (i) Daily mean temperature on 1.8.1975 = (ii) Daily range of temperature on 1.8.1975 = 35°C – 26°C = 9°C. 1.2.4 Air Pressure Measurement Introduction: Atmospheric pressure is not constant at a place. It also varies from place toplace. The study of the variations in the atmospheric pressure from place to place and from time to time is very essential for forecasting a storm, rain, dry conditions, fair weather, etc. The knowledge of these weather conditions in advance is useful for sailors, airmen, fanners, etc. Barometer: Air has weight. Therefore, the atmosphere exerts pressure. This pressure is measured with an instrument called a barometer. There are four types of barometers. They are: (i) Aneroid Barometer (ii) Barograph (iii) Fortins Barometer (iv) Kew Pattern Barometer. (i) Aneroid Barometer: This barometer is commonly used by seamen, airmen and mountaineers for knowing the atmospheric pressure and related weather, and height. above sea-level. This barometer has no liquid in it. It consists of a small metallic box appearing like a disc, A partial vacuum is crated inside the box and' it is closed air-tight with a thin cormgated flexible metallic lid (Fig.2.4). The lid is depressed when the atmospheric pressure increases and is raised upward when theatmospheric pressure decreases. This up and down movement of the lid is very small and is, therefore, magnified with the help of levers. Fig. 2.4

175 The levers are connected to a needle which moves over a graduated dial marked with figures indicating the pressure in kilometres, inches and millibars. In addition to these figures a few words namely 'Stormy', 'Rain'; 'Fair', and Dry' are written on the dial. There is another needle, generally of red colour. It can be rotated with the help of a metallic stud fixed at the glass cover of the barometer. This is an index needle and is brought above the needle which actually moves due to changes in pressure. After some time the needle below moves away indicating how much variation there has been in the pressure after the index needle was brought above this needle. This is a small-sized, porlabte and metallic barometer it is also qulte sensitive to the changes in pressure. A sensitive instrument will indicate a change in pressure when it is raised up even for a metre. It can be fixed in any position m constrast to a mercurial barometer which has to be fixed in a vertical position for correct readings. Owing to these merits of an aneroid barometer, it is very wmmody used by seamen, ailmen and mountaineers. Uses of aneroid barometer. There are two types of aneroid barometer. One is used for forecasting weather and the other is used to measure height above sea-level. The barometer used to measure altitude is knoivn as an altimeter. If the needle of an aneroid barometer does not fluctuate and remains nearly steady, it indicates that there will be no appreciable change in the weather conditions for some time. If the pressure starts increasing, it inidcates that anticyclonic conditions are establishing themselves and dry conditions will prevail for some time. The falling pressure, however, indicates that cyclonic conditions have started developeing and rain may fall. If the pressure falls rapidly, there is a possibility of a storm. An altimeter is a special type of aneroid barometer used to measure height above sea-level. The graduations on its dial show height in metres or feet. Altimeters are carried by mountaineers. surveyors and are fitted in aeroplanes for knowling the height above sea-level. The atmosperic pressure decreases with height. It falls roughtly at the rate of 34 millibars for an ascent of 270 metres or one inch for an ascent of 900 feet. It should, however, be noted that the atmospheric pressure at a place changes from time to time and above a height of 1000 metres, the rate of fall in pressure progressively declines. Therefore, the readings recorded by an altimeter at a place change accordingly. Temperature and latitude of a place also affect its atmospheric pressure. To get accurate height,'temperature, altitude and latitude corrections are applied to the

176 readings of the altimeter. But this involves mathematical calculations. Therefore, tables are provided with each altimeter for finding out the height of a place above sea-level. (ii) Barograph. It is a combination of an aneroid barometer and a rotating drum. A set of levers is so arranged as to convery the movement of the flexible lid of the box of the barometer, to a needle which rests on the drum. This has an ink or a pencil point. A graph paper is wrapped round the drum and the drum is allowed to complete one rotation in a day (24 hours) or a week. A curve indicating the changes in the pressure is marked on the graph paper. The graph paper is changed in some barographs daily and in the others every week. (iii) Fortin's Berometer. It is a mercurial barometer and is fitted in the laboratories and meteorological observatories for recording atmospheric pressure. It indicates atmospheric pressure accurately. It consists of a 100 cm. long glass tube (Fig.2.5). The tube is mounted on a board and stands in a vertical position. Its upper end is closed and its lower end is bent upwards. The tube contains mercury and its lower end dips in mercury kept in a reservoir made of glass. A leather piece in the form of a bag is attached to the lower end of the reservoir. The leather can be raised or lowered with the help of a screw fixed at the bottom of the leather bag. With the rise or fall of the leather piece, the level of mercury in the reservoir can be raised or lowered. An ivory pointer pointing downward to the mercury reservoir is fixed in the lid of the reservoir. The ivory pointer indicates zero reading. A vernier scale is used to read the pressure accurately. The scale is made to move up or down with the help of a knob. To read the pressure, proceed as follows: (a) Make the ivory pointer just touch the surface of mercury by using the scrett S (Fig. 2.5). (b) Slide the vernier scale up or down till its lower edge appears to touch the convex surface of mercury. (c) If the zero of the vernier scale is, say, between 745 and 746 mm. and the vernier constant is 0.1 mm. and if the 5th division on the the vernier scale coincides with a scale division, the atmospheric pressure = 745+5×0.1 = 745.5 mm.

177 (iv) Kew Pattern Barometer. Fortin's Barometer is no longer used in the meteorological observatories. Now Kew Pattern Barometer is used. Its construction is almost similar to that of Fortin's Barometer except that the reservoir of mercury is made of steel and there is no screw under it. Thus, there is no need to bring the ivory pointer in contact with mercury. This barometer is easy to operate and it gives the pressure reading quickly. There is also an arrangement by which it always remains vertical. Unit of measurement of atmospheric pressure. Atmosphere has weight. Therefore, the atmospheric pressure is measured in the units of force. The unit of force used for measuring atmospheric pressure is the millibar. The average value of the atmospheric pressure on the surface of the earth at sea-level is equivalent to 760 mm. or 29.925 inches at latitude 45°N, and temperature 0°C. The force exerted by 760 mm. high mercury column is equal to 1,013,231 dynes per square centimetre. Now a bar is equal to 1,000,000 dynes and a millibar is equal to 1,000 dynes i.e. one thousandth part of a bar. 1 bar = 1,000,000 dynes 1 millibar (mb) = 1000 dynes But 1000 mb = 750.1 mm. or 29.53 inches ∴ 1 mb. = 0.7501 mm. or 0.02953 inch and 34 mb = 1 inch. The average atmospheric pressure at sea-level is 1013.23 mb. The atmospheric pressure at sea-level varies generally between 940 mb. and 1050 mb. Fig. 2.5

178 1.3 Case Study: Weather Element Measurement by Analogue Instrument 1.3.1 Barometer: 1.3.1.1 Introduction: In, 1643 Torrecelli first introduce Barometer. Later, Fortin, Kew and Aneroid Barometers were being prepared based on the method of Torrecelli. 1.3.1.2 Measurement of Reading: It is important to know the reading of vernier scale to determine the vernier constant. The value of vernier constant may differ according to instruments. The vernier constant is to be determined by the formula— Vernier constant (v.c.) = 1.3.1.3 Example: (a) Smallest main scale division (d) = 0.1 cm. (b) Number of vernier division (n) = 10 (which is equal to 9 main scale division) Then, v.c. = = It is helpful for the final reading from Barometer. Barometer reading = (Main scale + Vernier scale) reading [0.01 × 15 = 0.15 cm] = (76.40 + 0.15) cm = 76.55 cm = 765.3 (mm) N.B. : For the correct reading. We need to take the Barometer thrice and the make the average value. Determination of wind pressure by Fortin's Barometer Place: Date: Instrument No.: Time:

179 No. of Main Vernier No. of Vernier Final Mean Tempe- reading Scale constant vernier scale reading pressure rature reading scale reading (cm) (mm) (cf) division 1st 76.4 0.01 11 0.01×11 76.4+0.11 84 = 0.11 = 76.51 2nd 76.4 0.01 12 0.01×12 76.4+0.12 765.2 84 = 0.12 = 76.52 3rd 76.4 0.01 13 0.01×13 76.4+0.13 84 = 0.13 = 76.53 1000 dynes = 1 milibar (mb) 1000 mb = 1 bar 1 bar = 29.92 Inch or 76 cm or 760 mm. Therefore, the above reading (765.20 mm) represents the air pressure of 1006.84 mb. 1.3.2 Six's Maximum and Minimum Thermometer: 1.3.2.1 Introduction: Six introduced the thermometer for the daily maximum and minimum temperature determination. It is helpful to determine daily, monthly and annual average temperature and range of temperature. 1.3.2.2 Measurement of Reading: Determination of Maximum and Minimum Temperature by Maximum and Minimum thermometer is as follows: Place: Date: Instrument No.: Date Time Temperature (°C) Range of Maximum Minimum Temperature (°C) 15.04.2018 2.30 pm 32.5 24.3 8.2 [mb = milibar mm = milimeter cm = centimeter]

180 Fig. 2.7 Six's thermometer Fig. 2.6 Fortin Barometer

181 Unit 2 Interpretation of a Daily Weather Map of India: Pre-Monsoon, Monsoon & Post-Monsoon Structure 2.1 Concepts 2.2 Purpose 2.3 Types 2.4 Analytical matter of Weather Map 2.5 Identification of Season from Weather Map 2.5.1 Winter Season 2.5.2 Summer Season / Pre-Monsoon Season 2.5.3 Rainy Season / Monsoon Season 2.5.4 Post-Monsoon Season 2.6 Weather Symbols 2.7

65% **MATCHING BLOCK 92/121** **W**

Reading a Weather Map 2.8 Some notes on the Weather Maps of India 2.9 Metric Units for Weather Reports 2.10 Weather Map Interpretation 2.10.1 Introduction 2.10.2 Pressure 2.10.3 Wind Condition 2.10.4 Sky Condition 2.10.5 Rainfall / Precipitation 2.10.6 Pressure-

Wind-Cloudiness-Rainfall Relation 2.10.7 Other Atmospheric Phenomena 2.10.8 Sea Condition 2.10.9 Weather Forecasting 2.11 Indian Daily Weather Report 2.12 Weather Elements in a Weather Map/Report.

182 2.13 Exercise of Weather Maps 2.1 Concepts A weather map or chart shows on a flat sheet of paper on which all the data available consulting the weather for the given area at a particular moment of time is plotted.

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A weather map is the representation of the weather of a portion of the earth or a part of it on a flat surface. The term weather denotes, the condition of

the weather elements at a particular place and time. Generally six weather elements are recognised. These are— (i) Temperature (ii) Pressure (iii) Wind (iv) Humidity (v) Cloud (vi) Precipitation

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Thus, we can define a weather map as a map of the world or part of it showing at a stated time numerically and with the help of symbols. The temperature and pressure conditions and direction and velocity of wind, humidity, clouds, visibility, nature and amount of precipitation

weather chart enables to observe the development of weather patterns and to anticipate future developments. Conditions of weather elements are observed at different meteorological stations and same telegraphically to the head office for the final preparation of the weather report.

78%	MATCHING BLOCK 95/121	W

It is obvions that the recently of having a weather map was felt most by sailors. In 1699, Edmund Hallay published a map for 30°N and 30°S latitudes which showed trade wind and the direction of the prevailing monsoon. These map can not be taken to be a typical weather

map

95%	MATCHING BLOCK 96/121	W

because it denotes the weather condition over a period of time. For preparation of a weather map showing the weather elements at different places for a particular point of time, a quick system of sending information was necessary. Thus with the advent of electric telegraph it became popular to prepare such weather maps. With further improvements in the system of news transmission by the wireless telegraph weather information from a large area could be gathered at a central stations. The

first publication of weather map of India was started at Simla in 1864. After first world war, the office of the Indian Metgeorological Department was shifted to Pune. At present there are 350 Meteorological Observation Stations in India which have been classified into various categories based on the size, facilities and nature of information.
183 2.2 Purpose To study this portion anybody can understand— 1) Definition of weather map 2) Importance of weather map 3) Different elements of weather map 4) Concepts of weather map 5) Regional variation of weather map 6) Predict the weather of a place. 2.3 Types Meteorologists prepare different types of weather map taken— 1) Station Model based weather map 2) Non-station model based weather map 3) Upper air circulation weather map 4) Satellite photo based weather map The Indian Weather Map provides 3 charts in one sheet. There is one large map at the top accompanied by two small maps at the bottom which provide information regarding departure of minimum temperature from normal and the departure of 8.30 hrs. pressure from normal. 2.4 Analyse Matter of Weather Map Weather map discuss the following weather elements— (1) Atmosphoric Pressure— (a) Location of High Pressure (HP) (b) Location of Low Pressure (LP) (c) Trends of Isobars (d) Pressure Gradient (2) Wind Condition— (a) Wind Direction (b) Wind Velocity (3) Sky Condition— (a) Cloud Cover (b) Other Weather Elements (4) Precipitation— (a) Distribution of Rainfall (b) Location of Rainfall

184 (5) Temperature Departures from Normal (6) Sea Condition (7) Weather Forecasting 2.5 Identification of Season from Weather Map Climate of India mainly Tropical Monsoon type due to its location. But weather maps of India represent different seasons. The features of the weather elements are different during different season. The identifying features are mentioned here (season wise)— 2.5.1 Winter Season [December to February]: (a) Clear sky. (b) High Pressure (HP) over North-West parts of India. (c) Cold winds comes from the High Pressure belts (Origin of it is Siberia) (d) In peninsular India wind movement is from East to West. (e) Easterly are full of moisture which yield rainfall over south-east coastal region. (f) In North-West region precipitation is caused by depression that are associated with western disturbance moving from Mediteranean sea. (g) In this season, Precipitation is moderate to slanty. 2.5.2 Summer Season (Hot weather) [March-May] (a) Highest temperature in North India. (b) Precipitation occur in coastal area. (c) West Bengal, Assam, Burma (Myanmar), Bangladesh receive convectional precipitation. It is also refers as 'Mango Shower'. (d) In the Northern plains convective system produce Thunder Showering. (e) Sky is covered with cumulonimbus cloud produced by strong convection. (f) Other climatic characteristics are strong quall winds and Dust Storm. (g) These violent dust storm are known as 'Andhi' or 'Norwester'. Sometimes accompanied by heavy downpours and afternoon storms.
185 2.5.3 Rainy Season [June-September] / Monsoon Season : (a) Low pressure over North-Western India and High Pressure over ocean. (b) By the end of May and first week of June trade wind from southern nemisphere are drawn toward thermal in N.W. region of the subcontinent. (c) The southerly trades on crossing the Equator are deflected to right according to Ferrel's Law. (d) Now the S.E. trade wind become S. Westerly blowing winds towards North- East. (e) This season face rainfall across India. (f) Coastal areas are overcast or high cloud covered. (g) This season is also called Monsoon Season. 2.5.2 Post-Monsoon Season (Retreating Monsoon) [October - December]: (a) Temperature falls gradually. (b) Occasional rainfall occurs. (c) Wind blow from westerlies directrion in North India. (d) In, South India, North-Easterly winds prevail. (e) Weakening of Low Pressure over the continent. (f) Low Pressure centre of Bay of Bengal. (g) Cyclones can be seen on Southern Bay of Bengal. (h) Shower occurs in Tamilnadu. (i) Monsoon starts to retreat from North West India. 2.6

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Weather Symbols On weather maps for the sake of convenience, rainfall and other elements of weather are represented by symbols or abbreviation of names. Such a system was devised by Admiral Beaufort in 1806 and was later modified by him in 1830. The same table is even now being used with a few additions (Table). Beaufort Notation: b : blue sky—

to more than a quarter covered with cloud. be : sky

100%	MATCHING BLOCK 98/121	W

partly cloudy-one-half covered. 186 c : generally cloudy—detached opening

clouds.

85%	MATCHING BLOCK 99/121	W

d : drizzle. e : wet air without rain falling, a copious deposit of w3ater on trees, buildings, etc. f : fog, visibility 22-1,100 yd. fe : wet fog. fs : fog over sea (coast station). fg :

for

95%	MATCHING BLOCK 100/121	W

on lower ground (inland station). F : thick fog, visibility less than 220 yd. g : gloom. h : hail. i : intgermittent. jp : precipitation within sight of station. ks : storm of drifting snow. KQ : line squal. l : lightning m : most,m visibility 1,100 - 2,200 yd. o : overcast sky,m i.

92%	MATCHING BLOCK 101/121	W

e., the whole sky covered with one impervious cloud. p : passing showers. q : squalls. r : rain. s : snow. t : thunder. tl : thunderstorm. u : ugly threatening sky. v : unusual visibility of distant objects. w : dew. x : hoar-frost. y : dry air—less than 60 per cent humidity. z : haze, range of visibility 1,100 yd or more but less than 2,200 yd. 187

75%	MATCHING BLOCK 102/121	W

Table : Forms of Meteorological Symbols approved by the International Meteorological Organisation, Warsaw, 1935 Pure air Shower of Snow Hoar Frost Haze Shower of Rain Glazed Frost Mist Snow (Sleet) Soft Rime Fog v > lkm Soft Hail Hard Rime Shallow Fog Small Hail Gale Ground Fog Hail Sunshine Frost Fog Distant Lightning Solar Halo Drizzle Thunderstorm Lunnar Halo Rain Drifting Snow Solar Corona (

43%	MATCHING BLOCK 103/121	W

High up) Snow Snowstorm Lumar Corona Sle Drifting Snow Rainbow Granular Snow (Near the Ground) Aurora Borealis Grains of Ice Dust or Sandstorm Mirage Ice Needles Dust Devil Zodiacal Light Shower of Rain

Snow Lying

100%	MATCHING BLOCK 104/121	W

Capital letters indicate intensity of the phenomenon, and slight intensity by a small suffix

a

91%	MATCHING BLOCK 105/121	W

Repetition of letters indicate continuity and intermittence by prefixing the letter i. Thus: R : heavy rain. r : (moderate) rain. or : slight rain. RR : continuous heavy rain. rr : continuous (moderate) rain. iro : intermittent slight rain. Actual existing weather is demarcated from preceding conditions by a 'solidus', thus, b/r, blue open sky after rain. The sign (–) indicates decrease in the intensity of the particular phenomenon and the sing (+) indicates increase in intensity. A symbol 188 enclosed within brackets thus: (1) indicates the occurrence of the phenomenon in the vicinity of the station. Indices 0, 1, 2 may be used to denote intensity. On weather maps in addition to the above observations generally the barometric tendency is also indicated. The stations which are equipped with barographs report the amount and nature of change in pressure in the three hours preceding the time of observation. This rise or fall in pressure is known as the barometric tendency and the nature of the change, whether the fall or rise was continuous or there was first a fall and then a continuous rise or any other variety of change, is known as the "characteristic" which is also reported. If lines

are

91%	MATCHING BLOCK 106/121	W

drawn through places having the same tendency we get what are known as isallobars. In modern weather maps the type of cloud and the individual amounts of different types are also indicated by symbols. 2.7

96%	MATCHING BLOCK 107/121	W

Reading a Weather Map Before proceeding to read the Indian Daily Weather Map one should get familiar with the various symbols used on such maps. The following points are to be described while reading the weather map : 1. Pressure (a) location of bar high, (b) location of bar low, (c) trend of isobars, (d) gradient of pressure. 2. Wind (a) direction, (b) velocity. In relation to pressure variation. 3. Sky condition (

a)

99%	MATCHING BLOCK 108/121	W

cloud cover, (b) nature of the cloud, (c) other atmospheric phenomena. 4. Precipitation (a) general distribution. (b) special area of heavy precipitation. 189 5. Pressure departure from normal 6. Temperature departure from normal 7. Sea-condition 2.8 Some Notes on the Weather Maps of India With a view, to making improvements in the representation of weather conditions several changes have been introduced in the 'Weather Reports of India' in recent years. Up to the end of the year 1948 the weather maps in the 'Reports' used to show (a) pressure in the millibars, (b) wind direction and speed in miles, (c) rainfall in inches and sea. condition. There was, thus, no indication of clouds cover on the weather- maps. The symbols used were also different from those of later weather maps. On 1st January, 1949 various new informations regarding cloud cover and other atmospheric phenomena were introduced. The new maps, thus, gave a better picture of the weather conditions than the old maps. Further modifications, though only minor, have been made since January 1, 1957 so as to represent more clearly the wind condition on the. weather-maps. 2.9

96%	MATCHING BLOCK 109/121	W

Metric Units for Weather Reports From 1st January, 1957 weather reports in India are giving rainfall in millimetres, temperatures in degrees centigrade and cloud heights and distances of visibility in metres and so on. Wind speed generally meant for navigational purposes will continue to be printed in knots as hitherto, while those for other purposes will be expressed in kilometres per hour, consequently an inch of rainfall at any station will be reported as 25.4 millimetres of rainfall; 2 inches as 51 millimetres and so on. The conversion is very simple being proportional at a rate one inch = 25.4 millimetres. In the case of temperature, the conversion is not so simple. To convert degrees Fahrenheit to degrees Centigrade, equations are used. 190

Fig. 2.8

191 2.10 Weather Map Interpretation 2.10.1 Introduction The supplied weather map of wednesday, 22nd May 1985 indicates the weather condition of the Indian subcontinent recorded at 08.30 Hrs. I.S.T., 03.00 HRS. G.M.T. This weather map indicates pre-monsoon due to the following characteristics— (a) Law pressure over the landmass that means the temperature over landmass is high as the position of the sun is in the Northern Hemisphere. INDIAN DAILY WEATHER REPORT WEATHER MAP AT 0830 HRS I.S.T. (0800 HRS. G.M.T.) Fig. 2.9

192 (b) Trend of isobars are decreasing from South to North. (c) The direction of wind is more from West and Southwest direction. (d) Cloud cover is getting throughout India, as it covers almost South India. (e) Rainfall is not high over North-west India. On the basis of these characteristics the weather map clearly indicates summer season. 2.10.2 Pressure: Pressure variation is quite prominent all over the country. This variation of pressure is mostly dependent on the angle of insolation, humidity, altitude and rotational movement of the earth. Moreover, because of penticular location, humadity varies and due to topography altitudenal variation creates condition for pressure variation on the basis of the variation of pressure, various area of low pressure and high pressure can be flow over the Indian subcontinent. (i) Areas of low pressure: There is one low pressure zone that has developed over the North-Western part of India, over Afganisthan and parts of Pakistan. This low pressure zone is surrounded by the isobar of 994mb and is oval in shape. However apart from this low pressure zone, there is a depression that has developed over Bay of Bengal. This depression is could due to closely association of isobars of 996mb, 998mb, 1000mb, 1002mb. The isobars are more or less circular to semicircular in shape. This pressure condition is due to— (i) Relative position of the sun sun over Northern hemisphere vertical rays follows over of the Tropic of Cancer. (ii) Humidity is high. (iii) Inland location of the areas. (ii) Areas of High Pressure: As summer season so the relative position of the sun is over northern hemesphere and thus temperature over the landmass is higher confared to that of the oceans. Hence the temperature over oceans on watermass is comparatively low thus creating high

193 pressure zones over the watermass. There are two high pressure zones that can be seen over the water masses. One of them occurs over the Arabian Sea and stretches upto the Indian Ocean, towards South-West India and is surrounded is the isobar of 1010mb, elongated in shape however the second high pressure zone can be scan to the extream part of the Indian subcontinent and east of Myanmar or Burma. It is also surrounded by 1010mb, isobar and stretching in North-South direction than irregular manner. Factors responsible— (a) Relative position of sun (b) Humidity low, (c) Location over water. (iii) Pressure Gradient: From this section are can came to the conclusion that the pressure gradient is more or less gentle over the North and Nonth-Western part of the subcontinent in Pakistan, Rajasthan M.P. etc. overs as the spacing of the isobars are wide enough. But gradually decrease towards Bay of Bengal, we can see that the isobars over closely attached to each other and hence more is a steep pressure gradient as have develops a depression are Bay of Bengal. Moderate pressure gradient can be seen over the central India. PRESSURE GRADIENT

194 (iv) Trend of Isobars: The trend of isobars with its value decreasing from South to North constitude of in low pressure zone over North-West India and a depression in Bay of Bengal. There is also two high pressure zone found in South India and extream Eastern of India. The usual trend of isobars is from West to East. The isobars of LP. zones are irregular to oval in shape and gradually towards south, the isobars stretches from West from where it takes a south ward bend toward Tamil Nadu and further thus back towards Meghalaya over Bay of Bengal. The isobars over the oceanic zone is circular to semi-circular in shape. 2.10.3 Wind Condition: Wind system of any region is dependent on over of location of H.P. and areas of L.P. as winds blows from H.P. zone to L.P. zone. Generally winds are deflected to the right in N.H. (Northern Hemisphere) and left in S.H. (Southern Hemisphere) ace to series low. Thus the wind blows of the subcontinent is due to two characteristics— (i) Wind Direction (ii) Wind Velocity. (i)

95% **MATCHING BLOCK 110/121** **W**

Wind Direction: In keeping with the general law of wind motion,

the winds move from H.P. to L.P. areas in this map. The winds over the subcontinent has predominently blows from West and South-West direction. Specially over West and South India that is areas near Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, SriLanka, Now India over Rajasthan, Gujrat etc., the wind blowing from West, South and S.W. directions mostly. However, over East and North East India and also North, the winds are blows from East and South-East direction. Near Puna, Meghalaya, Assam, West Bengal, J & K, U.P., M.P., Orissa. The areas of H.P. is found in N.E. and E. India and L.P. zone over the Bay of Bengal. The dominance of wind blowing from West to South-West direction can be obtained with the help of statistical method—

195 Wind Direction Tally Fregnency N ||| 3 NE ||| 3 E |||| |||| 9 SE |||| || 7 S |||| 4 SW |||| |||| || 12 W |||| |||| |||| 13 NW |||| 4 N = 55 N NE E SE S SW W NW No. of Calm days 3 3 9 7 4 12 13 4 55 4.62 On the basis of the above statistical data wind direction in the particular day can be divided into four major zones of wind direction—

196 (ii) Wind Velocity: This wind velocity over the subcontinent depends on the pressure gradient over the subcontinent. Since the pressure gradient varies from gentle to steep, hence wind velocity is slightly high over the water mass, however over the landmass, the wind velocity is more or less gentle, where the isobars are closely associated to each other. The pressure gradient is steep and hence the wind velocity is slightly high. However, the wind velocity of the subcontinent of this particular day can be analysed with the help of following statistical method :— Wind Velocity Tally Frequency (in knots) > 5 |||| |||| | 11 5–10 |||| |||| |||| |||| |||| 25 10–15 |||| |||| |||| | 16 < 15 ||| 3 N = 55 The statistical method clearly indicates that the wind velocity is more or less moderate to high as it varies between 5 knots to 15 knots. However, it is found that this wind velocity in all over India and thus the landmass has a moderate wind velocity and that of the watermass, the wild velocity is quite high specially along the of strata Arabian sea and east of Srilanka. Thus, based on the above obtaced data, three wind velocity zones can be obtained—

197 The wind velocity is quite low over North and North West India. Specially near Pakistan, Rajasthan, J & K, U.P., M.P. and Gujrat, also in the central past near east of Maharashtra, parts of M.P., Meghalaya Plateau, Assam and also towards the eastern coast. The wind velocity gradually increases towards the coastal areas of S. India near Andhra Pradesh, Tamil Nadu, Karnataka, Kerala coast wind velocity decreases gradually rewards Bay of Bengal and over Andaman & Nicober island, South East of SriLanka. Thus, the wind velocity over the subcontinent can be analysed with the help of the following statistical method (Histogram)— Histogram with Polygon Showing Wind Velocity) 2.10.4 Sky Condition Nature of Cloud and Cloud Cover: The nature of high, medium and low clouds which are responsible for pattern of rain with their location should be mentioned. Distribution of cloudiness is discussed and analysed. In the present map, peninsular India, Indian ocean, arabian sea & bay of bengal are recorded overcast. It shows nearly 100% of the stations completely overcast while about 25% stations are absolutely clear sky. (Jammu & Kashmir, Punjab, Haryana, Rajasthan, Uttar Pradesh) This cloud cover may caused by—

198 (i) The Arabian and Bay of Bengal branches of S.W. Monsoon are moist and rainbearing by nature. (ii) Regional difference of weather condition. Database for cloud coverage: Cloudiness Blue Sky 1 / 8 th - 3 / 8 th 4 / 8 th - 5 / 8 th 6 / 8 th - 7 / 8 th Overcast Index - Tally |||| |||| || |||| || |||| ||| |||| |||| |||| |||| |||| Frequency 12 7 8 19 5 %Frequency 23.5 19.7 15.7 37.3 9.8 CLOUD COVER ZONE Oktus Blue sky 1 / 8 – 7 / 8 Oktus Overcast

199 2.10.5 Rainfall: In the present weather map, some scattered rainfall was observed in Karnataka, Tamil Nadu, Kerala, Andhra Pradesh and Meghalaya and Tripura. Other parts of India remained fairly dry. The rainfall has been widespread over Goa-Cochin (2 cm) & Tripura (1 cm) due to the moist S-W Monsoonal branches. BAR GRAPH Showing Rainfall Distribution in India Rainfall (c.m.) 2 1 0 Area of Rainfall

200 2.10.6 Pressure-Wind-Cloudiness-Rainfall Relation: The origin of the S-W monsoon was influced by the low pressure over the N- W part of the subcontinent. Here, the Bay of Bengal branch is southerly, while Arabian Sea branch is mostly westerly. Therefore, rainfall has been concentrated over the windward slope of the orographic barriers. The mentioned two branches of monsoon meet along the axis along which depressions are move affecting the rain. 2.10.7 Other Atmospheric Phenomena: Here, haze, sandstorm, duststorm and drizzde are observed in some places. U.P., M.P., Andhra Pradesh, Orissa observed haze, whereas Rajasthan experience duststorm and sandstorm. 2.10.8 Sea Condition: It represents the nature of sea. This condition fluctuated between calm and slight and it is mostly determined by the wind velocity and pressure. Here, the southern part of ocean over the Indian ocean was moderately disturbed (moding), whereas, the western part of Arabian Sea and places near SriLanka was quite rough (R 0 →) by nature. The sea of other portions was smooth. SEA CONDITION INDEX RO — Rough MOD — Moderate

201 2.10.9 Weather Forecasting: A short-range forecast for the next 24 to 48 hours may be made on the basis of above analysis, as follow: 1) The night temperature are likely to increase at some places — (Maharastra, M.P., Bihar, Karnataka) due to high cloud cover. 2) The minimum temperature is likely to increase over the semi-arid and arid regions which indicates a stormy weather. 3) The pressure is likely to romalise over most of the area. 4) Light and scattered rainfall may occur at Kerala, Tamil Nadu, Andhra Pradesh, Tripura and Manipur and North Eastern Hill states. 5) Jammu & Kashmir, Rajasthan, H.P., may experience a fair and clear sunny sky. 6) Due to the moderate to rough sea conditions, fishermen of those areas are requested not to go for fishing. WEATHER FORECASTING

202 2.11 Indian Daily Weather Report It is a six-page report and is published evey day by the Meteorological Office, Pune. It contains a summary af observations, a forecast of weather, meteorological data of a large number of stations, coded messages and two weather maps. The report gives a summary of the observations recorded at 0830 hours I.S T. The summary includes a brief account of the dominating pressure systems, rainfall received during the past 24 hours, departure of maximum temperature and minimum temperature from normal and a forecast of w eather valid until the evening of the next day. In addition to a brief summary of the weather, wireless reports from ships and coded messages received from various stations are given. The coded messages pertain to cloud amount, direction of wind, speed of wind in knots, visibility present and past, weather regarding rain and snow, barometric pressure, temperature, cloud amount with height, cloud type, change in barometric pressure recorded at 0830 hours of the date on which the report was published and at 1730 hours of the previous day, etc. The coded messages relate to the observations recorded at 1730 hours of the previous day and at 0830 hours of the date of the publication of the report. The report also includes temperature and rainfall data of all those stations of which coded messages are given. Maximum and minimum temperatures in °C and their departure from normal, rainfall of past 24 hours in millimetgres, season's total in mm. year's total (from 1 January), in cm. and annual normal rainfall in cm. are given. Two weather maps of India and the.neighbouring countries, one depicting the weather at 0830 hours on the day of the publication of the weather report and the other depicting the weather at 1730 hours of the previous day are also attached to the report. At the bottom of the weather map showing the weather at 0830 hours, there are two small maps of India, one showing the departure of minimum temperature from normal and the other departure of pressure recorded at 0830 hours from normal. The rainfall amounts given in the weather map showing the weather at 0830 hours, are those deceived during the past 24 hours. At the bottom of the weather map showing the weather at 1730 hours, there are also two small maps of India but one showing the departure of maximum temperature from normal and the other depicting winds, fronts and discontinuities at 1.5 km. above the mean sea-level at 1730 hours. The rainfall amounts given in the weather map depicting the weather at 1730 hours are those received during the past 9 hours only.
203 2.12 Weather Elements in a Weather Map/Report A map showing the distribution of weather elements for a given time, is called a weather map. The weather elements are represented on a weather map by symbols. Knowledge of these symbols is essential for making an attempt to study a weather map. A weather map is studied systematically as under: 1. Introduction. Give the time at which the weather observations were recorded and the date. Also make a brief mention of the special weather conditions represented on the two small-sized maps given at bottom of the main weather map of India and the neighbouring countries. 2. Barometric pressure. (i) Areas of high pressure, (ii) Areas of low pressure, (iii) Pressure systems, (iv) Trends of isobars, (v) Pressure gradient. Pressure is represented by isobars drawn at an interval of 2 mb. A close look at the weather map adicates that the isobars assume certain shapes. Locate the highest and the lowest pressures and various tressure systems namely cyclones, anticyclones, wedge, col, etc. 'L' is placed in the centre of a low' pressure area. 'H' in the centre of a high pressure area and 'D' in the centre of a depression. Mention the direction which the isobars run. Also identify the areas where pressure is uniformly the same and where the pressure rails rapidly. The rate of fall of pressure between two points is called pressure gradient or barometric gradient. Where the isobars are close together pressure gradient is steep and where the isobars are wide apart, it is gentle. The maximum gradient is along the line perpendicular to the isobars. Where the gradient gentle the wind is weak and where the gradient is steep it is strong. 3. Wind (i) Direction, (ii) Velocity. The direction of the wind is controlled by various pressure systems (Fig.) and it should be studied in relation to these systems The direction of the wind is indicated by a line one end of which meets a circle drawn at the station where the wind direction was recorded. The direction from which the iine comes to meet the circle indicates the direction of the wind. The wind velocity is shown by barbs (feather lines) attached to the line indicating-the direction of the wind (Fig.). The velocity of the wind is given in knots (page 320). Cyclonic storms if any should also be identified.
204 4. Cloud Cover (i) Cloud amount, (ii) Type of the cloud. Mention how much of the sky is covered with clouds in the various parts of the country. Also indicate whether the cloud is high, low or medium. 5. Rainfall (i) Distribution, (ii) Areas receiving exceptionally heavy rainfall. Rainfall is given in centimetres and is written close to the south-eastern side of the circle. The weather map depicting the weather at 0830 hours gives the rainfall received during the past 24 hours. The weather map depicting the weather at 1730 hours gives the rainfall received during the past 9 hours only (Fig.) A black dot indicating that it was raining when the map was drawn is placed near the western side of the circlr Identify the areas which have received exceptionally heavy rainfall giving thye probable causes. Describe and explain the distribution of rainfall throughout India and the neighbouring countries.

205 6. Other Weather Phenomena Mention the distribution of haze, dust-whirl, mist, shallow fog, lightening, squall, dust or sandstorm, drifting snow, fog, drizzle, rain, snow, shower, thunderstorm and hail. 7. Departure of minimum temperature from normal. 8. Departure of maximum temperature from normal. 9. Departure of pressure from normal. 10.Sea condition. 2.13 Exercise of Weather Maps 1. What is a weather map? What does it portray? Why it is important to geographers? 2. Name the instruments that record atmospheric. temperature, pressure, wind velocity, wind direction, cloudiness, sunshine, rainfall, evaporation,'and evapotranspiration. 3. Name the Headquarters'of IMO and WMO. 4. Name the different types of weather recording stations in India. 5. Define atmos pheric pressure. State the units of its measurement. 6. Name the different climatological seasons along with their duration in India. 7. What are the salient features of weather observed during the hot weather season in India? 8. What are the salient features of weather observed during the coldweather season in India? 9. What are the salient features of weather observed during the southwest monsoon season.in India? 10. What are the salient features of weather observed during the retreating monsoon season in India? 11. Critically study the isobaric pattern in the weather map. Identify the trends of isobars and explain it. 12. State the salient characteristics of the weather, elements as shown in the given weather map and identify the seasons. 13. Draw a sketch map to show the areas of high pressure and low pressure and the trends
206 of isobars with such features as axis of low pressure, axis of monsoon trough, wedge of high pressure, cyclonic circulation and the general pattern of isobars. . 14. What is meant by pressure gradient? How it is measured, on a weather map? Find the directions and magnitudes of the steepest, gentlest and average pressure gradient shown on the given weather map. 15. Draw isobaric sections along suitable directions on the given weather of pressure gradient. Explain it. 16. For, the given weather map draw a wind rose and analyse it to identify the season. 17. State the laws relating to wind direction. Draw a.sketch map to show the different zones and interpret it. 18. Draw a statistical diagram to analyse the distribution of wind velocity over a given weather map. 19. Draw a-sketch map to show the distribution of different wind velocity zones and interpret it. 20. Draw a statistical diagram to analyse the distribution of cloudiness over a given weather map. 21. Draw a sketch map to show the distribution of zones of different cloudiness and interpret it. 22. Draw a sketch map to show the distribution of rainfall, and interpret it. 23. Draw a sketch map to show the distribution of different sea conditions and interpret it. 24. Draw a transect chart to illustrate the relation between pressure gardient and wind velocity. 25. With the help of a transect chart, explain the relations between pressure condition wind condition, cloudiness, rainfall and other atmospheric phenomena. 26. Interpret the weather map under the heads pressure conditions, wind conditions cloud cover and rainfall. Comment on the weather conditions that would be most likely in the next 24-48 hours. 27. Critically analyse the weather conditions portrayed in the weather map and identify the season.
207 Exercise: Map 1
208
209
210 Unit 3 Construction and Interpretation of Climograph (G. Taylor) Structure 3.1 Introduction 3.2 Construction 3.3 Uses 3.4 Structure 3.5 Examples 3.6 Exercise 3.1 Introduction G. Taylor, in 1949, introduced a climatic diagram to represent mean-monthly values of wet bulb temperature (°C) and relative humidity (%) on a fixed frame. 3.2 Construction (1) In the fixed rectangle or square frame, wet bulbs temperature in plotted along the y-axis (from –10°F to 90°F) while the relative humidity is plotted along the x- axis (graduated from 20% to 100%). (2) The four corners of the frame are marked as Row in South-East (SE), Muggy in North-East (NE), Scorching in the North-West (NW) and Keen in the South-West (SW). (3) The diagram represents— Item Represents Do notes (i) Raw low wet-bulb (>40°F) & high relative humidity (over 70%) (ii) Muggy high wet-bulb (<60°F) & high relative humidity (over 70%) (iii) Scorching high wet bulb (<60°F) & low relative humidity (below 40%) (iv) Keen low wet bulb (>40°F) & low relative humidity (below 40%) (4) A scale of discomfort is marked on the right of the rectangular frame. The scale values are— Discomfort Features (i)

54% **MATCHING BLOCK 111/121** **W**

Very rarely uncomfortable Below 45°F (ii) Ideal 45° - 55°F (iii) Rarely uncomfortable 55° – 60°F (iv) Sometimes uncomfortable 60° – 65°F (v) Often uncomfortable 65° – 70°F (vi) Usually uncomfortable

Above 70°F

211 (5) Within the frame, the name of the months need to be write shortly after plotting the points by measuring the web-bulb temperature and relative humidity of each months. (6) The plotted points of each months should be joined gradually by the straight lines which finally represent the Polygonal Climograph. (7) Finally, analyse or interpret the polygonal climographs on the basis of its location (located in which corners of the frame) and shape. 3.3 Uses (1) It is used to indicate the physiological effects of climate on man. (2) It represents the discomfort level of climate. (3) Different zones or pattern of uncomfortableness can be best understood by climograph. 3.4 Structure * Climograph (The Taylor type): Name Position Wet bulb Relative Temper- Humidity (%) ature (°F) Raw South East (SE) Corner Below 40°F Over 70 Muggy North East (NE) Corner Ovcer 60°F Over 70 Scorching North West (NW) Corner Over 60°F Below 40 Keen South West (SW) Corner Below 40°F Below 40
212 3.5 Examples (a) Example-1: Draw 'Climograph' on the basis of the given data and also identify the climatic type. Month

90% MATCHING BLOCK 112/121 W

J F M A M J J A S O N D Wet-Bulb 33.6 36.3 42.2 50.2 59.2 65.7 68.9 67.9 64.4 54.9 45.4 38.5 Temp. (°

F) Relative 78 73 65 57 58 42 52 57 38 55 44 48 Humidity (%) N.B.: (b) Example-2: Draw 'Climograph' on the basis of the given data. Month

90% MATCHING BLOCK 113/121 W

J F M A M J J A S O N D Wet-Bulb Temp. (°

F) 64.8 68.5 70.5 78.1 82.9 82.3 80.8 80.7 80.5 78.0 68.9 68.4 Relative Humidity (%) 40 44 38 38 57 69 81 79 75 72 48 48
213 C) Example 3 : Data for

73% MATCHING BLOCK 114/121 W

Climograph of Kolkata: Month J F M A M J J A S O N D Wet-Bulb Temp. (°

F) 65 69 71 78 83 82 81 81 80 78 69 68 Relative Humidity (%) 40 44 38 38 57 69 81 79 `75 72 48 48
214 3.6 Exercise CLIMOGRAPH Draw 'Climograph' on the basis of the given data, also identify the climatic type: Month

90% MATCHING BLOCK 115/121 W

J F M A M J J A S O N D Wet-Bulb Temp. (°

F) 35.3 38.3 42.2 32.3 59.2 67.7 69.9 68.9 67.9 64.2 55.2 40.5 Relative Humidity (%) 80 78 66 58 45 54 53 40 52 45 46 50 Draw 'Climograph' on the basis of the given data also identify the climatic type: Month

90% MATCHING BLOCK 116/121 W

J F M A M J J A S O N D Wet-Bulb Temp. (°

F) 53 55 58 61 66 71 77 78 75 68 62 57 Relative Humidity (%) 49 44 45 47 51 55 57 73 77 76 78 79 Draw a climograph with the help of following data. Identity the climatic type. Month

90% MATCHING BLOCK 117/121 W

J F M A M J J A S O N D Wet-Bulb Temp. (°

F) 45 46 56 64 63 61 59 52 50 49 43 42 Relative Humidity (%) 35 36 61 62 66 70 75 80 79 67 55 38 Draw a climograph with the help of following data. Interpret the diagram. Month

90%	**MATCHING BLOCK 118/121**	**W**
J F M A M J J A S O N D Wet-Bulb Temp. (°		

F) 8 12 18 18.5 19.6 19.8 20.1 17 17.5 16.9 09 07 Relative Humidity (%) 61 60 55 54 49 71 83 84 70 68 64 58 Draw a climograph with the help of following data. Interpret the diagram. Month

90%	**MATCHING BLOCK 119/121**	**W**
J F M A M J J A S O N D Wet-Bulb Temp. (°		

F) 78 80 80.5 81 83 80.4 79 82 84 83 77.6 79.7 Relative Humidity (%) 86 77 91 78 82 76 74 83 90 86 85 88
215 Unit 4 Construction and Interpretation of Wind Rose Structure 4.1 Definition 4.2 Features 4.3 Construction 4.4 Uses 4.5 Example 4.1 Definition Wind rose is a diagram showing the relative frequency of wind directions at a place. 4.2 Features 1) It is a graphic tool used by meteorologists. 2) It gives a succinet view of wind direction. 3) It represents the prevailling winds. 4) It is associated with climograph. 5) It represents the calm condition of a month. 4.3 Construction The directions of the 12 months of a place is to be represented by a wind rose diagram, following the steps given below: 1) A circle is to be drawn on the basis of average value of cxalm condition. It can also be drawn representing maximum value of the calm condition. 2) The value of the calm conditions need to be write in the circle. 3) The straight lines are to be drawn (total 8) at 45° angle concentrating the centre circle. 4) The each 8 lines reepresent 8 wind direction. The straight lines should be drawn according to the average value wind directions of the 12 months on a certain scale. 5) The terminal points of the each 8 lines need to be joined by a boundary lines (extra portions of each lines need to be erase). 6) The directions of each lines should be mentioned. 7) The graphical scale and heading of wind rose diagram need to be write.
216 4.4 Uses 1) If is daily use to understand the monthly or yearly changes of wind direction and its stability of a place. 2) It is useful to represents the sea breeze and land breeze of the coastal areas. 3) It helps to understand the daily and or seasonal changes of atmosphere, especially wind condition. 4.5 Example Wind Direction: Table for wind direction (Wind Rose diagram) Wind N NE E SE S SW W NW Calm Direction No. of days 2 15 7 5 6 37 5 4 13 Scale 0.4 1 1.4 1 1.2 7.4 1 0.8 0.5 cm 1cm = 5 Units radius

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217 Unit 5 Construction and Interpretation of Climatic Chart Structure 5.1 Introduction 5.2 Construction 5.3 Data for Climatic Chart 5.4 Representation of Climatic Chart 5.5 Drawing of Climatic Chart a) Diagram in Two Frames b) Diagram in Four Frames c) Diagram in Single Frame 5.1 Introduction Climatic Chart provides an overview of the climate at a place. It helps to understand the association between temperature, pressure, relative humidity and rainfall. 5.2 Construction In this chart four elements of weather have been represented on the vertical (y- axis) and time on the abscissa (x-axis). The given climatic chart depicts the temperature, pressure, relative humidity and rainfall for three months of August, September and October for 2005 at Alipore, Kolkata at 8.30 hours. The temperature is depicted with a red curve, pressure with brown curve and relative humidity with blue curve. Rainfall is depicted using bars. On the ordinate, the scale for temperature, pressure, relative humidity and rainfall is 1 cm presents 5°C, 10 mb, 10% and 10mm respectively. On the abscissa 1 cm represents 5 days. The climatic conditions prevailing at Alipore, Kolkata during August - October, 2005 depict moderate to high temperature ranging from 25°C on September to 35° C on September. Temperature fluctuations are relatively lower in August and October. However, the temperature in October is generally lower than in August. Pressure follows the pattern of temperature and varies between 990 mb and 999 mb on September and October respectively. Pressure too fluctuates with temperature and in general high temperature is associated with low pressure baring few days when high temperature is not associated with low pressure probably on account of the influence of other weather elements. However, pressure increases continuously towards the end of October coinciding with decline in temperature. Relative humidity fluctuates considerably during these three months and ranges from around 60 per cent on October to nearly 100 per cent for certain days in September and October. It is interesting to observe that the peak in relative humidity in September and October is associated with a dip in pressure as well. Rainfall fluctuates more than the other three elements during these three months.

218 While there is practically no rainfall from mid to end of October; all through August to October beginning irregular rainfall is observed. The rainfall was maximum on th of October 2005 (mm). In August, more frequent and copious rainfall occurred during 5 th to 15 th of the month; and in September, more frequent and copious rainfall occurred during 10 th to 20 th of the month. As expected copious rainfa days coincide with days of high relative humidity. Thus, the three months of August - October are months of moderate though fluctuating temperature and low' pressure, moderate to high relative humidity and moderate to high rainfall. The only exception is from middle to end of October when temperature starts declining and pressure increasing. Fluctuations in relative humidity are more prominent and rainfall is negligible. Thus, the four elements of weather are associated and reflect that during the three months Alipore, Kolkata experiences rainy climate and October end reflects the end of rainy season on one hand and probably marks the grad ual ushering in of the winter season over the following days. 5.3 Data for Climatic Chart Average Rainfall (mm) Relative Pressure (mb) temperature (°C) humidity (%) 25 79.0 68 999.5 24 61.1 67 998.2 27 4.9 67 995.7 28 0.9 60 990.2 26 11.6 60 991.5 22 39.9 65 996.6 20 49.2 67 997.9 24 0.04 60 998.1 5.4 Representation of Climatic Chart This data of climatic chart can be represented in three different frames which can be considered as different method. The methods are— (a) Diagram in two frames— (i) One frame for temperature and Rainfall (ii) Another frame for Relative Humidity and Pressure. (b) Diagram in four frames— (i) One for Temperature, (ii) One for Rainfall, (iii) One for Relative Humidity (iv) One for Pressure (c) Diagram in single frame— Here Temperature, Rainfall, Relative Humidity and Pressure are plotted in a single frame based on their respective scales.

219 5.5 Drawing of Climatic Chart CLIMATIC CHART (A) Diagram in two frames

220 CLIMATIC CHART (B) Diagram in four frames

221 CLIMATIC CHART (C) Diagram in single frame INDEX Temperature Rainfall Relative humidity Pressure Pressure (mb) Relative humidity (%) Average temperature (°C) Rainfall (mm)

222 Unit 6 Construction and Interpretation of Ombrothermic Chart Structure 6.1 Introduction 6.2 Construction 6.3 Data table for Ombrothermic Chart 6.4 Drawing of Ombrothermic Chart 6.5 Interpretation of the Diagram 6.1 Introduction Ombrothermic Chart is a graph technique developed by Emberger et. al (1963) to identify water deficiency/stress conditions for plant growth. The word 'Ombrothermic' can literally be split up into 'ombro' i.e. 'relating to precipitation' and 'thermic' i.e. 'related to temperature'. 6.2 Construction This method graph represents mean monthly temperature (°C) and monthly precipitation (mm) on the vertical axis. The scale of the temperature is generally associated on the left and precipitation on the right. The temperature scale is generally half value that of precipitation. The temperature and precipitation are usually plotted aganist on axis of time (horizontal axis)—generally over a year for each month. The temperature are indicated by a red curve, whereas precipitation is represented by a blue curve. The resulting ombrothermic chart identifies water deficiency conditions, i.e. months with unfavourable conditions for plant growth. Plants are under water stress during the months when the precipitation curve drops below the temperature curve and plants are under temperature stress when the temperature curve drops below the freezing mark (0°C). When the curve of precipitation exceeds that of the temperature it is referred to as the wet period or water surplus period. On the other hand, when the temperature curve is higher than that of precipitation, it is referred to as dry or Xeric Period. This can be represented by the following equation : 2t° < P = < dry/xeric, 2t° > P = < wet/water surplus. Thus, ombrothermic chart represents the complex spatial relationships between temperature and precipitation. This relationship is used for identifying drought related phenomena as well as hydrological stress due to excessive amount temperature. Thus, the chart technique offers the possibility to highlight gradual shift that occur in the season pattern, then relative lengthening/constracting, as well as corresponding
223 seasonal drought conditions as they both tend to neutratize the impact of each other. The balance of the two main elements of weather and climate tend to determine the climate of the region and hence have an implication for plant growth in the area as they determine water surplus or xeric periods. 6.3 Data table for Ombrothermic Chart Table: 1 Station A Months Temperature Rainfall (mm)

87% **MATCHING BLOCK 120/121** **W**

J 16 3.0 F 18 12.0 M 22 14.0 A 25 140.0 M 27 400.0 J 28 1021.0 J 27 918.0 A 27 605.0 S 26 415.0 O 25 142.0 N 21 59.0 D 19 0.0

Table: 2 Station B Months Temperature Rainfall (mm)

87% **MATCHING BLOCK 121/121** **W**

J 18 4.0 F 19 25.0 M 24 8.0 A 30 71.0 M 31 121.0 J 31 170.0 J 30 318.0 A 29 165.0 S 28 302.0 O 27 41.0 N 23 0.0 D 19 0.0 224 6.4

Ombrothermic Chart of Station 'A' Showing THE RELATIONSHIP BETWEEN RAINFALL & TEMPERATURE INDEX
225 6.5 Ombrothermic Chart of Station 'B' Showing THE RELATIONSHIP BETWEEN RAINFALL & TEMPERATURE A B

226 6.5 Interpretation In both the Ombrothermic chart, there are two periods—xeric period and wet period. When the temperature. is higher than rainfall in Ombrathermic chart that is called Xeric Period and when then temperature. is lower than the rainfall that is called Wet Period. In Ombrothermic chart 'A' the Xeric Period starts from the middle of August and continues to the middle of May and June. In Ombrothermic chart 'B' there are two Xeric periods are present, one starts from the October and continues to June, it is the longer Xeric Period. Another Xeric Period; the smaller one, starts and ends in August. In chart 'A' the Wet period starts from June and ends in the middle of August. In chart 'B' the wet period is devided in two periods. One starts from the end of June to starting of August and another wet period starts from end of August to September. Summary/Learning Outcomes The learning outcomes of the blocks are : 1) The use of different instrument for measuring weather elements is understood by the learners and they became capable of measuring such elements and describe the weather condition. 2) The study of daily weather map of India helps the learners about the salient features of different seasons of India and their key element which enhance their skill to interpret different weather reports. 3) The study of construction, process of climograph, wind rose, climatic chart, ombrothermic chart help the learners to understand the condition and they can interpret those very well. 4) Different aspects of climatology are analysed in the block which help the learners to understand and prepare particular assignment and make them capable to slove problems related to the topic. 5) This practical experience will definately help the learners to understand and strengthen the theoritical base of climatology and enhanced their skills in this discipline.
227 Questions: 1. Measure the Mean daily temperature using the given instrument and interpret it. 2. Measure the Air pressure the given instrument and interpret it. 3. State about the basic criteria to identify the monsoon, pre-monsoon and post- monsoon season from a Daily Weather Map of India. 4. State about the major heads to interpret a a Daily Weather Map of India. 5. State about the Pressure and Wind Condition of the given Daily Weather Map of India with the help of suitable drawing. 6. Discuss about the Sky Condition and Rainfall/Precipitation of the given Daily Weather Map of India with the help of suitable drawing. 7. Explain about the Pressure-Wind-Cloudiness-Rainfall corelationsof the given Daily Weather Map of India with the help of suitable drawing. 8. Discuss about theother Atmospheric Phenomena, Sea Condition and Weather Forecasting of the given Daily Weather Map of India with the help of suitable drawing. 9. Draw and interpretation of Climograph using the given data. 10. Prepare a Wind Rose diagram and interpret it. 11. Prepare a Climatic Chart and interpret it. 12. Construct a Ombrothermic Chart and interpret it. References: Hammond, R. and Macullagh, P.S. (1974): Quantitative Methods in Geography, Clarendon Press, Oxford. Mishra, R.P.: Elements of Cartography. Monkhouse, F.J. and Wilkinson, H.R. (1789): Maps and Diagrams: Their compilation and construction, P.I. Pub. Pvt. Ltd., New Delhi. Robinson, A. H., Sale, R.D., Morrison, J. (1980): Elements of cartography, Wiley, New York. Saha, P.K. and Basu, P. (2003): Practical Geography: A Laboratory Monepal, Kolkata. Sarkar, A. (1997): Practical Geography: A systematic Approach, Orient Longman Ltd., Hyderabad. Singh, R.J., (1991): Elements of Practical Geography, Kalyani Publishers. Kimerling, A.J., Buckley, A.R., Muehrcke, P.C., Muehrcke, J.O. (2011). Map Use: Reading, Analysis, Interpretation, 7th ed, Esri Press.
NOTES

Hit and source - focused comparison, Side by Side

Submitted text	As student entered the text in the submitted document.
Matching text	As the text appears in the source.

1/121	**SUBMITTED TEXT**	12 WORDS	**95%**	**MATCHING TEXT**	12 WORDS
Conventional Signs for Topographical maps of survey of India 1.4.1 Description 1.4.1.1 Villages,			Conventional Signs for Topographical Maps of the Survey of India Description Villages,		

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Map reading, in actuality, denotes the formation of a visual picture of the ground depicted on a map.

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Undoubtedly a map is a good guide but it requires some art to follow the direction and information given by it.

Undoubtedly a map is a good guide but it requires some art to follow the direction and information given by it

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It is not always easy to grasp the general appearance of the land at the first glance over the map, because various details may be recorded by a complex set of conventional signs on it. It requires a good deal of practice, and only a well-trained mind in this art can visualise the correct picture of the country represented by it. In fact, all types of map do not present the same difficulties in their reading as the topographic survey map in which the topographic forms are very well expressed by different symbols or signs in a complex manner. The best way to be familiar with the topography of a region is to compare the survey map of the region at the spot in the field. But before proceeding to the actual field, the students must be trained in the laboratory in consulting the map. Moreover, it is not NSOU CC-GR-02 15 possible for a student even in his life-time to collect direct information from the field all over the earth; but one can easily manage to know of the different parts of the earth-surface from the topographical sheets thereof.

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5/121	SUBMITTED TEXT 55 WORDS	100% MATCHING TEXT 55 WORDS
	Though a map is the tool of a geographer, it is consulted by other people also. A traveller may, simply need to know about the location of his destination and the route followed; while in military strategy one may require to detect all possible routes along which to march or, which may be followed by the enemy.	Though a map is the tool of a geographer, it is consulted by other people also. A traveller may, simply need to know about the location of his destination and the route followed; while in military strategy one may require to detect all possible routes along which to march or, which may be followed by the enemy.

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6/121	SUBMITTED TEXT 103 WORDS	100% MATCHING TEXT 103 WORDS
	Thus, there are two methods of approach to a map. Firstly, a simple approach with some particular end in view, and secondly, a scientific approach. The simple approach points out to the mere consultations of the map; whereas a scientific study of map requires a critical outlook; it requires, at first, the collection of facts, their systematic arrangements and then deduction of suitable inferences. The first type of study is simple and it may be made even by a layman, but the second method is more elaborate and requires a comprehensive knowledge of physical geography as well as of human responses to natural environment, without which erroneous conclusions may be drawn.	Thus, there are two methods of approach to a map. Firstly, a simple approach with some particular end in view, and secondly, a scientific approach. The simple approach points out to the mere consultations of the map; whereas a scientific study of map requires a critical outlook; it requires, at first, the collection of facts, their systematic arrangements and then deduction of suitable inferences. The first type of study is simple and it may be made even by a layman, but the second method is more elaborate and requires a comprehensive knowledge of physical geography as well as of human responses to natural environment, without which erroneous conclusions may be drawn.

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7/121	SUBMITTED TEXT 49 WORDS	95% MATCHING TEXT 49 WORDS
	Obviously, this type of study is very useful to a student of geography in having a proper grasp of the regional geography of an area. A good practice in this type of practical work enables the student to write a systematic geographical account of any area. 1.3.2 Numbering of Topographical Maps of	Obviously, this type of study is very useful to a student of geography in having a proper grasp of the regional geography of an area. A good practice in this type of practical work enables the student to write a systematic geographical account of any area. Topographical Maps of India Topographical maps of

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8/121	SUBMITTED TEXT 18 WORDS	100% MATCHING TEXT 18 WORDS
	The Survey of India was started over hundred years ago. Many great British surveyors received their training here.	The survey of India was started over hundred years ago. Many great British surveyors received their training here

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9/121	SUBMITTED TEXT 62 WORDS	94% MATCHING TEXT 62 WORDS
	Due to their great effort our country is mapped on scales of 1, 2, 4 miles to the inch. But the most important are 1 : 1,000,000 scale maps, published in two series— (i) India and Adjacent Countries Series and (ii) the International Series of La carte. International du Monde. The former also extends into the contiguous lands of Afghanistan, Tibet and China. These sheets	Due to their great effort our counuy is mapped on scales of 1, 2, 4 miles to the inch. But the most important are 1 ; 1,000,000 scale maps, published in two series — (/) India and Adjacent Countries Series and (tr) the International Series of La carte International du Monde. The former also extends into the contiguous lands of Afghanistan, Tibet and China. These sheets

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10/121	SUBMITTED TEXT 86 WORDS	93% MATCHING TEXT 86 WORDS
	degrees. The whole country is planned to be divided in 4×4 degree sheets, each being numbered as 39, 40, 41, etc. Sometimes the sheet is named after the most important town of the area covered by it. For instance, sheet Nos. 43 and 53 are also known as Srinagar and Delhi sheets respectively. In these sheets lettering is done in black, water in blue, contours in brown, and roads and town sites in red colours. These sheets have been published in two editions. (i) Political edition with 16	degrees. The whole country is planned to be divided in 4 x 4 degree sheets, each being numbered as 39, 40, 41, etc. Sometimes the sheet is named after the most important town of the area convered by iL For instance, sheet Nos. 43 and 53 arc also known as Srinagar and Delhi sheets respectively. In these sheets lettering is done in black, water in blue, contours in brown, and roads and town sites in red colours. These sheets have been published in two editions, (i) Political edition with

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11/121	SUBMITTED TEXT 35 WORDS	72% MATCHING TEXT 35 WORDS
	boundaries in colour, and (ii) Layered edition with graduated layers of colours to show altitudes. The publication of the latter has been stopped and in its place maps of International Series are being published. These sheets	boundaries in colour, and (if) Layered edition with Fig. 106 INTIKPRirrATION OP TOPOGRAPillCAL MAPS 85 graduated layers of colours to show altiludcs. The publication of the latter has been slopped and in its place maps of International Series arc being published. Tlicsc sheets

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12/121	SUBMITTED TEXT 30 WORDS	81% MATCHING TEXT 30 WORDS
	also known as 1/M sheets or one-in-million maps. The maps of International Series are being prepared according to the scheme adopted by the International Map Committee held in London in 1909, for	also known as 1/M sheets or onc-in-million maps. The maps of International Series, as already pointed out in Chapter 1, an: being prepared according to the scheme adopted by the International Map Committee held in London in 1909, for

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13/121	SUBMITTED TEXT	28 WORDS	90%	MATCHING TEXT	28 WORDS

elevation is shown in metres. Besides, some maps as "Southern Asia Series" have also been published on 1:2,000,000 or 2M scale by reducing one-in-million maps to half the scale.

elevation is shown in metres. Besides, some maps as "Soutlicm Asia Series" have also been published on 1 : 2,000,000 or 2 M scale by reducing onc-in-million maps to half the scale.

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14/121	SUBMITTED TEXT	77 WORDS	96%	MATCHING TEXT	77 WORDS

The colour scheme is the same as in 1/M maps. The one-in-million sheet has been further sub-divided into 16 equal sheets, each of one degree dimension as shown in Fig. 3. Each sheet is known as degree sheet as it represents only one degree extent. In Fig. 3 A, B, C, D, E, F, G, H, I, J, K, L, M, N, O and P are 16 degree sheets. They may be separately numbered as 63A, 63B, 63C etc., because they

The colour scheme is the same as in 1/M maps. The onc-in-million sheet has been further sub- divided into 16 equal sheets, each of one degree dimension as shown in Fig. 106. Each sheet is known as degree sheet as it represents only one degree extent. In Fig. 106 A, B, C, D. E, F. G, H. I. J. K, L, M, N. O and P arc 16 degree sheets. They may be separately numbered as 63 A. 63 B, 63 C, etc., because they

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15/121	SUBMITTED TEXT	55 WORDS	94%	MATCHING TEXT	55 WORDS

in-million map No. 63. They are also sometimes called quarter inch maps as they show a scale of 4 miles to he inch. The contour interval is generally 250°. The degree sheets have been again sub-divided into 16 equal sheets, each representing an extent of 15 (See the square 63 K in Fig. 3). These smaller sheets

in-million map No. 63. They arc also sometimes called quarter inch maps as they show a scale of 4 miles to the inch. The contour interval is generally 250'. The degree sheets have been again sub-divided into 16 equal sheets, each representing an extent of 15' (See the square 63 K in Fig. 106). These smaller sheets

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16/121	SUBMITTED TEXT	38 WORDS	96%	MATCHING TEXT	38 WORDS

one inch maps as they show a scale of one inch to a mile. Sheets showing an extent of 30° are known as half inch maps because they represent a scale of half inch to one mile. One inch maps

one inch maps as they show a scale of one inch to a mile. Sheets showing an extent of 30′ arc known as half inch maps because they represent a scale of half inch to one mile. One inch maps

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17/121	SUBMITTED TEXT	16 WORDS	95%	MATCHING TEXT	16 WORDS
numbered as 63 K/1, 63 K/2, 63 K/3, 63 K/4 etc., while the half inch maps			numbered as 63 K/l, 63 K/2. 63 K/3. 63 K/4 etc., while the half inch maps		

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18/121	SUBMITTED TEXT	87 WORDS	86%	MATCHING TEXT	87 WORDS
numbered as 63 K/NW. 63 K/NE, 63 K/SE, and 63 K/SW, because they in the corresponding directions from the centre of the 63 K degree sheet. In selecting sheets for study, in the beginning simple sheets should be taken in which contours are not complicated but instead, they may be easily marked. For instance, a sheet representing a plain or plateau with low hills and ranges and clear drainage pattern may be selected. The sheets No. 63 K/12 may provide such simple features; a coloured sheet may be preferred because on coloured			numbered as 63 K/N. W., 63 K/ N. E., 63 K/S. E.. and 63 K/S. "W., because they lie in the corresponding directions from the centre of the 63 K degree sheet. In selecting sheets for study, in the beginning simple sheets should be taken in which contours arc not complicated but instead, they may be easily marked. Fex" instance, a sheet representing a plain or plateau with low hills and ranges and clear drainage pattern may be selected. The sheets No. 63 K/l 2 may provide such simple features; a coloured sheet may be preferred because on coloured		

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19/121	SUBMITTED TEXT	84 WORDS	84%	MATCHING TEXT	84 WORDS
vegetation and other features are very distinctly marked. 1.4 Conventional Signs for Topographical Maps of Survey of India 1.4.1 Description 1.4.1.1 Villages, Buildings, etc. : (1) Village, as surveyed: (a) open (b) walled (2) Ruined village as surveyed. (3) Scattered buildings and huts: (a) permanently occupied, (b) temporarily occupied. (4) Deserted site. (5) Mounment (6) Sati (7) Factory Chimney (8) Cave (when not antiquity): (a) inhabited, (b) uninhabited (9) Piquet or Post (10) Church (11) Temple (12) Tomb (13) Pagoda (14) Mosque (15) Idgah (16) Fort: (			vegetation and other features arc very distinctly marked. Conventional Signs for Topographical Maps of the Survey of India Description Villages, Building.s, etc. (1) Village, as surveyed: (a) open (6) walled. (2) Ruined village as surveyed. (3) Scattered buildings and hubs: (a) permanently occupied, (b) temporarily occupied. (4) Deserted site. (5) Monument. (6) Sati. (7) Factory Chimney. (8) Cave, (when not antiquity): (a) inhavited, (b) uninhabited. (9) Piquet or Post. (10) Church. (11) Temple. (12) Tomb. (13) Pagoda. (14) Mosque. (15) Idgah. (16) Fort: (		

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20/121	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS
thickness of line should be increased for large forts according to size			thickness of line should be increased for large forts according to size		

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

21/121	SUBMITTED TEXT	25 WORDS	100%	MATCHING TEXT	25 WORDS

importance), (b) conventional (17) Watchtower (18) Chhatri or way side temple (19) Battlefield (with name and year) (20) (a) Burial ground, as surveyed. (	importance), (b) conventional. (17) Watchtower. (18) Chhatri or way side temple. (19) Battlefield (with name and year). (20) (a) Burial ground, as surveyed. (6)

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22/121	SUBMITTED TEXT	36 WORDS	85%	MATCHING TEXT	36 WORDS

Graves, (21) Oilwell (21A) Oil-tank (22) Mine-shaft (23) Boundary pillar: (a) Survgeyed, (b) not found at time of survey. (24) Rifle-range, (as surveyed) (25) Aerodrome: (a) as surveyed, (b) conventional (26) Landing ground: 18	Graves. (21) Oilwcll. (21A) Oil-tank. (22) Mine-shaft. (23) Boundary pillar: (a) Surveyed, (b) not found at time of survey. (24) RiBc-range, (as surveyed). (25) Aerodrome: (a) as surveyed, (b) conventional (26) Landing ground: (

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

23/121	SUBMITTED TEXT	39 WORDS	100%	MATCHING TEXT	39 WORDS

as surveyed (b) conventional (27) Air bombing (or firing) range, as surveyed. (28) Air bombing target (29) Air firing target (30) Air mooring or Tall telegraph mast. (31A) Seaplane alighting area. (31B) Seaplane station. (31C) Trijunction pillars: (a) when village boundary	as surveyed, (b) conventional. (27) Air bombing (or firing) range, as surveyed. (28) Air bombing target. (29) Air firing target. (30) Air mooring or Tall telegraph mast. (31 A) Seaplane alighting area. (31B) Seaplane station. (31C) Trijunction pillars: (a) when village boundary

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24/121	SUBMITTED TEXT	71 WORDS	97%	MATCHING TEXT	71 WORDS

shown, (b) when village boundary is not shown. 1.4.1.2 Water Features : (32) Well: (a) lined or in rock, (b) unlined (33) Spring (34) Karez (with) depth of shaft in feet) (a) in use, (b) disused. (35) Pipe line: (a) water, (b) oil, (36) Swamp or marsh, with cultivation. (37) Reeds in perennial water. (38) Lake or tank, as surveyed: (a) with defined limit of perennial water, (b) with fluctuating, limit of pernnial water, (c) with	shown, (b) when village boundary is not shown. Water Features (32) Well: (a) lined or in rock, (b) unlined. (33) Spring. (34) Karez. (with) depth of shaft in feet) (a) in use, (b) disused. (35) Pipe line: (a) water, (b) oil. (36) Swamp or marsh, with cultivation. (37) Reeds in perennial water. (38) Lake or tank, as surveyed: (a) with defined limit of perennial water, (b) with fluctuating, limit of pemnial water, (c) with 86

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25/121	SUBMITTED TEXT	36 WORDS	63%	MATCHING TEXT	36 WORDS

ft. (d) with embankment 10ft or over, (e) with very steep embankment. (39) Excavated tank, as surveyed: (a) perennial, (b) non- perennial, (c) perennial with high embankment (40) Tank, conventional: (a) perennial, (b) non- perennial, (41) Quarry,

ft., (d) with embankment 10 fL or over, (c) with vciy steep embankment. (39) Excavated lank, as .surveyed; (a) perennial*, (h) non-perennial, (c) perennial with high embankment. (40) Tank, conventional: (a) perennial, (b) non- perennial, (41) Quarry,

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26/121	SUBMITTED TEXT	118 WORDS	77%	MATCHING TEXT	118 WORDS

greatest depth, (42) Singleline stream: (a) perennial, (b) non-perennial, (c) approximate or undefined, (d) indicating change from non-perennial to perennial. (43) Stream bank, north bank shows continuous, unbroken, steep or precipitous bank from 1' to 100' or over, in height, and south bank shows the same, but broken, as surveyed, heights corresponding with those on the north bank: (a), (b) and (c) show treatment of side stream junctions in accordance with the extent to which the river-bank is broken, (d) breaks in banks that extend to river bed level, (e) small breaks that have not been eroded down to river bed level, (f), (g) and (h) types of gorges or narrow rivers with high banks. (44) Dry nala: (a) with broken ground along bank (as surveyed), (

greatest depth, (42) Singlelinc stream: (a) perennial, (b) non-perennial, (c) approximate or undefined, (d) indicating change from non-perennial to perennial. (43) Stream bank, north bank shows continuous, unbroken, steep or precipitous bank from 1' to 100' or over, in height, and south bank .shows the same, but broken, as surveyed, heights corresponding with tho.sc on the nortli bank: (a), (h) and (c) show treatment of side stream junctions in accordance with the c,xtcnt to which the river-bank is broken, (d) breaks in banks tlat extend to river bed level, (c) small hrcalcs that have not lx:cn eroded down to river bed level, (/), (g) and (h) l^pcs of gorges or narrow rivers with high banks. (44) Dry nala: (a) with broken ground along bank (as surveyed), (6)

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27/121	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

ravines (as surveyed) (45) Double-line stream (width 1/20 inch or more on published sheet): (

ravines (as surveyed) (45) Double-line stream (width 1/20 inch or more on published sheet): (

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28/121	SUBMITTED TEXT	29 WORDS	87%	MATCHING TEXT	29 WORDS

Waterfall with height (perennial and non-perennial). (47) Rapids. (48) Sluice. (49) Perennial canal with distance stone: (a) single-line (thickness according to importance), (b) double-line according to width and with embankment shown

Waterfall with height (perennial and non- perennial). (47) Rnptd.s. (48) Sluice. (49) Perennial canal with di.stancc stone: (a) single-line (thickness according to importance), (b) double-line according to width and with embankment shown

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29/121	SUBMITTED TEXT	37 WORDS	94%	MATCHING TEXT	37 WORDS

relative height. (50) Non-perennial canals with distance stone. (51) Disused canals. (52) Canal: (a) with navigation lock, (b) with lock or weir carrying— (i) road, (ii) foot-path, (c) aqueduct or (if printed in black or red) viaduct (53) Dam: (

relative height. (50) Non-perennial canals with distance .stone. (51) Disused canals. (52) Canal: (a) with navigation lock, (b) with lock or weir cany'ing — (i) road, (ii) foot-path, (c) aqueduct or (if printed in black or red) viaduct. (53) Dam; (

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

30/121	SUBMITTED TEXT	45 WORDS	95%	MATCHING TEXT	45 WORDS

masonry, (b) earth work. (54) Weir (Anicut in Madras): on single-line and narrow double line streams, the sluice symbol should be used with the word 'Weir' typed alongside. (55) Canal tunnel, with or without cutting, surveyed. (56) Siphon in perennial canal (black in case of non-perennial canal).

masonry, (b) earth work. (54) Weir (Anicut in Madras); on single- line and narrow double line streams, the sluice symbol should be used with the word 'Weir' typed alongside. (55) Canal tunnel, with or without cutting, as surveyed. (56) Siphon in perennial canal (black in ease of non-perennial canal).

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31/121	SUBMITTED TEXT	36 WORDS	93%	MATCHING TEXT	36 WORDS

Telegraph lines : (57) Telegraph line. (58) Telephone line. (59) Electric Power line: (a) main transmission line (i) conventional on all scales, (ii) where spans vary largely the position of pylons should be as surveys when suitable to

Telegraph lines, etc. (57) Telegraph line. (58) Telephone line. (59) Electric Power line: (a) main transmission line — (i) conventional on all scales, (ii) where .spans vary largely the position of pylons should be as surveyed when suitable to

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32/121	SUBMITTED TEXT	43 WORDS	92%	MATCHING TEXT	43 WORDS

scale, (b) local distribution line (conventional): for lines of intermediate importance the size of the large dots will be graduated between symbols (a) as surveyed, (b) conventional. 1.4.1.4 Railway and bridges: (Gauge, if other than 5'-6', should always be stated) (62) Railway, 5'-6' gauge double-line: (a) open

scale, (b) local disuibution line (conventional): for lines of intermediate importance, the size of the large dots will be graduated between .symbols (a) as surveyed, (b) conventional. Railway, railway cro.s.sing and bridges (Gauge, if other than 5' — 6", should always be stated) (62) Railway, 5' — 6" gauge double-line: (a) open,

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33/121	SUBMITTED TEXT	26 WORDS	93%	MATCHING TEXT	26 WORDS

as surveyed), (b) under construction (63) Railway, 6'-6" gauge single-line: (a) open with sidings, and station and enclosure (conventional): (b) under construction. (64) Railway, other gauges double-line: (

as surveyed), (b) under construction. (63) Railway, 6′ — 6" gauge single-line: (a) open with .sidings, and station and enclosure (conventional), (b) under constmetion. (64) Railway, other gauges double-line: (

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34/121	SUBMITTED TEXT	105 WORDS	95%	MATCHING TEXT	105 WORDS

open with sidings, (b) under construction. (65) Railway, other gauges single-line: (a) open with sidings, (b) under construction, [In symbols (62) to (65) the sidings may be drawn narrower when space is limited]. (66) Mineral line or tramway. (67) Level crossing. (68) Road over railway. (69) Road (or railway) under railway. (70) Railway tunnel, with or without cutting, as surveyed. (71) Bridge carrying railway. (72) Bridge carrying: (a) railway over road, (b) road over railway (the descriptive wording should be omitted only where there is no room). (73) Bridge carrying road and railway of: (a) 5'-6" gauge, (b) other gauges. 1.4.1.5 Roads and bridges: (74) Roads of 1st importance: (a) metalled, and important bridge

open with sidings, (b) under construction. (65) Railway, other gauges .single- line: (a) open witli sidings, (b) under construction. (In symbols (62) to (65) the sidings may be drawn narrower when .space is limited). (66) Mineral line or tramway. (67) Level crossing. (68) Road over railway. (69) Road (or railway) under railway. (70) Railway tunnel, with or without cutting, as surveyed. (71) Rridge carrying railway. (72) Bridge carrying: (a) railway over road, (b) road over railway (the descriptive wording should be omitted only where there is no room). (73) Bridge carrying road and railway of: (a) 5'— -6" gauge, (b) other gauges. Ronds and bridges (74) Roads of 1st importance: (a) metalled, and important bridge

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35/121	SUBMITTED TEXT	85 WORDS	76%	MATCHING TEXT	85 WORDS

piers over river (the normal distance between the piers should be 1/8" on scale of drawing, varying slightly to permit of equal spacing between piers), (b) unmetalled (75) Roads of 2nd importance: (a) metalled, (b) unmetalled (76) Other roads: (a) metalled, also mile stone, bridge and Irish bridge or causeway, and avenue of trees, (b) unmetalled (c) motor transport turning point on roads. (77) Cart-track with bridge. (78) Pack-track with bridge culvert. (79) Pack-track with pass and height. (80) Foot-path with bridge, culvert. In symbols (77 to 80) the heavier symbols

piers over river (the normal distance between the piers should be 1/8" on scale of drawing, v.arying slightly to permit of equal spacing between piers), (b) unmctallcd. (75) Roads of 2nd importance: (a) metalled, (b) unmctallcd. (76) Other roads; (a) metalled, also mile stone, bridge and Irish bridge or causeway, and avenue of trees, (b) unmctallcd, (c) motor transport turning point on roods. (77) Carttrack with bridge. (78) Pack-track with bridge culvert. (79) Pack-track with pa.ss and height. (80) Foot-path with bridge, culvert. In symbols (77 to 80) the heavier symbols

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36/121	SUBMITTED TEXT	32 WORDS	95% MATCHING TEXT	32 WORDS
should be used in afforested or contoured areas, or where emphasis is required in open areas. Symbols may be still heavier if required to give emphasis in afforested or contoured sreas, (81) Road			should be used in afforested or contoured areas, or where emphasis is required in open areas. Symbols may be still heavier if required to give emphasis in afforested or contoured areas. (81) Road	

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37/121	SUBMITTED TEXT	239 WORDS	97% MATCHING TEXT	239 WORDS
tunnel, with or without cutting, as surveyed. (82) Bridge or boats or pontoon bridge (explanatory words to be typed against the symbol). (83) Ferry or ford. (84) Track or path coincident with bed of stream: (a) for short distance, (b) long distance. (85) Track or path following notified boundary: (a) short distance, (b) long distance. (86) Roads in dry river bed: (a) with steep river banks, (b) with shelving river banks. (87) Unmetalled road along tank bund. (88) Forest fire-line, not in regular use as line of communication, race-course track and similar special cases (explanatory words to appear along the symbol but when in regular use as line of communication the appropriate road symbol is to be used. 1.4.1.6 Embankments: (89) Road or railway embankment: (a) 5ft to 9ft high, (b) 10ft high or over and steep with sharp edge at top. (90) Road or railway cutting: (a) 5 to 9 ft deep, (b) 10ft deep or more and steep, with sharp edge at top. (91) Protective embankment: (a) 5ft to 9ft high, (b) 10ft high or over steep, with sharp edge at top (92) Embankments, cuttings and bridges with narrow gauge railway (Sleepers omitted) (a) along single-line, (b) along double-line (Note: ("Single line" or "Double line" may be typed along the line, if necessary) 1.4.1.7 Boundaries, limits and Gardens: (93) International: (a) demarcated, (b) undemarcated. (94) Province or State: (a) demarcated, (b) undemarcated (95) District or Tribal (96) Sub-division, Township, Taluk, Tahsil, Zamindari or similar partition. (97) Pargana in U.P. (98) Reserved, Protected or State Forest (green riband			tunnel, with or without cutting, as surveyed. (82) Bridge or boats or pontoon bridge (explanatory words to be typed against the symbol). (83) Ferry or ford. (84) Track or path coincident with bed of stream: (a) for short distance, (b) long distance. (85) Track or path following notified boundary: (a) short distance, (b) long distance. (8Q Roads in dry river bed: (a) with steep river banks, (b) with shelving river banks. (87) Unmetalled road along tank bund. (88) Forest fire-line, not in regular use as line of communication; race-course track and similar special cases (explanatory words to appear along the symbol but when in regular use as line of communication the appropriate road symbol is to be used. Embankments and cuttings (89) Road or railway embankment: (a) 5 ft to 9 ft high, (b) 10 ft. high or over and steep with sharp edge at top. (90) Road or railway cuttings: (a) 5 to 9 fL deep, (b) 10 ft deep or more and steep, with sharp edge at top. (91) Protective embankment: (a) 5 ft to 9 ft. high, (b) 10 ft. high or over steep, with sharp edge at top (92) Embankments, cuttings and bridges with narrow gauge railway (Sleepers' omitted) (a) along single- line, (b) along double-line (Note: "Single line" or "Double line" may be typed along the line, if necessary). Boundaries, limits and gardens (93) International: (a) demarcated, (b) undemarcated. (94) P/ovince or State: (a) demarcated, (b) undemarcated (95) District or Tribal. (96) Sub-division, Township, Taluk, Tahsil, Zamindari or similar partition. (97) Pargana in U.P. (98) Reserved, Protected or State Forest (green riband	

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38/121	SUBMITTED TEXT	177 WORDS	88%	MATCHING TEXT	177 WORDS

appear along the external boundaries and along those between forests of different ownerships. (99) Village with trijunction pillar: In symbols 93 to 99 boundary pillars should be drawn first, fitting in the boundary symbol afterwards, even if the length of bars does not agree. (100) Boundaries along: (a) one side of road, track or path, (b) center of road, track or path (when it is recognised boundary), (c) one side of river, (d) centre of river (e) bed of river as surveyed. (101) Wooded area (a) not enclosed, (b) enclosed by wall or permanent fence. (102) Limits of cultivation, open and along stream or ravine. (103) Demarcated limits camping ground. (104) Salt pan. (105) Orchard garden: (a) not enclosed, (b) enclosed by a wall permanent fence. (106) Tea garden, as survey (107) Betel or vine on trellis. (108) Vegetable garden. NSOU CC-GR-02 23 1.4.1.8 Ornamentation and Trees: (109) Scattered trees. (110) Scrub and undergrowth. (111) Grass: high 112) Cane-brake (113) Pine, fir, etc. (114) Palm. (115) Palmayrs (116) Betelnut (117) Bamboo. (118) Aloes or cactus. (119) Other trees. (120) Plantain trees. Symbols (109) to (120) can be varied

appear along the external boundaries and along those between forests of different ownerships. (99) Village with trijunction pillar: In symbols 93 to 99 boundary pillars should be drawn first, fitting in the boundary symbol afterwards, even if the length of bars does not agree. (100) Boundaries along: (a) one side of road, track Or path, (b) cenitrc of road, track or path (when it is recognised boundary), (c) one side of river, (d) centre of river, (c) bed of river as surveyed. (101) Wooded area: (a) not (enclosed, (b) enclosed by wall or pennanent fenae. (102) Limits of cultivation, open and along stream or ravine. (103) Demarcated limits of camping ground. (104) Salt pan. (105) Orchard or garden: (a) not enclosed, (b) enclosed by a wall Or permanent fence. (106) Tea garden, as surveyed. (107) Betel or vine on trellis. (108) Vegetable garden. , Trees (109) Scattered trees. (110) Scrub and undergrowth. (Ill) Grass : high. (112) Cane- brake. (113) Pine, fir, etc. (114) Palm. (115) Palamyra. (116) Betelnut (117). Bamboo. (118) Aloes or cactu s. (1 19) Other trees. (120) Plantain trees. Symbols (;i09) to (120) can be varied

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39/121	SUBMITTED TEXT	23 WORDS	87%	MATCHING TEXT	23 WORDS

size. Trees surveyed individually will appear in black, grass and all other tres will appear in green. Authorised symbols will be used where suitable,

size. Trees surveyed individually will appear in black, grass and all other trees will appear in green. Authorised synnbols will be used where suitable;

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40/121	SUBMITTED TEXT 125 WORDS	91% MATCHING TEXT 125 WORDS
	wooded areas small circles and half circles representing tres of uncertain nature, and representing scrub, under-growth or tea bushes, may be mixed with actual symbols which should very with the character of the vegetation. Symbols should not be drawn with elaborate care except when isolated. (121) Stony waste, (122) Sand features: (a) sand hills and dunes, shape as surveyed, (b) shifting sand, (c) confused sand hills (conventional), (d) fla sandy areas, Loose free sand should be indicated by closer spacing of dots. (123) Sandy river bed showing: (a) perennial channels, (b) non-perennial channels. (124) River bed showing: (a) sheet rocks, (b) rounded rocks, (c) edged rocks, and (d) rock ribs. 1.4.1.9 High Mountain Features: (125) Snow, ice and rock forms: (a) Medial moraine, (b) Lateral moraine, (c) Terminal morain, (d) Hanging glacier, (e) Ice fall, (	wooded area!! small circles and half circles, representing tiees of uncertain nature, and dots, representing scrub, under-growth or tea bushes, may be mixed with actual symbols which should very with the characUir of the vegetation. Symbols should not be drawn with elaborate care except when isolated. (121) Stony waste. (122) Sand features: (a) sand hills and dunes, shape as surveyed, (b) shifting sand, (c) confused sand hills (conventional), (d) flat sandy areas. Loose free sand should be indicated by closer spacing of dots. (123) Sandy river bed showing: (a) perennial channels, (b) non-perennial channels. (124) River bed showing: (a) sheet rocks, (b) rounded rocks, (c) edged rocks, and (d) rock ribs. High Mountain Features (125) Sriow, ice and rocFt forms: (a) Medial moraine, (b) Lateral moraine, (c) Terminal moraine, (d) Hanging glacier, (e) Ice fall, (/)

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

41/121	SUBMITTED TEXT 42 WORDS	70% MATCHING TEXT 42 WORDS
	Scree (q) Rock fall (large rocks) (r) Recognised route over glacier, with pass, (s) Snow cornice. 1.4.1.10 Hill and Mountain Features (126) Contours, with form-lines showing sub-features and contour value. (127) Depressions or Devil's cauldrons. (128) Broken or rocky ground. (129) Sheet rock on mountain side,	Scree (t/) Rock fall (Large rocks), (r) Recognised route over gl.acicr, with p.x<;s, (.r) Snow cornice. Hill and Mountain reaturcs (126) Contours, with form-lines showing .sub- features .and contour value. (127) Dcprc.ssions or Devil'.s c.autdrons. (128) flrokcn or rocky ground. (129) .Sheet rock on mountain side,

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42/121	SUBMITTED TEXT 32 WORDS	75% MATCHING TEXT 32 WORDS
	Scarp or cliff; high. (131) Scarp or cliff: medium (about 20' to 50'). (132) Scarp or cliff: low. (133) Earth or gravel slide. (134) Isolated rock masses (shape as surveyed). (135) Rock outcrops	Scarp or cliff; high. (131) .Scarp or cliff: medium (alx<ut 20' to .SO^, (132) .Sc.arp or cliff: low. (133) l-2arlh or gravel slide. (134) IsoLated rock masses (shape, as .surveyed). (135) •Rock outcrops

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43/121	SUBMITTED TEXT	27 WORDS	42%	MATCHING TEXT	27 WORDS
type of country shown in the specimens but should be drawn illustrated whenever they occur. The list of feature is not exhaustive. 1.4.1.11 Heights, Trigonometrical Symbols (141) Heights: (a) Triangulation			type of counuy sliown in the specimens but should be drav-m a.s illustrated wherever they occur. The list of fcaturc,s is not cxluausiivc. (see also para 35. Chap. V. T. H. B.) Heights, Trigonometrical .Symbols and Abbreviatioas (142) Heights: (a) TrianguLalion		

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44/121	SUBMITTED TEXT	30 WORDS	79%	MATCHING TEXT	30 WORDS
canal, (c) others. (143) Post Office. (144) Telegraph Office. (145) Combined post and telegraph office. (146) Police station. (147) Dak bungalow, (148) Rest-house. (149) Travellers bungalow. (150)Inspection bunglow (151) Circuit house. (152)			canal, (c) others. (144) Post Office. (145) Telegraph Office. (146) Combined post and telegraph office. (147) Police .station. (148) Dak bungalow. (149) Rc.st-housc. (150) Travellers bungalow. (151) Inspection bungalow. (152) Circuit house.		

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

45/121	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS
Coastal Symbols: (156) Tidal water: (a) with limit in double line dry stream, (			Coastal Symbols (158) Tidal water: (a) with limit in double- line dry .stream, (6)		

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

46/121	SUBMITTED TEXT	12 WORDS	89%	MATCHING TEXT	12 WORDS
in double-line perennial stream (c) in single-line stream, (d) with definite bank			in double-line perennial .stream, (c) in single-line stream, (d) widi definite bank		

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47/121	SUBMITTED TEXT	11 WORDS	87%	MATCHING TEXT	11 WORDS
junction with a double-line dry stream, (e) without definite bank at			junction with a double-line dry .stream, (c) without definite bank at		

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48/121	SUBMITTED TEXT	24 WORDS	46% MATCHING TEXT	24 WORDS

junction. (157) Coast-line as surveyed, showing: (a) high water line, (b) low water line, (c) tidal flat with mud, (d) shingle and sand, (e) cliff, (

junction. (159) Coast-line as .surveyed, .sliowing; (a) high water line, ((<) low water line, (c) tidal flats with mud. (d) shingle and sand, (c) cliff. (/)

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

49/121	SUBMITTED TEXT	10 WORDS	100% MATCHING TEXT	10 WORDS

with danger line. (162) Steamer service: (a) in double-line river, (

with danger line. (163) Steamer .service: (a) in double-line river, (6)

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

50/121	SUBMITTED TEXT	20 WORDS	91% MATCHING TEXT	20 WORDS

in single-line river. (163) Mangrove swamp. (164) Lightship. (165) Light-house. (166) Buoy: (a)lighted, (b) unlighted. (167) Anchorage. (168) Pier or jetty (

in single-line river. (164) Mangrove swamp. (165) Lightship. (166) Light-house. (167) Buoy: (a) lighted, (b) unlighlcd, (168) Anchorage. (169) Pier or jetty (

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

51/121	SUBMITTED TEXT	13 WORDS	100% MATCHING TEXT	13 WORDS

b) carrying railway as surveyed (169) Pier or jetty (open. framework or piles): (

b) carrying railway as surveyed. (170) Pier or jetty (open, framework or piles): (

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

52/121	SUBMITTED TEXT	94 WORDS	89% MATCHING TEXT	94 WORDS

conventional, (b) carrying, road as surveyed, (c) carrying railway as surveyed. (170) Beacon, steamer signal, navigation mark, etc. of a fairly permanent character (with appropriate lettering typed against the symbol): (a) lighted, (b) unlighted. 26 CC-GR-02 NSOU 1.4.2 Scientific Study of Topographical Maps 1. Preliminary information: (a) Note the nature, number and scale of the sheet, (b) measure the area of the sheet into square miles by the scale; (c) find out the districts represented by the sheet and also the adjoining districts with reference to the index below the sheet; (d) note down the latitudinal and

conventional, (b) carrying, road as surveyed, (c) carrying railway as surveyed. (171) Beacon, .steamer .signal, navigation mark, etc., of a fairly permanent character (with appropriate icticring typed against the symbol): (a) lighted, (b) unlightcd. Hints for the Scientific Study of Topographical Maps t. Preliminary information: (a) Note the nature, number and scale of the sheet, (b) measure the area of the sheet into square miles by die scale; (c) find out the districts represented by the sheet and also the adjoining districts with reference to the index below the sheet; (d) note down the latitudinal and '

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53/121	SUBMITTED TEXT	216 WORDS	98%	MATCHING TEXT	216 WORDS

longitudinal extent of the area depicted on the sheet. 2. Observation of the topography : Topography is the expression of the interaction of physical and cultural environments, and as such it includes physical as well as cultural (man-made) elements which are charted below. As already indicated in the foregoing, these features are marked over the sheet by some definite symbols —conventional signs and colours which are generally used to aid legibility in the map. Maps may be both coloured and uncoloured. Generally seven colours have been used in coloured maps. Hills are shown by brown contours or hachures and grey shades, water-courses are blue, forest are green, cultivated areas are yellow, railways are black and roads, towns and villages are red. These are shown on the "Characteristic sheet of the conventional signs and writing" used for British Ordinance Survey maps and some are also given on the margins of the map. Every country follows, more or less, the same conventional signs, with a few additions or a little alterations. In the topographical survey maps of India. British symbols have been adopted. In some maps more symbols are required, while in others only a few will do; for instance, in one inch maps less symbols are used than in cadastral maps, whereas quarter inch maps and 1/ m maps require less symbols than one inch maps. The student should, however, be familiar with these symbols

longitudinal extent of the area depicted on the sheet 2. Observation of the topography: Topography is the expression of the interaction of physical and cultural environments, and as such in includes physical as well as cultural (man-made) elements which are charted below. As already indicated in the foregoing, these features are marked over the sheet by some definite symbols — conventional signs, and colours which are generally used to aid legibility in the map. Maps may be both coloured and uncoloured. Generally seven colours have been used in coloured maps. Hills are shown by brown contours or hachures and grey shades, water-courses are blue, forest are green, cultivated areas are yellow, railways are black and roads, towns and villages are red. These are shown on the "Characteristic sheet of the conventional signs and writing" used for British Ordnance Survey maps, and some are also given on the margins of the map. Every country follows, more or less, the same conventional signs, with a few additions or a little alterations. In the topographical survey maps of India British symbols have been adopted. In some maps more- symbols are required, while in others only a few will do; for instance, in one inch maps less symbols are used than in Cadastral maps, whereas quarter inch maps and I/m maps require less symbols than one inch maps. The student should, however, be familiar with these symbols

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54/121	SUBMITTED TEXT	128 WORDS	100%	MATCHING TEXT	128 WORDS

be able to identify various features on the map. For convenience the conventional signs are given earlier. 3. Picturing the sheet as a whole: Ignoring the details for the time, picture the map as a whole. Do not look too closely at the map but try to have an idea of the most outstanding features of the landscape depicted on it. In the first place you should identify whether the area exhibits one type of physical feature— plain or plateau or hill, etc. If it includes more than one type, try to divide the area into sub-regions so that appropriate and systematic description may be given. For this purpose observe carefully the main river valleys and main contours indicating high and low lands which will enable you to divide the area into different units. In this

be able to identify various features on the map. For convenience the conventional signs are given earlier. 3. Picturing the sheet as a whole: Ignoring the details for the time, picture the map as a whole. Do not look too closely at the map but try to have an idea of the most outstanding features of the landscape depicted on it. In the first place you should identify whether the area exhibits one type of physical feature — plain or plateau or hill, etc. If it includes more than one type, try to divide the area into sub- regions so that appropriate and systematic description may be given. For this purpose observe carefully the main river valleys and main contours indicating high and low lands which will enable you to divide the area into different units. In this

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55/121 SUBMITTED TEXT 157 WORDS	94% MATCHING TEXT 157 WORDS
may be noted that the nature of rocks is not legible on such maps, so only by the character of drainage it may merely be hinted whether it is a linestone region of any other region. 4. Observing the relief: After recognising the major units of relief, primary landforms—peaks, ridges, hills, spurs, escarpments, knolls, cols, etc. should be noted as identified. For this trace out important contours on a piece of paper and along suitable lines across them draw one or more profile sections which will give a clear conception of landforms. Drawing of sections to identify landforms is necessary only in the beginning. After a good deal of training and practice, the relief features can be marked only by eye-observation of the map. The profile sections will enable you to use appropriate adjectives to typical features, just as for ridge: long, narrow or board, steep-sided or with gentle slopes —closely spaced contours expressing steep slopes and widely spaced contours indicating gentle slopes; for hills: rounded. 28	may be noted that the nature of rocks is not legible on such maps; so only by the character of drainage it may merely be hinted whether it is a limestone region of any other region. 4. Observing the relief: After recognising the major units of relief, primary landforms — speaks, ridges, hills, spurs, escarpments, knolls, cols, etc., should be noted and identified. For this trace out important contours on a piece of paper and along suitable lines across them draw one or more profile sections (vide Chapter 3) which will give a clear conception of landforms. Drawing of sections to identify landforms is necessary only in the beginning. After a good deal of training and practice, the relief features can be marked only by eye-observation of [he map. The profile sections will enable you to use appropriate adjectives to typical features, just as for ridge: long, narrow or broad, steep-sided or with gentle slopes — closely spaced contours expressing steep slopes and widely spaced contours indicating gentle slopes; for hills: rounded,

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56/121 SUBMITTED TEXT 17 WORDS	70% MATCHING TEXT 17 WORDS
the proportion of the area of the surface at various elevation above or below a given datum.	the proportion of the area of tlie surface at different elevations above or depths below a given datum

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57/121 SUBMITTED TEXT 37 WORDS	100% MATCHING TEXT 37 WORDS
being scratched; ten minerals are selected to measure the degree of hardness from 1-10. They are: 1. talc; 2. gypsum; 3. calcite; 4. fluorite; 5. apatite; 6. feldspar; 7. quartz; 8. topaz; 9. corundum; 10. diamond.	being scratched; ten minerals are selected to measure the degree of hardness from 1-10. They are: • talc; • gypsum; • calcite; • fluorite; • apatite; • feldspar; • quartz; • topaz; • corundum; • Diamond.

W https://blog.forumias.com/question/arrange-the-following-minerals-according-to-their-hardness-in- ...

58/121	SUBMITTED TEXT	37 WORDS	63%	MATCHING TEXT	37 WORDS
Chromite 4.5–4.8 (5.5) Zircon 4.7 (7.5) Molybdnite 4.7–4.8 (1-1.5) Pyrolusite 4.8 (2-2.5) Pyrite 4.8–5.1 (6-6.5) Haematite 4.9–5.3 (5.5-6.5) Magnetite 5.18 (5.5-6.5) Zincite 5.4-5.7 (4-4.5) Cuprite 5.8–6.15 (3.5-4) Arsenopyrite 5.9–6.2 (5.5-6) 5.3.7 Very Heavy Minerals (Sp. Gr. above 6) Cuprite 5.8–6.15 (3.5-4) Wolframite 7.1–7.9 (5-5.5)			Chromite 4.54.8 (5.5) Slronlianile 3.6-3.7 (3.54) Zircon 4.7 (7.5) Limonilc 3.64 (5-5.5) Molybdnitc 4.74.8 (1-1.5) Staurolile 3.7 (7-7.5) Pyrolusite 4.8 (2-2.5) Azuritc 3.7-3.8 (3.54) Pyrite 4.8-5.1 (6-6.5) Sidcrilc 3.7-3.9 (3.54.5) Haematite 4.9-5.3 (5.5- 6.5) Psilomclane 3.74.7 (5-6) Magnetite ^ 5.18 (5.5-6.5) Malachite 3.94 (3.54) Zincite 5.4-5.7 (44.5) Corundum 3.94.1 (9) Cuprite 5.8-6.15 (3.54) Sphalerite 3.94.2 (3.54) Arscnopyrile 5.9-6.2 (5.5-6) Garnet 3.94.2 (6.5-7.5) Very Heavy Minerals (Sp. gr. above 6) Cuprite 5.8-6.15 (3.54)- Wolframite 7.1-7.9 (5-5.5)		

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59/121	SUBMITTED TEXT	20 WORDS	97%	MATCHING TEXT	20 WORDS
The minerals can also be arranged according to their common colours. The arrangement followed here is a modification of Warner's scheme.			The minerals can also be arranged according to their common colours, the arrangement followed j here is a modification of Warner's scheme. \		

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

60/121	SUBMITTED TEXT	19 WORDS	80%	MATCHING TEXT	19 WORDS
Milk-white—slightly Bluish—some chalcedomy. B. Gray i) Green gray—talc. C. Black i) Velvet black—black tourmaline. ii) Greenish black—augite. iii) Bluish black—black cobalt. D. Blue i) Blackish blue—			Milk-white — slightly Bluish — some chalcedony. B. Gray: (i) Green gray — talc. MINERAUj and ROCKS 371 C. Black (i) Velvet black — ^black tourmaline. (it) Greenish black — augite. (Hi) Bluish black — black cobalt. D. Blue (0 Blackish blue —		

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61/121	SUBMITTED TEXT	70 WORDS	79%	MATCHING TEXT	70 WORDS

Azure blue—a clear shade of bright blue-azurite. iii) Violet blue—blue mixed with red-fluorite. iv) Prussian blue—pure, blue—Kyanite. v) Smalt blue—some gypsum. vi) Indigo blue—blue with black and green tourmaline. E. Green i) Verdigris green—green, inclining to bluesome feldspar. ii) Celandine green—green, white blue and gray—talc and beryl. iii) Mountain green—green, with much blue—beryl. iv) Grass green—green, with more yellow-green diallage. v) Pistacho green—light green with some brown epidote. vi) Asparagus greeen—yellowish green-apatite. vii) Blakish green—serpentine. viii) Oil green—olive oil colour—beryl. F. Yellow i) Sulphur yellow—

Azure blue — a clear shade of bright bluc- azuritc. (Hi) Violet blue — blue mixed with red-fluorite (iv) Prussian blue — pure blue — Kyanitc. (v) Smalt blue-some gypsum. (vO Indigo blue — blue with black and green — tourmaline. E. Green (f) Verdigris green — green, inclining to blue- some feldspar. O'O Celandine green — green, white blue and gray — talc and beryl. (Hi) Mountain green — green, with much blue — beryl. (iV) Grass green — green, with more yellow- green diallagc. (v) Pistachio — green — light green with some brown cpidotc. (vf) Asparagus green — ^yellowish green-apatite. (vii) Blackish green — serpentine. (viii) Oil-green — olive oil colour — beryl. F. Yellow (i) Sulphur yellow —

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62/121	SUBMITTED TEXT	7 WORDS	88%	MATCHING TEXT	7 WORDS

Straw yellow—pale yellow—topaz iii) Wax-yellow —brownish gray yellow—sphalerite, opal.

Straw yellow — pale yellow — topaz. (Hi) Wax-yellow — brownish gray yellow — sphalerite, opal. (

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63/121	SUBMITTED TEXT	14 WORDS	78%	MATCHING TEXT	14 WORDS

Honey—yellow, with shads of brown and red—calcite. v) Lemon yellow—sulphur, orpiment. 130

Honey — yellow, with shades of brown and red — calcilc. (v) Lemon yellow — sulphur, orpiment (

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64/121	SUBMITTED TEXT	36 WORDS	92%	MATCHING TEXT	36 WORDS

Ochre—yellow—brownish—yellow—yellow ochre. vii) Wine-yellow—topaz and flourite. viii) Cream yellow —kaolinite. ix) Orange yellow—orpiment. G. Red i) Aurora red—red with much yellow—some realgar. ii) Hyacinth red—red with shades of brown and yellow—garnet. iii) Scarlet red—red with a tinge of yellow—cinnabar. iv) Blood—red—garnet. v) Rose—red—rose quartz. vi) Brownish red—limonite.

Ochre — yellow — brownish yellow — yellow ochre. (v/0 Wine-yellow — topaz and flouriic. (viii) Cream yellow — ^kaolinite. (ix) Orange yellow — orpiment. G. Red (0 Aurora red — red with much yellow — some realgar. (ii) Hyacinth red — ^red with shades of brown and yellow — garnet. (Hi) Scarlet red — ^red with a tinge of yellow — cinnabar. (iv) Blood — red — garnet. (v) Rose — red — rose quartz. (vi) Brownish red — limonite.

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65/121	SUBMITTED TEXT	8 WORDS	100%	MATCHING TEXT	8 WORDS

Brown i) Reddish brown—garnet, zircon. ii) Wood-brown—some asbestos. 5.3.9 Rocks

Brown (i) Reddish brown — ^garnet, zircon. (ii) Wood-brown — some asbestos. Rocks

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66/121	SUBMITTED TEXT	65 WORDS	93%	MATCHING TEXT	65 WORDS

earth's crust and are composed of minerals. A rock may be formed of only one mineral or it may be composed of several minerals. In popular conception the term rock is associated with something hard and heavy but in cientific usage a soft clay is as much a rock as the hard granite. Genetically the rocks may be classified into three major groups. viz. (i) Igneous, (ii) Sedimentary and (

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67/121	SUBMITTED TEXT	18 WORDS	81%	MATCHING TEXT	18 WORDS

commonly massive rocks without showing any tendency of foliation and banding. When metamorphosed they are banded or foliated and

commonly massive rocks with- out showing any tendency of foliation or banding. When metamorphosed they are banded or foliated and

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68/121	SUBMITTED TEXT	51 WORDS	100%	MATCHING TEXT	51 WORDS

more properly called granite-gneiss. The granites are a completely crystalline rock without any glassy matter and the texture varies from fine to coarse. Mineralogically they are composed chiefly of quartz, feldspars, and accessories like biotite muscovite, hornblende, other ferromagnesian minerals and iron oxides. These rocks are named according to the most prominent accessories as biotite-granite,

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69/121	SUBMITTED TEXT	46 WORDS	95%	MATCHING TEXT	46 WORDS

etc. In hand specimen the quartz, feldspar and the chief accessories can be distinguished with the help of a pocket lens. In colour the granites are commonly of shade of gray but pink or red varieties also occur frequently. The colour of the rock depends on the

etc. In hand specimen the quartz, feldspar and the chief acces- sories can be distinguished with the help of a pocket lens. In colour the granites are commonly of shade of gray but pink or red varieties also occur frequently. The colour of the rock depends on the

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70/121	SUBMITTED TEXT	23 WORDS	93%	MATCHING TEXT	23 WORDS

the feldspars to the ferromagnesian minerals and also the colour of the feldspar itself. The specific gravity of the rock varies from 2.63

the feldspars to the ferromagnesian minerals and also the colour of the feldspar itself. The specific gravity MINKRAI^ AND ROCKS 373 of the rock varies from 2.63

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71/121	SUBMITTED TEXT	82 WORDS	92%	MATCHING TEXT	82 WORDS

plutonic mass but are characterized by the presence of large crystals of, say, quartz, fedspars, mica, etc. They also contain minerals which require volatile matter in their formation. e.g., tourmaline, fluorite, topaz, etc. and compounds of rare minerals like lepidolite, beryl, etc. Syenite: It is completely crystalline rock and resembles granite in appearance but it contains very little or no. quartz. In colour it varies from nearly white to light or deep gray, but pink syenites are also not uncommon. The rock is massive and evenly granular. Banding

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72/121	SUBMITTED TEXT	119 WORDS	94%	MATCHING TEXT	119 WORDS

SUBMITTED TEXT	MATCHING TEXT
foliation may be caused due to metamorphism. Mineralogically the typical rock is composed of alkali feldspars, hornblende, with accessories of plagioclase, apatite, magnetite and a little or no quartz. In mica-syenite the hornblende is replaced by biotite and in augite-syenite, augite is the chief ferreomagnesian mineral. In nepheline-syenite nepheline is present along with feldspars. The specific gravity of the rock varies from 2.6 to 2.8 depending on the kind and proportion of minerals. Diorite: It is completely crystalline even to coarse granuled rock. It is generally massive but may be foliated due to metamorphism. The constituent minerals are chiefly plagioclase, with little or no quartz and hornblende along with other ferromagenesian minerals as accessories. Sometimes one of these accessories like augite or biotite might occur in large quantities.	foliation may be caused due to meta- morphism. Mineralogically the typical rock is composed of alkali feldspars, hornblende, with acces- sories of plagioclase, apatite, magnetite and a little or no quartz. In mica-syenite the hornblende is replaced by biotite and in augite-syenite, augite is the chief ferreomagnesian mineral. In nepheline- syenite nepheline is present along with feldspars. The specific gravity of the rock varies from 2.6 to 2.8 depending on the kind and proportion of minerals. Diorite It is completely crystalline even to coarse granuled rock. It is generally massive but may be foliated due to metamporphism. The constituent minerals are chiefly plagioclase, with little or no quartz and hornblende along with other ferromag- nesian minerals as accessories. Sometimes one of these accessories like augite or biotite might occur in large quantities.

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73/121	SUBMITTED TEXT	78 WORDS	98%	MATCHING TEXT	78 WORDS

SUBMITTED TEXT	MATCHING TEXT
colour of the rock varies from shades of dark green to almost black. Since the proportion of ferromagnesian minerals is higher than in case of granite or syenite the rock has a darker colour and a heavier specific gravity varying from 2.85 to 3.0. Gabbro: These are massive even granular rocks typically made up of some of the plagioclases and pyroxenes. Some of these show original banded structure which might get pronounced by metamorphism. The colour vgaries from dark gray, greenish to black but	colour of the rock varies from shades of dark green to almost black. Since the proportion of ferromagnesian minerals is higher than in case of granite or syenite the rock has a darker colour and a heavier specific gravity varying from 2.85 to 3.0. Gabbro These are massive even granular rocks typically made up of some of the plagioclases and pyroxenes. Some of these show original banded structure which might get pronounced by metamorphism. The colour varies from dark gray, greenish to black but

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74/121	SUBMITTED TEXT	21 WORDS	92%	MATCHING TEXT	21 WORDS

SUBMITTED TEXT	MATCHING TEXT
sometimes white or light coloured. Their specific gravity is a little higher than diorities varying from 2.9 to 3.2. Peridotite: These rocks	sometimes white or light coloured. Their specific gravity is a little higher than diorites, varying from 2.9 to 3.2. Peridotite These rocks

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75/121	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

without feldspar and are made up entirely of ferromagnesian minerals. They

without feldspar and are made up entirely of ferromagnesian minerals. They

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76/121	SUBMITTED TEXT	13 WORDS	88%	MATCHING TEXT	13 WORDS

crystalline, massive and sometimes show a mottled appearance (due to poikilitic texture). They

crystalline, massive and sometimes show a mottled appearance (due to poikillitic texture). They

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77/121	SUBMITTED TEXT	14 WORDS	89%	MATCHING TEXT	14 WORDS

generally dark coloured varying from some shades of green (dunite) to complete black. They

generally dark coloured varying from some shades of green (dunitc) to complete black. They

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78/121	SUBMITTED TEXT	53 WORDS	70%	MATCHING TEXT	53 WORDS

heavier than gabbros and the specific gravity varies from 3 to 3.3. 132 CC-GR-02 NSOU Dolerite: It is dark, heavy, finely crystalline dyke rock. Typically it is composed of labradorite, augite and iron oxides, sp. gr. 2.64 to 3.12. Basalts: The basalts are very common volcanic rocks and the term covers many varieties. These

heavier than gabbros and the specific gravity varies from 3 to 3.3. It is dark, hcavry, finely crystalline dyke rock. Typically it is composed of labradorilc, augite and iron oxides, sp. gr. 2.64 to 3.12. Basalts The basalts arc very common volcanic rocks and the term covers many varieties. These

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79/121 SUBMITTED TEXT 340 WORDS	89% MATCHING TEXT 340 WORDS
basic lavas in which plagioclase feldspars and the ferromagnesian minerals occur in almost equal proportions. There may be a little quartz and alkali feldspar also. The ferromagnesian mineral is either augite or olivine and iron oxide. Sometimes hornblende or biotite also occur. In colour the basalts vary from gray black to black and rather dull in appearance. Gellular and amygdaloidal structures are common and less fewquently the rock is porphyritic showing large crystals of plagioclase in a fine ground mass. The specific gravity is high varying from 2.9 to 3.1. Rhyolete: It is the volcanic equivalent of granite. The texture is generally prophyritic, i.e., large crystals of quartz and orthoclase embedded in a partly crystalline or glassy ground mass. Obsidian is the pure glassy variety with a bright vitreous lustre. It is jet black to red colour and has conchoidal fracture. Many pitchstones have a rhyolitic composition and show homogeneous glassy mass with a dull or resinous lustre. The colour varies from black to red brown or green. The specific gravity varies from 2.30 to 2.70. Pumice: It is an extremely porous and cellular glassy rock. The colour is generally white or gray but darker varieties also occur. Title: These rocks have been formed by the denudation of pre-existing rocks and the deposition and consolidation of the denuded material in water or air. The sedimentary rocks are characterized by startification. ii) Sandstone: It is a rock made up of sand grains held together by some cementing materials like silica, iron oxide or lime. Some sandstones contain little cementing substance and their tenacity is due to the presure during the time of consolidation. Apart from sand the minor constituents are feldspar, mica, garnet, magnetite, etc. The size of the grains varies very widely. In the fine grained types the sand particles are generally anugular but in the coarser varieties the sand particles are well rounded. Bedded or cross-bedded structures are well marked. The colour varies widely from gray, white buff, brown to red depending primarily on the colour of the cementing material. Shale: These are finely startified rocks and are compacted muds, clays or silts. Sometimes the shales are so finely startified that each laminate is no thicker than a	basic lavas in which plagioclase feldspars and the ferto- magnesian minerals occur in almost equal propor- tions. There may be a litlc quartz and alkali fcld.spar also. The ferromagnesian mineral is cither augite or olivine and iron oxide. Sometimes hypcrsthcnc, horn- blende or biotite also occur. In colour the basalts vary from gray black to black and rather dull in ap- pearance. Cellular and amygdaloidal structures arc common and less frequently the rock is porphyritic showing large crystals of plagioclase in a fine ground mass. The specific gravity is high varying from 2.9 to 3.1. Ryholite It is the volcanic equivalent of granite. The 374 ELEMENTS OF PRACTICAL GEOGRAPHY texture is generally prophyritic, i.e., large crystals of quartz and orthoclase embedded in a partly ciystalline or glassy ground mass. Obsidian is the pure glassy variety with a bright vitreous lustre. It is jet black to red colour and has conchoidal fracture. Many pitchstones have a rhyolitic composition and show homogeneous glassy mass with a dull or resinous lustre. The colour varies from black to red brown or green. The specific gravity varies from 2.30 to 2.70. Pumice It is an extremely porous and cellular glassy rock. The colour is generally white or gray but darker varieties also occur. Sedimeatary These rocks have been formed by the denudation of pre- existing rocks and the deposition and con- solidation of the denuded material in water or air. The sedimentary rocks are characterised by stratification. Sandstone It is a rock made up chiefly of sand grains held together by some cementing material like silica, iron oxide or lime. Some sandstones contain little cementing substance and their tenacity is due to the pressure during the time of consolidation. Apart from sand the minor constituents are feldspar, mica, garnet, magnetite, etc. The size of the grains varies very widely. In the fine grained types the sand particles are generally anugular but in the coarser varieties the sand particles are well rounded. Bedded or cross-bedded structures are well marked. The colour varies widely from gray, white buff, brown to red depending primarily on the colour of the cementing material. Shares These are finely stratified rocks and are com- pacted muds, clays or silts. Sometimes the shales are so finely stratified that each laminate is no thicker than a

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80/121	SUBMITTED TEXT	135 WORDS	100% MATCHING TEXT	135 WORDS
sheet of paper. Apart from clay which is chiefly kaolin the shales contain varying proportions of sand and also calcareous matter and with the increase in the proportion of sand degrade into fine grained sandstone and with increase of calcareous matter they pass into limestone. Most shales are soft and disintegrate into small fragments. These occur in various shades of colour—gray, buff, yellow, red, brown, purple, green or black. Limestone: It is a widely distributed rock and is chiefly composed of calcite with varying proportions of silica or clay as impurities. In grain size it varies from a finely granular rock to a rock composed of coarse fragments of shells and corals. The rock shows a wide range of colours. It is white when pure and impure varieties vary from gray to black. The rock can be easily scratched with a knife and it effervesces			sheet of paper. Apart from clay which is chiefly kaolin the shales contain varying proportions of sand and also calcareous matter and with the increase in the proportion of sand degrade into fine grained sandstone and with increase of calcareous matter they pass into limestone. Most shales are soft and disintegrate into small fragments. These occur in various shades of colour — ^gray, buff, yellow red, brown, purple, green or black. Limestone It is a widely distributed rock and is chiefly composed of calcite with varying proportions of silica or clay as impurities. In grain size it varies from a finely granular rock to a rock composed of coarse fragments of shells and corals. The rock shows a wide range of colours. It is white when pure and impure varieties vary from gray to black. The rock can be easily scratched with a knife and it effervesces	

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81/121	SUBMITTED TEXT	147 WORDS	93% MATCHING TEXT	147 WORDS
acid. The specific gravity of the rock varies from 2.5 to 2.8. Breccia: A rock composed of cemented stone fragments. The fragments are angular and typically do not show any stratification. These fragments may be of any kind of rock. The colour of the rock varies widely depending on the constituents. Conglomerate: This rock is entirely of an aqueous origin. It consists of rounded water-worn pebbles cemented together. The size of the pebbles varies widely. The pebbles may be entirely of one rock but more commonly they are fragments from different rocks. The colour and texture present a heterogeneous appearance. iii) Metamorphic: These rocks were originally sedimentary or igenous and their present state is due to a change brought about by intense heat and/or pressure. Quartzite: These are chiefly formed by the metamorphism of standstone. It is fine to coarse grained rock and is hard and compact. The colour varies widely—white, gray, yellowish, greenish or reddish. Broken surfaces show			acid. The specific ^vily of the rock varies from 2.5 to 2.8. Breccia A rcick composed of cemented stone fragments. The fragments are angular and typically do not show any stratification. These fragments may be of any kind of rock. The colour of the rock varies vddely depending on the constituents. Conglomerate This rock is entirely of an aqueous origin. It consists of rounded water-worn pebbles cemented together. The size of the pebbles varies widely. The pebbles may be' entirely of one rock but more commonly they are fragments from different rocks. The colour and texture presents a heterogeneous appearance (Fig. 369). Metamorphic These rocks were originally sedimentary or igneous and their present state is due to a change brought about by intense heat and/or pressure. Quartzite These are chiefly formed by the metamorphism of sandstone. It is fine to coarse grained rock and is hard and compact The colour varies widely-white, gray, yellowish, greenish or reddish. Broken surfaces show	

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82/121	SUBMITTED TEXT	39 WORDS	88%	MATCHING TEXT	39 WORDS

lustre and conchoidal fracture. Slate: It is a fine grained hard and dense rock derived chiefly from the metamorphism of shales. The rock is cleavable into very thin laminae. The cleavage surface may be lustrous or dull, smooth or complicated but sometimes

lustre and conchoidal fracture. MINERALS AND ROCKS 375 Slates It is a fine grained hard and dense rock derived chiefly from the metamorphism of shales. The rock is cleavable into very thin laminae. The cleavage surface may be lustrous or dull, smooth or complicat- ed but sometimes

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83/121	SUBMITTED TEXT	164 WORDS	85%	MATCHING TEXT	164 WORDS

also knotty due to graines of pyrite or magnetite. The colour is generally gray to black but red, purple of green slates also occur. The specific gravity is about 2.75. Marble: It is a metamorphic form of limestone. The rock is massive and has generally an even-grained texture. The endless varieties of coloured marble are due to the presence of impurities in the original rock. Black marbles are produced from 134 CC-GR-02 NSOU bituminuous limestone. The red, brown and yellow varieties are due to disseminated iron compounds. Gneiss: It is compact, completely crystalline, coarsely foliated rock. The darker bands are composed of ferromagnesian minerals and the light bands are commonly a mixture of quatz and feldspar. These bands may be regular or curved and contorted. The lines may be continuous or short and penticular. The colour varies from white through shades of gray, red, brown, green to nearly black. The rocks are named either according to chief ferromagnesian mineral as hornblende-gneiss, biotite-gneiss, augite- gneiss, etc., or after the parent rock as granite-gneiss. syen.te-geniss. etc. Schists:

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84/121	SUBMITTED TEXT	90 WORDS	96%	MATCHING TEXT	90 WORDS

characterised by marked foliation along which they split readily. The rocks are completely crystalline and individual minerals are large enough to be visible, but sometimes the grain size is very fine. The colour varies widely according to the ferromagnesian minerals: mica-schists-may be gray to brown, chlorite-schists— shades of green, hornblede-schists—from green to black; talc-shists—light white to pale green or gray. Phyllite: These also show a slaty cleavage but are characterised by the presence of mica and the latter gives the rock a silvery appearance. Sometimes the cleavage face is knotted by crystals of garnet, quartz, pyrite. etc. 5.3.10

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85/121	SUBMITTED TEXT	24 WORDS	90%	MATCHING TEXT	24 WORDS

b) Ferromagnesian rock, generally dark in colour to black in colour with quartz without quartz with subordinate feldspar, without feldspar Non- Granite Syenite Diorite Peridotite

b) Ferromagnesian rock, generally light in colour dark to black in colour with quartz without quartz with subordinate Feldspar, without Feldspar Non-porphyrtitic Granite Syenite Diorite Peridotite (

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86/121	SUBMITTED TEXT	48 WORDS	73%	MATCHING TEXT	48 WORDS

B. Dense, constituents nearly or wholly unrecognizeable— Instrusive and Extrusive (a) Light, colour, usually Feldspathic (b) Dark coloured to black, usually ferromagensian Non- Felsite Basalt Porphyritic Porphyritic Felsiteprophyry Basalt-porphyry C. Rocks composed wholly or in part of glass—Extrusive Non-porphyritic obsidian, pitchstone, perlites, pumice, etc. Porphyriotic vitrophyre (obsidian and pitchstone porphyry) Fragmental Igneous material—Extrusive Tuffs, Breceias (volcanic ashes, etc.) 136

B. Dense, constituents nearly or wholly unrecognizeable. Instrusive and Extrusive Non-porphyritic Porphyritic (a) Light colour, usually (b) Dark coloured to black, usually Feldspathic- ferromagnesian Felsite Basalt Felsitcporphyry Basalt-^rphyry , C. Rocks composed wholly or in part of glass. Extrusive Non-porphyritic obsidian, pitchstone, perlites, pumice, etc. Porphyritic vitrophyre (obsidian and pitchstone porphyry) Fragmental Igneous material. Extrusive Tuffs, Breccias (volcanic ashes, etc.)

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87/121	SUBMITTED TEXT	216 WORDS	96%	MATCHING TEXT	216 WORDS

The slope of land in degrees can be fdound with the help of a clinometer. As already explained, if the slope is 1° a Vertical Interval (V.I.) of 1 foot corresponds to a Horizontal Interval (H.I.) of 57.3 feet, or about 20 yards, so that we get the relation: Where D = degree of slope. If a land with uniform slope of 5° is to be contoured at vertical intervals of 10 feet then the H.I. will be = yards. That is the contour lines are to be drawn 40 yards apart. In other words the land rises 10 feet vertically in a horizontal distance of 40 yards. To minimise calculation a scale can be prepared for a given V.I. to show H.I. corresponding to different degrees of slope. Supposing a hillock is to be contoured at 10 feet interval with a clinometer. First, one contour line is established round the eminence a little below the summit at a distance less than 10 feet. To level a line round the hill marking the position of the first contour a piece of cloth is tied round a ranging rod at a height equal to the height of the eye of the observer with the clinometer. The ranging rod is moved about and with the clinometer at zero a number of positions are fixed by noting the cloth mark on the rod.

The slope of land in degrees can be found with the help of a clinometer. As already explained, if the slope is 1° a Vertical Interval (V.I.) of 1 foot corresponds to a Horizontal Interval (H.I.) of 57.3 feel, or about 20 yards, so that we get the relation; H.I where D— degree of slope. If a land with uniform slope of 5° is to be contoured at vertical intervals of 10 feet then the 20 X 10 H.I. will be = — ^ — = 40 yards. That is the contour lines are to be drawn 40 yards apart. In other words the land rises 10 feet vertically in a horizontal distance of 40 yards. To minimise calculation a scale can be prepared for a given V.I. to show H.I. corresponding to different degrees of slope. Supposing a hillock is to be contoured at 10' interval with a clinometer. First, one contour line is established round the eminence a little below the summit at a distance less than 10 feet. To level a line round the hill marking the position of the first 340 ELEMENTS OF PRACTICAL GEOGRAPHY contour a piece of cloth is tied round a ranging rod at a height equal to the height of the eye of the observer with the clinometer. The ranging rod is moved about and with the clinometer at zero a number of positions are fixed by noting the cloth mark on the rod.

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88/121	SUBMITTED TEXT	22 WORDS	80%	MATCHING TEXT	22 WORDS

Rock strata may be bent or folded into a series of troughs or downfolds or arches or upfold due to horizontal compressional forces.

Rock strata may be bent or folded into a scries of troughs or downfolds and arches or upfolds due to horizontal comprcssional forces.

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89/121	SUBMITTED TEXT	12 WORDS	87%	MATCHING TEXT	12 WORDS

The imaginary surface about which folding occurs is axial plane of fold.

The imaginary surface about which folding occurs is called the axial plane of the fold.

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90/121	SUBMITTED TEXT	30 WORDS	48%	MATCHING TEXT	30 WORDS

The beds on either side of fold is called limbs. e) The fold in which limb dip towards the axial plane is a syncline. f) The fold in which limbs dip

the beds on either side of the axial plane form the limbs of the fold. A fold in which the limbs dip towards the axial plane is a syncline, and one in which they dip

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91/121	SUBMITTED TEXT	44 WORDS	76%	MATCHING TEXT	44 WORDS

A rock series may be broken or fractured due to stresses setup in the Earth's crust by the tectonic forces and they are accompanied by dislocation or relative movement of strata on either side, the rocks are said to be faulted, fracture called fault and surface

A rock series may be broken or fractured due to the stresses set up in the earth's crust by the tectonic forces. When a fracture is accompanied by dislocation or relative movement of strata on either side, the rocks are said to be faulted, and the fracture is called a fault. The surface

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92/121	SUBMITTED TEXT	30 WORDS	65%	MATCHING TEXT	30 WORDS

Reading a Weather Map 2.8 Some notes on the Weather Maps of India 2.9 Metric Units for Weather Reports 2.10 Weather Map Interpretation 2.10.1 Introduction 2.10.2 Pressure 2.10.3 Wind Condition 2.10.4 Sky Condition 2.10.5 Rainfall / Precipitation 2.10.6 Pressure-

Reading a Weather Map. Some Notes on the Weather Maps of India. Metric Units for Weather Reports. Cyclonic Storms — Depressions — Thunder Storms. Examples I, Pressure, Wind, Sky Condition, Precipitation, Pressure

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93/121	SUBMITTED TEXT	31 WORDS	95%	MATCHING TEXT	31 WORDS

A weather map is the representation of the weather of a portion of the earth or a part of it on a flat surface. The term weather denotes, the condition of

A weather map is the representation of the weather of a portion of the earth or part of it on a flat surface. The term weather denotes the condition of

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94/121	SUBMITTED TEXT	46 WORDS	96%	MATCHING TEXT	46 WORDS

Thus, we can define a weather map as a map of the world or part of it showing at a stated time numerically and with the help of symbols. The temperature and pressure conditions and direction and velocity of wind, humidity, clouds, visibility, nature and amount of precipitation

Thus we can define a weather map as a map of the WOTld or part of it showing at a stated time numerically and with the help of symbols the temperature and pressure conditions, and direction and velocity of wind, humidity, clouds, visibility, nature and amount of precipitation.

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95/121	SUBMITTED TEXT	48 WORDS	78%	MATCHING TEXT	48 WORDS

It is obvions that the recently of having a weather map was felt most by sailors. In 1699, Edmund Hallay published a map for 30°N and 30°S latitudes which showed trade wind and the direction of the prevailing monsoon. These map can not be taken to be a typical weather

It is obvious that the necessity of having a weather map was felt most by sailors. In 1688 Edmund Halley published a map for 30* N and 30" S latitudes which showed trade winds and the direction of the prevailing monsoon. This map cannot be taken to be a typical weather

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96/121	SUBMITTED TEXT	74 WORDS	95%	MATCHING TEXT	74 WORDS

because it denotes the weather condition over a period of time. For preparation of a weather map showing the weather elements at different places for a particular point of time, a quick system of sending information was necessary. Thus with the advent of electric telegraph it became popular to prepare such weather maps. With further improvements in the system of news transmission by the wireless telegraph weather information from a large area could be gathered at a central stations. The

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97/121	SUBMITTED TEXT	55 WORDS	100%	MATCHING TEXT	55 WORDS

Weather Symbols On weather maps for the sake of convenience, rainfall and other elements of weather are represented by symbols or abbreviation of names. Such a system was devised by Admiral Beaufort in 1806 and was later modified by him in 1830. The same table is even now being used with a few additions (Table). Beaufort Notation: b : blue sky—

Weather Symbols On weather maps for the sake of convenience, rainfall and other elements of weather are represented by symbols or abbreviation of names. Such a system was devised by Admiral Beaufort in 1806 and was later modified by him in 1830. The same table is even now being used with a few additions (Table 2). Beaufort Notation b : blue sky —

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98/121	SUBMITTED TEXT	9 WORDS	100%	MATCHING TEXT	9 WORDS

partly cloudy-one-half covered. 186 c : generally cloudy —detached opening

partly cloudy — one-half covered. c : generally cloudy — detached opening

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99/121 SUBMITTED TEXT 33 WORDS	85% MATCHING TEXT 33 WORDS
d : drizzle. e : wet air without rain falling, a copious deposit of w3ater on trees, buildings, etc. f : fog, visibility 22-1,100 yd. fe : wet fog. fs : fog over sea (coast station). fg :	d : drizzle. e : wet air without rain falling, a copious deposit of water on trees, buildings, etc. f : fog, visibility 220 — 1,100 yd. ’ fc : wet fog. fs : fog over sea (coast station). fg :

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

100/121 SUBMITTED TEXT 33 WORDS	95% MATCHING TEXT 33 WORDS
on lower ground (inland station). F : thick fog, visibility less than 220 yd. g : gloom. h : hail. i : intgermittent. jp : precipitation within sight of station. ks : storm of drifting snow. KQ : line	on lower ground (inland station). F ; thick fog, visibility less than 220 yd. g : gloom, h : hail, i : intermittent. jp : precipitation within sight of station, ks : storm of drifting snow. KQ : line

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

101/121 SUBMITTED TEXT 59 WORDS	92% MATCHING TEXT 59 WORDS
e., the whole sky covered with one impervious cloud. p : passing showers. q : squalls. r : rain. s : snow. t : thunder. tl : thunderstorm. u : ugly threatening sky. v : unusual visibility of distant objects. w : dew. x : hoar-frost. y : dry air—less than 60 per cent humidity. z : haze, range of visibility 1,100 yd or more but less than 2,200 yd. 187	e., the whole sky covered with one impervious cloud, p : passing showers, q : squalls, r : rain, s : snow, rs : sleeL l : thunder, tl : thunderstorm, u : ugly threatening sky. V : unusual visibility of distant objects, w : dew. X : hoar-firost. y : dry air — less than 60 per cent humidity, z : haze, range of visibility 1,1(X) yd or more, but less than 2,200 yd.

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102/121 SUBMITTED TEXT 52 WORDS	75% MATCHING TEXT 52 WORDS
Table : Forms of Meteorological Symbols approved by the International Meteorological Organisation, Warsaw, 1935 Pure air Shower of Snow Hoar Frost Haze Shower of Rain Glazed Frost Mist Snow (Sleet) Soft Rime Fog v > lkm Soft Hail Hard Rime Shallow Fog Small Hail Gale Ground Fog Hail Sunshine Frost Fog Distant Lightning Solar Halo Drizzle Thunderstorm Lunnar Halo Rain Drifting Snow Solar Corona (	Table 2. Form of Meteorological Symbols approved by the International Meteorological Organization, Warsaw, 1935 0 Pure air Shower of Snow i 1 Hoar Frost oo Haze V Shower of Rain & OO Glazed Frost — Mist Snow (Sleet) V Soft Rime = Fog V > 1km Soft Hail V Hard Rime E= Shallow Fog A Small Hail Gale — Ground Fog A Hail o Sunshine Frost Fog > Disumt Lighming © Solar Halo 9 Drizzle R Thunderstorm © Lunar Halo • Rain + Drifting Snow (High up) 0 Solar Corona

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

103/121 SUBMITTED TEXT 17 WORDS	43% MATCHING TEXT 17 WORDS
High up) Snow Snowstorm Lumar Corona Sle Drifting Snow Rainbow Granular Snow (Near the Ground) Aurora Borealis Grains of Ice Dust or Sandstorm Mirage Ice Needles Dust Devil Zodiacal Light Shower of Rain	High up) 0 Solar Corona Snow Snowstorm VO/ Lunar Corona Sleet Drifting Snow (Near the Ground) Rainbow A Granular Snow s- Dust or Sandstorm Aurora Borealis A Grains of Ice I Dust Devil <>o> Mirage Ice Needles "!i Snow Lying Zodiacal Light V Shower of Rain

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

104/121 SUBMITTED TEXT 14 WORDS	100% MATCHING TEXT 14 WORDS
Capital letters indicate intensity of the phenomenon, and slight intensity by a small suffix	Capital letters indicate intensity of the phenomenon, and slight intensity by a small suffix

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

105/121 SUBMITTED TEXT 184 WORDS	91% MATCHING TEXT 184 WORDS
Repetition of letters indicate continuity and intermittence by prefixing the letter i. Thus: R : heavy rain. r : (moderate) rain. or : slight rain. RR : continuous heavy rain. rr : continuous (moderate) rain. iro : intermittent slight rain. Actual existing weather is demarcated from preceding conditions by a 'solidus', thus, b/r, blue open sky after rain. The sign (–) indicates decrease in the intensity of the particular phenomenon and the sing (+) indicates increase in intensity. A symbol 188 enclosed within brackets thus: (1) indicates the occurrence of the phenomenon in the vicinity of the station. Indices 0, 1, 2 may be used to denote intensity. On weather maps in addition to the above observations generally the barometric tendency is also indicated. The stations which are equipped with barographs report the amount and nature of change in pressure in the three hours preceding the time of observation. This rise or fall in pressure is known as the barometric tendency and the nature of the change, whether the fall or rise was continuous or there was first a fall and then a continuous rise or any other variety of change, is known as the "characteristic" which is also reported. If lines	Repetition of letters indicate continuity and intermittcnce by prefixing the letter i. Thus : R : heavy rain, r : (moderate) rain, or : slight rain. RR : continuous heavy rain, rr ; continuous (moderate) rain, iro : intermittent slight rain. Actual existing weather is demarcated from preceding conditions by a 'solidus', thus; b/r, blue open sky after rain. The sign (—) indicates decrease WEATHER MAP 127 in the intensity of the particular phenomenon and the sign (+) indicates increase in intensity. enclosed within brackets thus: (1) indicates the occurrence of tlie phenomenon in the vicinity of the station. Indices o, 1,2, may be used to denote intensity. On weather maps in addition to the above observations generally the barometric tendency is also indicated. The stations which arc equipped with barographs report the amount and nature of change in pressure in the three hours preceding the time of observation. This rise or fall in pressure is known as the barometric tendency and the nature of the change, whether the fall or rise was continuous or there was first a fall and then a continuous rise or any other variety of change, is known as the "characteristic" which is also reported. If lines

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

106/121	SUBMITTED TEXT	32 WORDS	91%	MATCHING TEXT	32 WORDS

Submitted text	Matching text
drawn through places having the same tendency we get what are known as isallobars. In modern weather maps the type of cloud and the individual amounts of different types are also indicated by symbols. 2.7	drawn through places having the same tendency we get what are known as isallobars. In modem weather maps the type of cloud and the individual amounts of different types arc also indicated by symbols.

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

107/121	SUBMITTED TEXT	60 WORDS	96%	MATCHING TEXT	60 WORDS

Submitted text	Matching text
Reading a Weather Map Before proceeding to read the Indian Daily Weather Map one should get familiar with the various symbols used on such maps. The following points are to be described while reading the weather map : 1. Pressure (a) location of bar high, (b) location of bar low, (c) trend of isobars, (d) gradient of pressure. 2. Wind (a) direction, (b) velocity. In relation to pressure variation. 3. Sky condition (	Reading a Weather Map Before proceeding to read the Indian Daily Weather Map one should get familiar with the various symbols used on such maps. The following points are to be described while reading the Weather map: 1. Pressure (a) location of bar high, WEATimR MAP 145 (b) location of bar low, (c) trend of isobars, (d) gradient of pressure. 2. Wind (a) direction, (b) velocity. In relation to pressure variation. 3. Sfy condition {

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108/121	SUBMITTED TEXT	168 WORDS	99%	MATCHING TEXT	168 WORDS

Submitted text	Matching text
cloud cover, (b) nature of the cloud, (c) other atmospheric phenomena. 4. Precipitation (a) general distribution. (b) special area of heavy precipitation. 189 5. Pressure departure from normal 6. Temperature departure from normal 7. Sea-condition 2.8 Some Notes on the Weather Maps of India With a view, to making improvements in the representation of weather conditions several changes have been introduced in the 'Weather Reports of India' in recent years. Up to the end of the year 1948 the weather maps in the 'Reports' used to show (a) pressure in the millibars, (b) wind direction and speed in miles, (c) rainfall in inches and sea. condition. There was, thus, no indication of clouds cover on the weather- maps. The symbols used were also different from those of later weather maps. On 1st January, 1949 various new informations regarding cloud cover and other atmospheric phenomena were introduced. The new maps, thus, gave a better picture of the weather conditions than the old maps. Further modifications, though only minor, have been made since January 1, 1957 so as to represent more clearly the wind condition on the. weather- maps. 2.9	cloud cover, (b) nature of the cloud. (c) other atmospheric phenomena. 4. Precipitation (a) general distribution, (b) special area of heavy precipitation. 5. Pressure departure from normal 6. Temperature departure from normal 1. Sea-condition Some Notes on the Weather Maps of India With a view to making improvements in the representation of weather conditions several changes have been introduced in the 'Weather Reports of India' in recent years. Up to the end of the year 1948 the weather maps in the 'Reports' used to show (a) pressure in the millibars, (b) wind direction and speed in miles, (c) rainfall in inches and sea-condition. There was, thus, no indication of cloud cover on the weather-maps. The symbols used were also different from those of later weather maps. On 1st January, 1949 various new informations regarding cloud cover and other atmospheric phenomena were introduced. The new maps, thus, gave a better picture of the weather conditions than the old maps. i Further modifications, though only minor, have been made since January 1, 1957 so as to represent more clearly the wind condition on the weather-maps.

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109/121	SUBMITTED TEXT	114 WORDS	96%	MATCHING TEXT	114 WORDS

Metric Units for Weather Reports From 1st January, 1957 weather reports in India are giving rainfall in millimetres, temperatures in degrees centigrade and cloud heights and distances of visibility in metres and so on. Wind speed generally meant for navigational purposes will continue to be printed in knots as hitherto, while those for other purposes will be expressed in kilometres per hour, consequently an inch of rainfall at any station will be reported as 25.4 millimetres of rainfall; 2 inches as 51 millimetres and so on. The conversion is very simple being proportional at a rate one inch = 25.4 millimetres. In the case of temperature, the conversion is not so simple. To convert degrees Fahrenheit to degrees Centigrade, equations are used. 190

Metric Units for Weather Reports From 1st January, 1957 weather reports in India arc giving rainfall in millimetres, temperatures in degrees centigrade and cloud heights and distances of visibility in metres and so on. Wind speed generally meant for navigational purposes will continue to be printed in knots as hitherto, while those for other purposes will be expressed in kilometres per hour, consequently an inch of rainfall at any station will be reported as 25.4 nnllimetres of rainfall; 2 inches as 51 millimemcs and so on. The conversion is very simple being proportional at a rate one inch = 25.4 millimetres. In the case of temperature, the conversion is not so simple. To convert degrees Fahrenheit to degrees Centigrade, equations are used.!

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110/121	SUBMITTED TEXT	12 WORDS	95%	MATCHING TEXT	12 WORDS

Wind Direction: In keeping with the general law of wind motion,

Wind (a) Direction: In keeping with the general law of wind motion

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111/121	SUBMITTED TEXT	27 WORDS	54%	MATCHING TEXT	27 WORDS

Very rarely uncomfortable Below 45°F (ii) Ideal 45° - 55°F (iii) Rarely uncomfortable 55° – 60°F (iv) Sometimes uncomfortable 60° – 65°F (v) Often uncomfortable 65° – 70°F (vi) Usually uncomfortable

very rarely uncomfortable; 45° F — 55° F ideal; 55° F — 60° F very rarely uncomfortable; 60° F — 65° F sometimes uncomfortable 65° F — 70° F often comfortable; 70° F — ^75° F, usually uncomfortable.

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112/121	SUBMITTED TEXT	25 WORDS	90%	MATCHING TEXT	25 WORDS

J F M A M J J A S O N D Wet-Bulb 33.6 36.3 42.2 50.2 59.2 65.7 68.9 67.9 64.4 54.9 45.4 38.5 Temp. (°

J F M A M J J A S 0 N D Wet-bulb Temp.

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113/121	SUBMITTED TEXT	14 WORDS	90%	MATCHING TEXT	14 WORDS

J F M A M J J A S O N D Wet-Bulb Temp. (°

J F M A M J J A S 0 N D Wet-bulb Temp.

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114/121	SUBMITTED TEXT	17 WORDS	73%	MATCHING TEXT	17 WORDS

Climograph of Kolkata: Month J F M A M J J A S O N D Wet-Bulb Temp. (°

climograph of Calcutta. Table 9 Months J F M A M J J A S 0 N D Wet-bulb Temp.

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115/121	SUBMITTED TEXT	14 WORDS	90%	MATCHING TEXT	14 WORDS

J F M A M J J A S O N D Wet-Bulb Temp. (°

J F M A M J J A S 0 N D Wet-bulb Temp.

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116/121	SUBMITTED TEXT	14 WORDS	90%	MATCHING TEXT	14 WORDS

J F M A M J J A S O N D Wet-Bulb Temp. (°

J F M A M J J A S 0 N D Wet-bulb Temp.

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117/121	SUBMITTED TEXT	14 WORDS	90%	MATCHING TEXT	14 WORDS

J F M A M J J A S O N D Wet-Bulb Temp. (°

J F M A M J J A S 0 N D Wet-bulb Temp.

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118/121	SUBMITTED TEXT	14 WORDS	90%	MATCHING TEXT	14 WORDS

J F M A M J J A S O N D Wet-Bulb Temp. (°

J F M A M J J A S 0 N D Wet-bulb Temp.

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119/121	SUBMITTED TEXT	14 WORDS	90%	MATCHING TEXT	14 WORDS

J F M A M J J A S O N D Wet-Bulb Temp. (°

J F M A M J J A S 0 N D Wet-bulb Temp.

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120/121	SUBMITTED TEXT	25 WORDS	87%	MATCHING TEXT	25 WORDS

J 16 3.0 F 18 12.0 M 22 14.0 A 25 140.0 M 27 400.0 J 28 1021.0 J 27 918.0 A 27 605.0 S 26 415.0 O 25 142.0 N 21 59.0 D 19 0.0

J F M A M J J A S 0 N D

W https://archive.org/stream/in.ernet.dli.2015.132129/2015.132129.Elements-Of-Practical-Geography_d ...

121/121	SUBMITTED TEXT	27 WORDS	87%	MATCHING TEXT	27 WORDS

J 18 4.0 F 19 25.0 M 24 8.0 A 30 71.0 M 31 121.0 J 31 170.0 J 30 318.0 A 29 165.0 S 28 302.0 O 27 41.0 N 23 0.0 D 19 0.0 224 6.4

J F M A M J J A S 0 N D

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PREFACE In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. core, generic, discipline specific elective, ability and skill enhancement for graduate students of all programmes at Honours level. This brings in the semester pattern which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. I am happy to note that the university has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade "A". UGC (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for U.G. programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Material (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English/Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor

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Unit 1 ?Earth's Tectonic And Structural Evolution With Reference To Geological Time Scale Structure 1.0 Objectives 1.1 Introduction 1.2 Dating Techniques 1.3 Division of Time in GTS 1.4 History of GTS 1.5 Geological and Biological Events of GTS 1.5.1 Precambrian Supereon 1.5.2 Phanerozoic Eon 1.5.2.1 Paleozoic Era 1.5.2.2 Mesozoic Era 1.5.2.3 Cenozoic Era 1.6 Significance of GTS 1.7 Summary 1.8 Questions 1.0 Ovjectives ? The learners will learn about the tectonic and structural evolution of the earth ? To learn about the different Era's ? To learn about the geological Time Scale 1.1 Introduction The geologic time scale (GTS) is an arbitrary chronological arrangement or sequence of geologic events that relates geological strata to time. The Geologic Time Scale (GTS) is used as a measure of the relative or absolute duration or age of any part of geologic time and is used by geologists, paleontologists, and other Earth scientists to describe the timing and relationships of events that have occurred during Earth's history. GTS is an internationally developed and agreed scheme of subdividing the passage of time since the origin of Earth. The original structure of GTS was developed during the late nineteenth to early twentieth century. The geological time 7

NSOU ? CC-GR-03 8 scale is currently maintained by the International Commission on Stratigraphy (ICS), which is part of the International Union of Geological Sciences (IUGS). The time scale is continuously being updated as we learn more about the timing and nature of past geological events. Today, the geologic time scale is hierarchically divided (from largest to smallest) into Eons, Eras, Periods, Epochs, and Ages. The corresponding rocks that represent these subdivisions are referred to as Eonothems, Erathems, Systems, Series, and Stages. Geologic Time Scale divisions mark major events which highlight changes in climate, geography, atmosphere, and life. 1.2 Dating Techniques Geologists often need to know the age of ancient rocks and fossils of the living organism that they find. There are two types of age determination methods—1) Relative dating and 2) Absolute dating. • Relative Dating Geologists in the late 18th and early 19th century studied rock layers and the fossils in them to determine relative age. William Smith was one of the most important scientists who helped to develop knowledge 01 the succession of different fossils by studying their distribution through the sequence of sedimentary rocks in southern England. 'Relative age' means the age of one object compared to the age of another, not the exact age of an object. This method can only be used when the rock layers are in their original sequence. Most common relative dating techniques are stratigraphy and bio-stratigraphy which are only used to know which of the object is older or younger. So, the relative dating is less advanced technique as compared to the absolute dating. • Absolute Dating The absolute dating is the technique which tells about the exact age of the artifact or the site using different modern methods. The absolute dating is also known as the numerical dating as it comes up with the exact numerical age of the item. Modern geologists use a variety of techniques to establish absolute age, including radiometric dating, tree rings, ice cores, and annual sedimentary deposits. Radiometric dating is the most useful of these techniques—it is the only technique that can establish the age of objects older than a few thousand years. Unlike relative dating, which relies on sequencing of rock layers (i.e. younger vs. older), absolute dating can produce an actual age in years. The table below shows characteristics of some common radiometric dating methods.

NSOU ? CC-GR-03 9 Table 1.1 : Different dating Method Dating method Material dated Age range dated Carbon-14 to nitrogen-l4 Organic remains, Up to 70,000 years ago (radiocarbon) archaeological artifacts Luminescence Tephra, loess, lake Up to 100,000 years ago sediments Fission track Tephra 10,000 to 400 million years ago Potassium-40 to argon-40 Volcanic rocks 20,000 to 4.5 billion years ago Uranium-238 to lead-206 Volcanic rocks I million to 4.5 billion years ago • Isotopic Dating Methods Absolute age can be determined by using radiometric dating. It was only in the early part of the 20th century, when isotopic dating methods were first applied, that it became possible to discover the absolute ages of the rocks containing fossils. Isotopic dating of rocks, or the minerals in them, is based on the decaying rates of certain unstable isotopes of elements. Decaying rates of elements have been constant over geological time. It is also based on the premise that when the atoms of an element decay within a mineral or a rock, they stay there and don't escape to the surrounding rock, water, or air. Elements are defined by the number of protons and neutrons in the atomic nucleus. The mass of a neutron is almost identical to that of a proton. When an element's atoms have different numbers of neutrons they are said to be isotopes of that element. Some isotopes are unstable and break down into other isotopes through a process called radioactive decay. Radioactive decay is characterized by beta decay, where a neutron changes into a proton by giving off an electron, and alpha decay, when isotopes give off 2 protons and 2 neutrons in the form of an alpha particle and changes into a new product. The original isotope is called the parent and the new isotope product is called the daughter. Radioactive isotopes can be found in the rock record because radioactive isotopes are incorporated into the crystals of igneous rock as it cools.

NSOU ? CC-GR-03 10 • Half-Life of elements Half-life is the time required for half of the parent material to change or decay. Half- lives can be calculated from measurements on the change in mass of a nuclide and the time it takes to occur. If an isotope has a half-life of 4000 years, then after 4000 years ½ of the parent isotope remains. After another 4000 years, ½ of ½ or ¼ of the original amount of parent isotope remains. In another 4000 years (12,000 years total), ½ more of the remaining amount decays, so after 3 half-lives, there only remains 1/8 (½ of ½ of ½) of the original parent isotope. So, if the half-life and the proportion of parent isotope to daughter isotope are known, then the absolute age of the rock is determined by simple calculation. This method is called radiometric dating. Fig 1.1: Radioactive decay and half-life 1. Potassium-Argon Dating Potassium-Argon dating is the only viable technique for dating very old archaeological materials. Geologists have used this method to date rocks as much as 4 billion years old. This method is widely used for numerical age measurement of rocks, especially igneous rocks, which are formed by cooling of magmas after emplacement or after eruption as lava flows. Since potassium is a constituent of many common minerals

NSOU ? CC-GR-03 11 and occurs with a tiny fraction of radioactive potassium-40, it finds wide application in the dating of mineral deposits. One of the isotope pairs widely used in geology is the decay of 40 K to 40 Ar (potassium-40 to argon-40). 40 K is a radioactive isotope of potassium that is present in very small amounts in all minerals that have potassium in them. It has a half-life of 1.3 billion years, meaning that over a period of 1.3 BY one-half of the 40 K atoms in a mineral or rock will decay to 40 Ar, and over the next 1.3 BY one-half of the remaining atoms will decay, and so on. By comparing the proportion of K-40 to Ar-40, and knowing the decay rate of K-40, the date that the rock formed can be determined. 2. Uranium-lead Dating Of all the isotopic dating methods in use today, the uranium-lead method is the oldest and the most reliable. Uranium (U) comes in two common isotopes with atomic weights of 235 and 238 (235 U and 238 U), Both are unstable and radioactive. So. this method uses the radioactive decay of uranium isotopes (238 U, 235 U, 232 Th) into stable isotopes of lead (Pb) (206 Pb) 207 Pb, and 208 Pb, respectively). 238 U decays to 206 Pb (half-life = 4510 Ma) by a process of eight alpha-decay steps and six beta-decay steps. 235 U decays to 207 Pb (half-life = 713 Ma) by a similar series of stages that involves seven alpha-decay steps and four beta-decay steps. These differing rates of decay help make uranium-lead dating one of the most reliable methods of radiometric dating because they provide two different decay clocks. This provides a built-in cross-check to more accurately determine the age of the sample. Uranium-lead is one of the oldest and most refined of the radiometric dating schemes. It can be used over an age range of about 1 million years to over 4.5 billion years. 3. Radiocarbon Dating Radiocarbon dating is a common method used to date anything that was once alive (including plants) and up to 70,000 years old. All living things take in carbon from the environment in the form of carbon-I 2 and carbon-l 4. When an organism dies, carbon intake stops and the carbon-I 4 begins to decay at a known rate. Scientists can determine how much C-14 remains in an organism by measuring radiation emitted by the C-14 isotopes. Carbon dating can be used on wood, plants, humans, and even old paper made out of papyrus. The half-life ofC-14 is 5,730 years. Because of this, it should not be used with material older than ~70,000 years or 12 half-lives.

NSOU ? CC-GR-03 12 However, it has also some limitations. Substances must have obtained C-14 from the atmosphere. For this reason, aquatic samples cannot be effectively C-14 dated. 1.3 DIvision Of Time In GTS In the geological time scale, the largest defined unit of time is the eon, which is further divided successively into eras, periods, epochs, and stages. The period is the basic unit of geological time in which a single type of rock system is formed. Two or more periods comprise a geological Era. Two or more Eras form an Eon, the largest division of geologic time. Some periods are divided into epochs. • The Eons An eon, the largest division of the geologic time scale, spans hundreds to thousands of millions of years. Geological time has been divided into four eons: Hadean, Archean, Proterozoic, and Phanerozoic. The first three of these represent almost 90% of Earth's history. The last one, the Phanerozoic (meaning "visible life"), is the time that we are most familiar with because Phanerozoic rocks are the most common on Earth, and they contain evidence of the life forms that we are

all somewhat familiar with. Fig 1.2 : The Eons of Earth's history • The Eras The term Phanerozoic means visible life, which refers to the fact that fossils are usually quite evident in sedimentary rocks deposited during the Phanerozoic.

The Phanerozoic—the past 540 Ma of Earth's history—is divided into three eras: the Paleozoic (early life), the Mesozoic (middle life), and the Cenozoic (new life), and each of these is divided into a number of periods.

Most of the organisms that we share Earth with evolved at various times during the Phanerozoic.

NSOU ? CC-GR-03 13 Fig 1.3 : The Eras (middle row) and Periods (bottom row) of the Phanerozoic • The Periods Period is one of several subdivisions of geologic time enabling cross-referencing of rocks and geologic events from place to place.The Cenozoic which represents the past 65.5 million years ago to present is divided into three periods: the Paleogene (65.5 to 23.03 million years ago), Neogene (23.03 to 2.6 million years ago) and the Quaternary (2.6 million years ago to present). Paleogene and Neogene are relatively new terms that now replace the deprecated term, Tertiary. • The Epochs An Epoch is a subdivision of the geologic timescale that is longer than an age and shorter than a period. The Paleogene is subdivided into three epochs: the Paleocene (65.5 to 55.8 million years ago), the Eocene (55.8 to 33.9 million years ago), and the Oligocene (33.9 to 23.03 million years ago). The Neogene is subdivided into two epochs: the Miocene (23.03 to 5.332 million years ago) and Pliocene (5.332 to 2.588 million years ago). Most of the boundaries between the periods and epochs of the geological time scale have been fixed on the basis of significant changes in the fossil record. Fig 1.4 : The periods (middle row) and epochs (bottom row) of the Conozoic Paleo- gene

NSOU ? CC-GR-03 14 1.4 HISTORY OF GTS • Nicholas Steno (1638-1686) was the first to lay down the principles underlying geologic time scales in the late seventeenth century. Steno in 1669 described two basic geologic principles. The first stated that sedimentary rocks are laid down in a horizontal manner, and the second stated that younger rock units were deposited on top of older rock units. Steno's principles were simple, but applying them to real rocks proved complex. During the eighteenth century, geologists came to realize that the Sequences of strata were often eroded, distorted, tilted, or even inverted after deposition. Table 1.2 : of GTS with years. Years Ago Supereon Eon Era Period Years Ago Present Quaternary Cenozoic ------------------1.8 mil. Tertiary 65 mil. -- 65 mil. Cretaceous ------------------145 mil. Jurassic Mesozoic ------------------200 mil. Triassic 245 mil. -- 245 mil. Permian ------------------290 mil. Carbonferous ------------------360 mil. Devonian Paleozoic ------------------410 mil. Silurian ------------------440 mil. Ordovician ------------------505 mil. Cambrian 544 mil. -- 544 mil. Proterozoic 2.5 bil. --- Archean 3.8 bil. --- Hadean 4.6 bil. -- Origin of Earth PRECAMBRIAN PRECAMBRIAN

NSOU ? CC-GR-03 15 Besides, strata laid down at the same time in different areas could have entirely different appearances. • Another related concept was introduced by James Hutton (1726-1797) in 1795, and later emphasized by Charles Lyell (1797-1875) in the early 1800s. This was the idea that natural geologic processes were uniform in frequency and magnitude throughout time, an idea known as the "principle of uniformitarianism". • The first serious attempts to formulate a geologic time scale that could be applied anywhere on Earth were made in the late I 8th century. Geologists of that time divided the rocks of Earth's crust into four types: Primary, Secondary, Tertiary, and Quaternary. Each type of rock, according to the theory, formed during a specific period in Earth history. Most geologists at this time believed the Earth was much older than 6,000 years. They also believed that the Primitive rocks were covered by an average of at least two miles of Secondary and Tertiary strata, which showed slow deposition during successive periods of calm and catastrophe • The 'identification of strata by the fossils' was developed in the early 19 th century by Georges Cuvier, Jean d'Omalius d'Halloy, and Alexandre Brongniart. Next major contribution to the geologic. time scale was by William Smith (1769- 1839), a British surveyor and amateur geologist. In 1815 Smith produced a geologic map of England in which he successfully demonstrated the validity of the principle of faunal succession. This principle simply stated that fossils are found in rocks in a very definite order. This principle led others that followed to use fossils to define increments within a relative time scale • The early time scales were only relative because 19th century geologists did not know the ages of the rocks. That information was not available until the development of isotopic datingtechniques early in the 20th century. The first geologic time scale that included absolute dates was published in 1913 by the British geologist Arthur Holmes. In 1977, the Global Commission on Stratigraphy (now the International Commission) started an effort to define global references (Global Boundary Stratotype Section and Points) for geologic periods and faunal stages. The tables of geologic periods presented here are in accordance with the dates and nomenclature proposed by the International Commission on Stratigraphy.

NSOU ? CC-GR-03 16 1.5 Geological And Biological Events Of GTS Four main time spans generally mark the Geologic Time Scale. The first, Precambrian Time, is not an actual era on the scale because of the lack of diversity of life, but the other three are defined eras: 1.5.1 Precambrian Supereon Precambrian time covers the vast bulk of the Earth's history, starting with the planet's creation about 4.5 billion years ago and ending with the emergence of complex, multi-celled life-forms almost four billion years later. The end of this time span saw the rise of a few more complex animals in the oceans, such as jellyfish. There was still no life on land, and the atmosphere was just beginning to accumulate the oxygen needed for higher-order animals to survive. Several rock types yield information on the range of environments that may have existed during Precambrian time. Evolution of the atmosphere is recorded by banded- iron formations (BIFs), paleosols (buried soil horizons), and red beds, whereas tillites (sedimentary rocks formed by the lithification of glacial till) provide clues to the climatic patterns that occurred during Precambrian glaciations. Precambrian includes approximately 90 percent of geologic time. It extends from 4.6 billion years ago to the beginning of the Cambrian Period (about 570 Ma). It includes 3 eons namely : • Hadean Eon (4.6 - 3.8 bya) : The Hadean Eon isn't formally recognized, but it essentially marks the era before there were any rocks. During the Hadean period the Late Heavy Bombardment occurred (approximately 3800 to 4100 Ma) during which a large number of impact craters are believed to have formed on the Moon as well as other planets including earth. • Archean Eon (3.8-2.5 bya) : The Archean Eon began about 3.8 billion years ago with the formation of Earth's crust and extended to the start of the Proterozoic Eon 2.5 billion years ago. During this time, the Earth's crust cooled enough that rocks and continental plates began to form. Archean rocks are often heavily metamorphized deep-water sediments, such as graywackes, mudstones, volcanic sediments, and banded iron formations. Carbonate rocks are rare, indicating that the oceans were more acidic due to dissolved carbon dioxide. Archean greenstone- granite belts contain many economic mineral deposits, including gold and silver.

NSOU ? CC-GR-03 17 • Proterozoic Eon (2.5-0.57 bya) : The period of Earth's history that began 2.5 billion years ago and ended 542.0 million years ago is known as the Proterozoic, which is subdivided into three eras: the Paleoproterozoic (2.5 to \.6 billion years ago), Mesoproterozoic (\.6 to 1 billion years ago), and Neoproterozoic (1 billion to 542.0 million years ago) The geologic record of the Proterozoic is much better than that for the preceding Archean. Many of the most exciting events in the history of the Earth and of life occurred during the Proterozoic - stable continents first appeared and began to accrete, a long process taking about a billion years. The first traces of life appear nearly 3.5 billion years ago, in the early Archean. However clearly identifiable fossils of stromatolites, layered mounds produced by the growth of microbal mats, become common in the rock record of this eon. Table 1.3 : Brief tabular outline of historical evolution. Paleozoic Major Geological events Wisconsin Ice 7000 BP: Cycles of glaciations N & S Americajoin; Continents assuming modern positions K/T Boundary event; N America & Eurasia separate; S America & Africa separate Breakup of Pangaea as Gondwanaland (S) & Laurasia (N) Continents adrift Pangaea supercontinent & Tethys Sea Origins of coal fields Milestone in Biology Age of Humans Hominidae 5 MYBP Radiation of Mammalia & Aves; Dominance of Teleosts Massive extinctions Origin of Angiosperms, colonial insects Age of Dinosaurs; Origin of Aves Origin of Teleost fishes Gvmnosperms dominant; Origin of *Therapsida Origin of Dinosaurs "Great Dying": <95% of marine invertebrates extinct Forests of tree ferns; Age of Arnphibia; Origin of Amniota MYBP 0.4 3 5 25 38 55 65 Epoch Holocene Pleistocene Pliocene Miocene Oligoccne Eocene Palcocene MYBP 3 65 135 215 250 290 360 Era Period Quaternary Tertiary Cretaceous Jurassic Triassic Permian Carboniferous [Pennsylvanian / Mississippian] Cenozoic Mesozoic

NSOU ? CC-GR-03 18 Major Geological events Pangaea coalescing Oldest rocks Milestone in Biology Abundant terrestrial life: bryophytes, club mosses, Insecta Age of Fishes; Origin of Amphibia Invasion of Land by Arthropoda & Trachaeophyta Origin of Gnathostomata *Ostracodermi domi- nant; Origin of *Placodermi Invertebrates dominate seas; Trilobites dominant Origin of Vertebrata "Cambrian explosion": Invertebrate phyla & algae abundant Origin of Chordata (Pikaia) Origins of Life — MYBP Epochs MYBP 405 435 505 570 610 800 3800 4560 Era Period Devonian Silurian Ordovician Cambrian Vendian Sturtian ..... Proterozoic [Sinian] Archaeozoic [Hadean] Source : www.geosociety.org 1.5.2 Phanerozoic Eon The Phanerozoic Eon covers roughly 545 million years and is typically subdivided into three eras. These eras are: A) Paleozoic Era: 542 to 251 million years ago; B) Mesozoic Era: 251 to 65 million years ago and C) Cenozoic Era: 65 million years ago to present. 1.5.2.1 Phanerozoic Era The Paleozoic spanned from roughly 542 Ma to roughly 251 Ma, and is subdivided into six geologic periods; from oldest to youngest they are: the Cambrian, Ordovician, Silurian, Devonian, Carboniferous, and Permian.

NSOU ? CC-GR-03 19 • Cambrian Period The Paleozoic Era began with a metaphorical explosion of life called The Cambrian explosion', which saw single-celled bacteria evolve into an abundance of diverse organisms. The emergence of all the animal phyla that exist today can trace their origins back to the 40 million-year span that was the Cambrian explosion. The period gets its name from Cambria, the Roman name for Wales, where Adam Sedgwick, one of the pioneers of geology, studied rock strata. In the early Cambrian, Earth was generally cold but was gradually warming. Rocks of Cambrian age are distributed in the Great Basin of the western United States, parts of the northeastern United States, Wales, Scandinavia and the Baltic region, Siberia, and China, among other places. P-T extinction The end of the Paleozoic Era (251 million years ago) was more like an 'implosion of life,' as much as 96% of all life on Earth went extinct during the event known as the P-T extinction (Permian- Triassic extinction). Although the cause is not entirely understood, the P-T extinction almost turned Earth into a lifeless planet. • Ordovician Period Ordovician Period, in geologic time, the second period of the Paleozoic Era. It began 485.4 million years ago, following the Cambrian Period, and ended 443.8 million years ago, when the Silurian Period began. The Ordovician period started at a major extinction event called the Cambrian-Ordovician extinction events some time about 488.3 $\pm$ 1.7 Ma. During the Ordovician most of the world's landmasses came together to create the supercontinent of Gondwana, which included the continents of Africa, South America, Antarctica, and Australia. Gondwana drifted south throughout the period, finally settling on the South Pole. For the most part the Earth's climate was warm and wet, with sea levels rising as much as 600 meters above those of today. Ordovician rocks have the distinction of occurring at the highest elevation on Earth-the top of Mount Everest.

NSOU ? CC-GR-03 20 • Silurian Period The Silurian is a major division of the geologic timescale that started about 443.7 $\pm$ 1.5 Ma. During the Silurian, Gondwana continued a slow southward drift to high southern latitudes. The climate was much warmer during this Period. This caused the glaciers to melt and the seas to rise. Cratons and continent fragments drifted together near the equator, starting the formation of a second supercontinent known as Euramerica. The vast ocean of Panthalassa covered most of the northern hemisphere. During the Silurian, continental elevations were generally much lower than in the present day, and global sea level was much higher. • Devonian Period The Devonian Period occurred from 416 million to 358 million years ago. It is often known as the "Age. of Fishes," although significant events also happened in the evolution of plants, the first insects and other animals. During this period, the world's land was collected into two supercontinents, Gondwana and Euramerica (or Laurussia). The period was a time of great tectonic activity, as Laurasia and Gondwanaland drew closer together. The continent Euramerica was created in the early Devonian by the collision of Laurentia and Baltica, which rotated into the natural dry zone along the Tropic of Capricorn. There is limited evidence of ice caps, and the climate is thought to have been warm and equitable. Near the end of the Devonian, a mass extinction event occurred. Glaciation and the lowering of the global sea level may have triggered this crisis, since the evidence suggests warm water marine species were most affected. • Carboniferous Period The Carboniferous extends from about 359.2 $\pm$ 2.5 Ma, to about 299.0 $\pm$ 0.8 Ma. In the United States, the Carboniferous is divided into two epochs. The Mississipian Epoch is the older one third and the Pennsylvanian Epoch is the more recent two- thirds. A global drop in sea level at the end of the Devonian reversed early in the Carboniferous; this created the widespread epicontinental seas and carbonate depo- sition of the Mississippian.

NSOU ? CC-GR-03 21 Table 1.4 : Geologic milestones in GTS Years Ago Event (Some Important Dates in the History of the Earth) 4,600,000,000 Origin of the Earth 3,900,000,000 Oldest Dated Crustal Rocks 3,800,000,000 Oldest Evidence for Life 2,000,000,000 First Oxygen Atmosphere/Ozone Layer Forms 900,000,000 Oldest Metazoan Fossils 510,000,000 Oldest Fossil Fish 458,000,000 First Land Plants 375,000,000 That important first step: Amphibians Evolve 245,000,000 Huge Mass Extinction at End of Permian Period / Close of the Paleozoic Era 200,000,000 First Mammals 160,000,000 First Birds 145,000,000 Atlantic Ocean first opens 130,000,000 Angiosperms (Flowering Plants) on the Scene 65,000,000 Adaptive Radiation of Mammals, Dinosaurs Go Extinct, Close of the Mesozoic Era/Beginning of the Cenozoic Era 3,400,000 New discoveries of Australopithecus afarensis (Lucy) fossils from Ethiopia 2,000,000 Pleistocene Ice Age begins 600,000 Age of Homo erectus fossils from Ethiopia 125,000 Oldest rocks in the Bahamas 100,000 Homo sapiens appears in the fossil record 15,000 Last ice sheet retreats from northern United States 7,000 Grahams Harbor, San Salvador, Bahamas floods due to rising sea level after ice sheets are reduced to modern day volume 506 Columbus lands in New World ? You were born Source: Ritger, S.D. and R.H. Cummins. 1991. Using student-created metapho

NSOU ? CC-GR-03 22 The large land masses of Euramerica and Gondwana continued to move toward one another and collide during this Period resulting into land uplifted into mountains. So the Carboniferous period was called a time of ‘active mountain-building’. Geologi- cally, the Late Carboniferous collision of Laurasia into Gondwana produced the Appalachian Mountain belt of eastern North America and the Hercynian Mountains in the United Kingdom. A further collision of Siberia and eastern Europe created the Ural Mountains of Russia. The Carboniferous Period is famous for its vast swamp forests. Vegetation included giant club mosses, tree ferns, great horsetails, and towering trees with strap-shaped leaves. Over millions of years, the organic deposits of this plant debris formed the world’s first extensive coal deposits. • Permian Period The Permian extends from about 299.0 $\pm$ 0.8 Ma to 251.0 $\pm$ 0.4 Ma. The Permian period ended in the largest mass extinction ever known in the Earth. By the early Permian, the two great continents of the Paleozoic, Gondwana and Laurussia had collided to form the supercontinent Pangaea. During the Permian, all the Earth’s major land masses except portions of East Asia were collected into a single supercontinent known as Pangaea. Two important groups of animals dominated the Permian landscape: Synapsids (reptiles) and Sauropsids (mammal-like reptiles). During the early Permian period, large portions of southern Pangea were covered by glaciers, but by the beginning of the Triassic period temperature was gradually increasing with the reappearance of vast rain forests at or near the equator. The Permian Period ended with the greatest mass extinction event in Earth’s history. In a blink of Geologic Time - in as little as 100,000 years - the majority of living species on the planet were wiped out of existence. 1.5.2.2 Mesozoic Era The Mesozoic Era lasted almost 180 million years from approximately 250 to 65 million years ago. This era includes 3 well known periods called the Triassic, Jurassic, andCretaceous periods. During the Mesozoic, or “Middle Life” Era, life diversified rapidly and giant reptiles, dinosaurs and other monstrous animals wan- dered the Earth. NSOU ? CC-GR-03 23 Fig 1.5: Major geological column in relation to appearance of animals Source: geologyearthscience.com • Triassic Period The Triassic period extends from about 251 $\pm$ 0.4 to 199.6 $\pm$ 0.6 Ma. During this period, almost all the Earth’s land mass was concentrated into a single superconti- nent centered more or less on the equator, called Pangaea. Terrestrial climates were predominately warm and dry with very hot summers and cold winters resulting into highly seasonal monsoon climate prevailed nearer to the coastal regions. In the early Triassic, it appeared that the Therapsids or the genus, Lystrosaurus (one of the survived animals in the Permian Extinction) would dominate the new era. However, by the mid-Triassic, most of the Therapsids had become extinct and the more reptilian Archosaurs were clearly dominant. During the late Triassic Period, the
NSOU ? CC-GR-03 24 relative importance of land animals grew. Reptiles increased in diversity and number, and the first dinosaurs appeared. • Jurassic Period The Jurassic period extends from about 199.6 $\pm$ 0.6 Ma to 145.4 $\pm$ 4.0 Ma. The Jurassic was a time of significant global change in continental configurations, oceanographic patterns, and biological systems. During the Jurassic Period, the supercontinent Pangaea split apart. The northern half, known as Laurentia/Lauresia, was splitting into North America and Eurasia. The Gulf of Mexico opened in the new rift between North America and what is now Mexico’s Yucatan Peninsula. The southern half, Gondwana, was drifting into an eastern portion forming into present day Antarctica, Madagascar, India and Australia, and a western portion forming into present day Africa and South America. Climates were warm, with no evidence of glaciations. Reptiles were the dominant animal life forms during the Jurassic Period. Some of the largest animals ever to live were dinosaurs of the Jurassic Period. Sauropods, the “lizard hipped” dinosaurs (Herbivorous) were common followed by Carnosaurus means “meat-eating dinosaur’ .The earliest known bird, Archaeopteryx, took to the skies in the late Jurassic, most likely evolved from an early coelurosaurian dinosaur. Early mammals also were present, though they were still fairly insignificant. • Cretaceous Period The Cretaceous period extends from about 145.5 $\pm$ 4.0 Ma to about 65.5 $\pm$ 0.3 Ma. During the Cretaceous Pangaea completed its breakup into present day continents, although their positions were substantially different at the time. However, by the end of this period, Laurasia had separated into North America and Eurasia and Gondwana had separated into South America, Africa, Antarctica, and Africa. Madagascar and the Indian subcontinent were still connected and would separate after the Cretaceous period. The Cretaceous period marks the end ofthe age of Dinosaurs with what is known as the Great Extinction. However, this period gives us some of the most beloved dinosaurs of modem days, like the Triceratops and, of course, the Tyrannosaurusrex, king of the dinosaurs. Flowering plants (angiosperms) began to appear for the first time. This in turn contributed to an increase In insect populations.

NSOU ? CC-GR-03 25 The extinction occurred at the end of the Cretaceous Period, about 65.5 million years ago. The end-Cretaceous extinction is best known of the “Big Five” because it was the end of all dinosaurs except birds (the non-avian dinosaurs). It also created opportunities for mammals. The real cause of extinction is not identified yet. However, there is evidence of plant decay which would have contributed to the extinction, as all dinosaurs, whether directly or indirectly, depended on plant life. This could have been caused by large asteroid collisions or volcanic eruptions or both. 1.5.2.3 Cenozoic Era The Cenozoic Era is the most recent of the three major Eras. The Cenozoic spans only about 65 million years, from the end of the Cretaceous Period to the present. The Cenozoic is sometimes called the Age of Mammals, because the largest land animals have been mammals during that time. The Cenozoic era is divided into three periods, and seven systems: Table 1.4 : Divisions of Cenozoic Era Paleogene (65-23 Ma) 1.

Paleocene (65.5 Ma - 55.8 Ma) 2. Eocene (55.8 Ma - 33.9 Ma) 3. Oligocene (33.9 Ma - 23.03 Ma) Neogene (23-2.5 Ma) 2. Miocene (23.03 Ma - 5.33 Ma) 3. Pliocene (5.332 Ma - 2.588 Ma) Quaternary (2.5 Ma-present) 4. Pleistocene (2.588 Ma - 12,000 years) 5. Holocene (12,000 years -

present • Paleogene period The Paleogene period is a unit of geologic time that began 65.5 $\pm$ 0.3 and ended 23.03 $\pm$ 0.05 Ma. This period consists of the Paleocene, Eocene, and Oligocene Epochs. i) Paleocene Epoch The Paleocene Epoch lasted from 65.5 $\pm$ 0.3 Ma to 55.8 $\pm$ 0.2 Ma. This Epoch opens and closes with major events in Earth’s history. The Paleocene epoch immediately

NSOU ? CC-GR-03 26 followed the mass extinction event at the end of the Cretaceous, known as the K-T boundary (Cretaceous - Tertiary), which marks the demise of the dinosaurs including about 80% of animals. During this epoch, North America, Greenland, and Europe were joined together in a supercontinent called Laurasia in the Northern Hemisphere. North America was connected to Asia by a land bridge and beginning to break away from Greenland. In the Southern Hemisphere, Gondwana, another supercontinent that had previously begun breaking apart, continued to do so through this epoch intoSouth America, Africa, India, Australia, and Antarctica. Africa was heading north towards Europe, slowly closing the Tethys Ocean, and India began its migration to Asia that would lead to a tectonic collision and the formation of the Himalayas. Climate during this epoch was cooler and dryer than the previous period. However, it rapidly warmed up. The end of the Paleocene (55.5/54.8 Ma) was marked by a sudden global change known as ‘the Paleocene-Eocene Thermal Maximum’, which upset oceanic and atmospheric circulation and led to the extinction of numerous deep-sea benthic foraminifera and on land, a major turnover in mammals. The Paleocene is usually broken into early, middle, and late sub-epochs which correspond to the following faunal stages, from youngest to oldest: ii) Eocene Epoch The Eocene epoch commenced 10 million years after the extinction of the dinosaurs, 65 million years ago, and continued for another 22 million years, up to 34 million years ago. During the Eocene (55.8 $\pm$ 0.2 - 33.9 $\pm$ 0.1 Ma), the continents continued to drift toward their present positions. By the beginning of the Eocene, Gondwana had almost split apart, but Australia, Antarctica and South America remained joined. The northern supercontinent of Laurasia began to break up, as Europe, Greenland and North America drifted apart. The Rocky Mountains in western North America were formed during this time as well. In Europe, the Tethys Sea finally vanished, while the uplift of the Alps isolated its final remnant, the Mediterranean. India continued its journey away from Africa and began its collision with Asia, folding the Himalayas into existence.

NSOU ? CC-GR-03 27 Marking the start of the Eocene, the planet heated up in one of the most rapid (in geologic terms) and extreme global warming events recorded in geologic history, called the Paleocene-Eocene Thermal Maximum. This was an episode of rapid and intense warming (up to 7°C at high latitudes) that lasted less than 100,000 years. At the beginning of the Eocene, the high temperature and warm moist environment created luxurious growth of forests spreading throughout the earth from pole to pole. This epoch was a great time for the evolution of mammals. Rhinoceroses, three-toed horses, and early relatives of pigs, camels, and hippopotamuses first appear. Source : earthwww.com. Fig 1.6 Major Biological milestones in GTS

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NSOU ? CC-GR-03 28 iii) Oligocene Epoch It extends from about 34 million to 23 million years before the present. During the Oligocene, the continents continued to drift toward their present positions. Antarc- tica continued to become more isolated, and finally developed a permanent ice cap. Mountain building in western North America continued. Alps started to rise in Europe as the African plate continued to push north into the Eurasian plate. Angiosperms (flowering plants) continued their expansion throughout the world; tropical and sub- tropical forests were replaced by temperate deciduous woodlands. Major changes during the Oligocene included a. There were two major trends in mammalian evolution during the Oligocene epoch. First the global expansion of grasslands and a regression of tropical broad leaf forests to the equatorial belt resulting into opening of a new ecological niche for grazing mammals. Consequently, on land, mammals such as horses, deer, camel, elephants began to dominate, except in Australia .. This period also marked the start of a generalized cooling, with glaciers forming in Antarctica for the first time during the Cenozoic. The cooling trend was also responsible for the reduced diversity in marine plankton, the foundation of the food chain. Gradual cooling formed ice sheets in the higher latitudes. The increase in ice sheets led to a fall in sea level. • Neogene Period The Neogene Period encompasses the interval between 23 million and 2.6 million years ago and includes the Miocene (23 million to 5.3 million years ago) and the Pliocene (5.3 million to 2.6 million years ago) epochs. The Neogene covers about 20 million years. During this period, mammals and birds continued to evolve into roughly modern forms, while other groups of life remained relatively unchanged. Early hominids, the ancestors of humans, appeared in Africa. i) Pliocene Epoch The Pliocene extends from 5.332 million to 2.588 million years before present. Moving continents during the Pliocene Epoch made a lot of mountain ranges. Himalayas in Asia, Rocky and Appalachian Mountains in North America and the Alps in Europe were formed during the Pliocene. During this Epoch, North America and South America were joined together for the first time at the Isthmus of Panama. During the Pliocene epoch, the earth continued its cooling trend from previous

NSOU ? CC-GR-03 29 epochs, still, average global temperatures were 2-3 QC higher than today. In North America, rhinoceroses became extinct. Camels, some of large size, were abundant and diverse, as were horses. The first recognizable hominins, the australopithecines, appeared in the Pliocene. However, near the end of the Pliocene, about 2.58 Ma, the current ice age began. ii) Miocene Epoch The Miocene extends from about 23.03 to 5.332 Ma. By the Miocene Epoch, North America and Europe were basically in the position they are today. Africa had moved north to collide with Europeand form the Alps mountain range. Similarly, to the east, India collided with Asia and created the Himalayan Mountains. Two major ecosys- tems first appeared during the Miocene: kelp forests (shallow underwater ecosystems with algae communities) and grasslands. In Eurasia and North America, the spread of grasslands forced an evolutionary change in herbivorous mammals. Mammal diversity reached its peak during the Miocene. The earth went from the Oligocene through the Miocene and into the Pliocene, with the climate slowly cooling towards a series of ice ages. • Quaternary Period The quaternary period began 2.6 million years ago and extends into the present. The Quaternary Period is divided into two epochs: the Pleistocene (2.588 million years ago to 11.7 thousand years ago) and the Holocene (11.7 thousand years ago to today). The Quaternary period saw a large number of climatic oscillations on a scale that was probably greater than at any other time in the last 60 My. Glaciers advance from the Poles and then retreat, carving and molding the land with each pulse. Sea levels falland rise with each period of freezing and thawing. i) Pleistocene Epoch The Pleistocene, the first epoch of the Quaternary Period, is the geological epoch which lasted from about 2,588,000 to 11,700 years ago, spanning the world's recent period of repeated glaciations. It is characterized by lower sea levels than the present epoch and colder temperatures. The end of the Pleistocene corresponds with the end of the last glacial period. During much of the Pleistocene, Europe, North America, and Siberia were covered by extensive ice sheets and glaciers. The Pleistocene was

NSOU ? CC-GR-03 30 an important time because it was when the human genus first evolved. Many of the animals common today were also common in the Pleistocene. Deer, big cats, apes, elephants, and bears could all be found in a Pleistocene landscape. Europe and Asia had significant populations of African fauna. ii) Holocene Epoch The Holocene Epoch began 12,000 to 1 1,500 years ago at the close of the Paleol ithic Ice Age and continues through today. Ice melt caused world sea levels to rise about 35 meters in the early part of the Holocene. Even though the human species was well developed before this epoch, it is still often called the "Age of Man" because of the huge impact humans have had on Earth during this time. The beginning of the Holocene Epoch is marked by the end of the Paleolithic Ice Age, when the Earth started to warm again and glaciers melted into the oceans. Animal and plant life have not evolved much during the relatively short Holocene, but there have been major shifts in the distributions of plants and animals. 1.6 Significance Of GTS The geological time scale (GTS) is a system of chronological dating that relates geological strata with time. Geological strata are referred to the sequence of soil or sediments or rocks which is relative to the space where the fossils of the dead organisms are found. It describes some significant events like: i) The geological time scale provides information about the list of rock layers by age. ii) Stratigraphical age of the rock layers can be determined simply by relative dating methods. iii) GTS gives an idea and evidence of evolution both biological and geological iv) STS articulates information about type of plants and also focuses when plants first appeared. v) The GTS is a system of chronological dating that relates with time. Geological strata are referred to the sequence of soil or sediments relative to the space where the fossils of the dead organisms are found.

NSOU ? CC-GR-03 31 GLOSSARY 1. Absolute age: The age of an object as established by some precise dating method, such as radiometric dating 2. Absolute dating: A means of estimating the age of rocks with some degree of accuracy using measurements of radioactive isotopes. 3. 14C method: A method for determining the age in years of organic matter by calculating the amount of radioactive carbon still remaining, as compared to the stable isotope, 12e. 4. Cenozoic: The third and current (most recent) geologic era of the Phanerozoic Eon, this began 65.5 million years ago. 5. Daughter element: The element or isotope which is produced by radioactive decay. 6. Eon: The largest division of geologic time in the geological timescale, embracing several Eras (for example, the Phanerozoic, 540 m.y. ago to present); 7. Epoch: A division of the geologic time shorter than a period. 8. Era: A division of the geologic time shorter than an eon, and measuring major stages in the evolution of life - e.g. Paleozoic, Mesozoic, Cenozoic. 9. Fossil: Petrified remains of the plants and animals. A fossil may be a bone, shell, leaf impression, footprint, insect in amber, etc. 10. Hadean: The oldest eon in the history of the Earth, extending from the origin of the Earth about 4.5 billion years ago to around 3.8 billion years ago. 11. Half-life: The amount of time it takes for half the atoms of a radioactive isotope to decay. 12. Holocene epoch: The most recent geologic epoch of the Quaternary Period extending from the end of the Pleistocene (I 1,000 years ago) to the present. 13. Geological time scale: A system of chronologic measurement relating stratigraphy to time that is used by geologists, paleontologists and other earth scientists to describe the timing of events that have occurred during the history of the Earth. 14. Isotope: Atoms of a given element that have the same atomic mass. Most elements have more than one isotope. Most radioactive elements used for dating have one radioactive isotope and at least one stable isotope. 15. Mesozoic: The second era of the Phanerozoic eon, lasting from 251 to 65.5 million ago, and characterised by the dominance of reptiles both on land and seas.

NSOU ? CC-GR-03 32 16. Paleozoic: The earliestera of the Phanerozoic eon, but also the longest, lasting from 542 to 251 million years ago. 17. Phanerozoic: The most recent of the four eons of geologic time. Characterized by complex multicellular life. 18. Proterozoic: The name means the era of "first (animal) life". This was the third eon in Earth history, during which eukaryote life and an oxygen atmosphere appeared. 19. Radioactivity: The spontaneous decay of the nucleus of an element resulting into the change in the number of protons in the nucleus and therefore creates an atom of a new element. 20. Stratigraphy: The succession and age relation of layered rocks. 1.7 Summary This unit allows the learners to know about the earth's tectonic evolution and the different eras through which evolution has taken place. 1.8 Questions A. Short Type (within 200 words) 1. Define Geologic Time Scale. 2. What is isotope? 3. Order the units of time from greatest to least. 4. When was the first great explosion of life recorded in the fossil record? 5. Explain the differences between relative and absolute dating. 6. What are the four eras of the earth? Mention with age. 7. What is period in geologic time scale? 8. Describe the major geological events under carboniferous period. 9. Can scientists use the same principles they use to study Earth's history. 10. What are the different eras of geologic time? 11. What is Holocene epoch? 12. Describe major tectonic events under Permian period. 13. How does an eon differ from an era? 14. Explain major geological events of Jurassic Period.

NSOU ? CC-GR-03 33 15. What is halflife of isotope? 16. Describe how the time scale was created. 17. Explain the relationships among eons, eras, epochs, and periods of the geologic time scale. 18. What is 14C method of dating? 19. Exp l ai n different peri ods of Cenozoi c era? 20. Explain different periods of Mesozoic era? 21. What is P-T extinction? 22. Explain the characteristics of Eocene Epoch. B. Long Type (within 600 words) 23. Describe in brief the tectonic and structural evolution of Pal eo zoic Era. 24. Describe in brief the tectonic and biological evolution of Mesozoic Era. 25. Describe in brief the biological and structural evolution of Cenozoic Era. 26. How did scientists account for fossils and other geological evidence as they developed the geologic time scale? 27. Explain characteristics of different eons under Precambrian supereon. 28. Describe in brief the tectonic and biological evolution of different epoch under Paleogene Period.

NSOU ? CC-GR-03 34 Unit 2 ?Earth's Interior With Special Reference To Seismology Structure 2.0 Objectives 2.1 Earthquake and Seismology 2.1.1 Introduction 2.1.2 Seismic Wave 2.1.3 Causes of Earthquake 2.1.4 Earthquake Shadow Zone 2.2 Earth's Interior study with reference to Seismology 2.2.1 Layers of Earth 2.2.2 Seismic discontinuities 2.2.3 The Crust 2.2.4 The Mantle 2.1.5 The Core 2.3 Isostasy : Models of Airy and Pratt 2.3.1 Concept of Isostasy 2.3.2 Airy's Concept of Isostasy 2.3.3 Pratt's Concept of Isostasy 2.3.4 Other Theories 2.3.5 Global Isostatic Adjustment 2.4 Summary 2.5 Glossary 2.6 Questions 2.2 Objectives ? To learn about the Earthi interior ? To know about the theories of Isostasy 2.1 Earthquake And Seismology 2.1.1 Introduction There are certain sudden movements on the earth's crust which abruptly change its features and the chief among them is the earthquake. An earthquake is an oscillation 34

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of the earth caused by a sudden disturbance of the equilibrium of the rocks at or beneath the earth's crust. In other words,

an earthquake the result of a sudden release of stored energy in the earth's crust that creates 1 seismic waves or shocks. There may be foreshocks and aftershocks. which are the energy released before and after the main quake. The place of origin of the earthquake below the ground is called the focus or hypocenter. The point on the surface which is vertically above the focus is the epicenter. Earthquake waves first come to that point, and therefore, shocking effects are maximum on that point or areas. Seismology is the study of earthquakes and seismic waves that move through and around the earth. Or, in other words, Seismology may be called as scientific discipline that is concerned with the study of earthquakes and of the propagation of seismic waves within the Earth. In the late 19th and early 20th centuries national and regional scientific societies devoted to the advancement of seismology were created in Japan, Europe, and North America. The International Association of Seismology (IAS) was first organized in 1901, but was dissolved after World War I. Seismology was one of the original six Sections of the International Union of Geodesy and Geophysics (IUGG) when it was created again after the World War I in 1919. 2.1.2 Seismic Wave When the earthquake occurs, the vibration called seismic waves spread out in all directions from the focus.

Three main types of waves are propagated during earthquakes. These are as follows : • Primary Wave : These are called longitudinal or compressional or simply 'P' waves. P wave makes the particles vibrate in the direction of their movements. The average speed is within 5 to 14 km/sec. P waves travel with the fastest speed through the interior layers & arrive first at the surface. • Secondary Wave : These are called transverse or shear waves, or simply'S' waves. Their rate of movement is less than that of the longitudinal waves. The average speed is within 5 to 8 km/sec. They are unable to pass through liquid layers in the interior. The vibration caused by S waves is at right angles to the direction of their movements.

NSOU ? CC-GR-03 36 • Surface Wave : Surface Waves are those waves which travel over the surface of the earth. They are the long waves and their speed is the lowest among three. But they are the most terrible and are responsible for most of the destruction associated with an earthquake. Surface waves are of two types: (1) the Rayleigh wave or L wave: an elliptical motion decreasing with depth (similar to ocean waves). (2) the Love wave: a lateral motion (sideways shaking). Why can't S-waves travel through liquids? S-waves are shear waves, which move particles perpendicular to their direction of propagation. They can propagate through solid rocks because these rocks have enough shear strength. The shear strength is one of the forces that hold the rock together, preventing it from falling into pieces. Liquid materials lack this type of shear strength because atomic attractions are low compare to solids which means rigidity is low. S-waves need a medium that is rigid enough for them to propagate. This is why S-waves cannot propagate through liquids. a) L-waves : They travel near the earth's surface and within a depth of 30-32 kilometers from the surface. These are also called Rayleigh waves named for John William Strutt, Lord Rayleigh, who mathematically predicted the existence of this kind of wave in 1885. A Rayleigh wave rolls along the ground just like a wave rolls across a lake or an ocean. Because it rolls, it moves the ground up and down and side-to-side in the same direction that the wave is moving. They generally move at a slower rate than Love waves. b) Love waves : Love waves make the ground vibrate at right angles to the direction of Waves,

named after A.E.H. Love, a British mathematician who

worked out the mathematical model for this kind of wave in 1911.They are a variety of S-waves where the particles of an elastic medium vibrate transversely to the direction of wave propagation, with no vertical components. They Involve shear motion in a horizontal plane. However, Love waves are most destructive kind of seismic wave.

NSOU ? CC-GR-03 37 Table 2.1 Difference between S Waves and P Waves. P waves S waves 1. First wave to hit seismographs, i.e., 1. Second waves to hit seismographs, P-waves travel at the greatest speed. i.e, S-waves travel following the P waves. 2. They are compression waves 2. They are shear waves 3. Can move through solids and liquids 3. Can only move through solids. 4. Shake the medium in the direction 4. Shake the medium in the direction in which they are propagating perpendicular to which they are moving 5. The P waves from an earthquake 5. S waves travel typically 60% of the arrive first. but because of their speed of P waves. They are typically small amplitudes don't do as much more damaging than the P waves damage as the S waves and surface because they are several times higher waves which follow. in amplitude. Fig. 2.1 : Propagation of P, S and Surface Wave 2.1.3 Causes Of Earthquake Earthquakes are a result of many factors. These are as follows: 1. Elastic Rebound Theory Geologist Henry Fielding Reid introduced first (1906) the concept of 'Elastic Rebound' mechanism for the occurrence of earthquakes. According to him earth- quake should have involved an "elastic rebound" or previously stored elastic stress. This may be explained by the following example. If a stretched rubber band is broken or cut elastic energy stored in the rubber band during the stretching will suddenly be Surface Waves rolling motion S waves larger jolt or strong shaking P waves small jolt or light shaking or not felt

NSOU ? CC-GR-03 38 released. Similarly. the crust of the earth can gradually store elastic stress that is released suddenly during an earthquake. So, the elastic rebound theory is an explanation for how energy is spread during earthquakes. As rocks on opposite sides or a fault are subjected to force and shin, they accumulate energy and slowly deform until their internal strength is exceeded. /\t that time, a sudden movement occurs along the fault, releasing the accumulated energy. and the rocks snap back to their original undeformed shape. If the stress is large enough, rocks undergo deformation, i.e. a change of shape and/or volume. The amount of deformation experienced by a rock is called strain. The behavior of a rock in response to stress can be elastic, brittle or ductile. A rock behaves in an elastic manner when it recovers its original shape after the stress is removed. When the stress exceeds a value called the rock strength, the rock experiences a permanent deformation. Fault or fold is the good example in this regard. Deformation with breaking of rock (i.e. fault), or without breaking (i.e. fold) may gradually occur in the earth crust because of the temperature/pressure changes. As a result, most of the earthquakes are produced by the brittle deformation of rocks. They are confined to the cold rigid lithosphere, mostly the crust, where rocks behave in a brittle manner. Rocks of the asthenosphere under conditions of high temperature and high pressure display a ductile behavior. Fig 2.2 : Elastic Rebound Theory 2.1.4 Earthquake Shadow Zone

Seismic waves recorded at increasing distances from an earthquake indicate that seismic velocities gradually increase with depth in the mantle. However, at

arc Earthquake Rocks on each side of the fault are forced to move, but rocks at the fault are "locked" together. Because rocks are locked together, they bend. storing energy like a coiled spring. Rocks suddenly "let go". springing back, causing an earthquake.

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distances of between about 105° and 140° no P waves are recorded. Furthermore, no S waves are recorded beyond about 105°
and 140° no P waves are recorded. Furthermore, no S waves are record beyond about 105°.
This is called Shadow zone. The shadow zone results from S waves being stopped entirely by the liquid core and P waves being bent (refracted) by the liquid core. Or in other sense, from the lack of S waves and a great slowing of the P wave velocity (by about 40%) it was deduced that the outer core is made of liquid. Fig 2.3 : Path of Earthquake waves 2.2 Earth's Interior Study With Reference To Seismology Our knowledge of the interior structure ofthe earth is certainly based upon some indirect evidences, as it is not possible for man to study the interior of the earth directly. The maximum depth of mines where man have gone for direct observation is petroleum digging of no more than 12 km .This depth is obviously negligible in comparison to the radius of the earth (6371 Km). So, man has to depend upon some indirect evidences like study of the earthquake waves, study of the ancient rocks etc for detailing of the interior information of the earth. Epicenter P- and S-waves P- and S-waves Solid inner core Liquid outer core P-wave shadow zone P-wave shadow zone Mantle 105 140 No direct P-waves No direct P-waves Crust No direct S-waves P-waves S-waves
NSOU ? CC-GR-03 40 2.2.2 Layers Of The Earth The shape of the earth is like a sphere. It has three different layers or zones - crust, mantle and core. The outer layer of the earth is the crust or the lithosphere which is hard and composed of rocks and minerals. The innermost part is known as the core, composed of heavy metals and in-between there is a transitional layer known as mantle. Before going to discuss in details of different layers, we may introduce the concept of seismic discontinuity, properties of these actually mark the layers of interior. 2.2.3 Seismic Discontinuities When seismic waves pass between geologic layers with contrasting seismic veloci- ties, reflections, refraction (bending), and the production of new wave phases often result. This type of sudden jumps in seismic velocities across a boundary is known as seismic discontinuities. Different well known discontinuities are listed below: When an earthquake occurs the seismic waves (P and S-waves) spread out in all directions through the Earth's interior. ... Sudden jumps in seismic velocities accross a boundary are known as seismic discontinuities. a) Conrad Discontinuity : The transition zone between the upper and lower part of the lithosphere, is called as Conrad discontinuity. The name comes from the Austrian geophysicist Vector Conrad (1876 - 19(2). According to geologists the upper crust in the continental region consists of felsic rock such as granite and the lower one consists of more magnesium rich malic rocks such as basalt. So, Conrad discontinuity should correspond to a sharply defined contact between the chemically distinct layers of SIAL and SIMA. In passing through the Conrad discontinuity the velocity of longitudinal seismic waves increases abruptly from approximately 6 to 6.5km/sec. b) Mohorovicic Seismic Discontinuity : This seismic discontinuity is now known as the Moho. It is the boundary between the crust and the mantle. The name came after the Croatian seismologist Andrija Mohorovicic' (1857-1936) who discovered it. The depth to the Moho beneath the continents averages around 35 km but ranges from around 20 km to 70 km. The Moho beneath the oceans is usually about 7 km below the seafloor.
NSOU ? CC-GR-03 41 Fig 2.4 : Mohorovicic discontinuity c) Gutenberg Seismic Discontinuity/Core-Mantle Boundary : Geophysicists Beno Gutenberg (1889-1960) established an accurate boundary line — or disconti- nuity — that separates and divides the lower mantle from the outer core. According to him this discontinuity occurs at a depth of about 2,900 km below the surface. At that depth there is an abrupt change in the seismic waves that travel through Earth. In addition, at this depth, P waves decrease in velocity while S waves disappear completely. This distinct change marks the boundary between two sections of Earth's interior, known as the lower mantle (which is considered solid) and the underlying outer core (believed to be molten).
Shear waves could not penetrate this molten layer and P waves would be severely slowed and refracted (bent).
d) Repetti discontinuity : The discontinuity between the upper mantle and the lower mantle is known as Repetti Discontinuity. The portion of the mantle which is just below the lithosphere and asthenosphere. but above the core is called as Mesosphere. This discontinuity is locate at effrt a depth of 700 km with a density 4.3 gm/cc. Here a dense olivine layer begins to transform into 'spinels' giving rise to geological faults. e) Lehman Seismic Discontinuity/Inner Core-Outer Core Boundary : The discontinuity between the upper core and the lower core is called as Lehmann Discontinuity, named after Danish seismologist Inge Lehmann (1888 -1993).
Sudden increase in P-wave velocities at a depth of 5150 km
is observed because of changing state of a molten outer core to a sol id inner core.

NSOU ? CC-GR-03 42 Lehmann Discontinuity In between Lighter Outer Crust and Denser Inner Crust there lies an area called as Lehmann Discontinuity. It is formed due to sudden change in the density between the two layers. The Danish seismologist Inge Lehmann (1888 199.1) deduced this discontinuity in 1936 marked by an abrupt increase of P-wave and S-wave velocities at the depth of 220J:30 krn., It appears beneath cant incnts, but not usually beneath oceans. Here, the p, and S-Wave velocities have an abrupt increase by 3-4%. Fig 2.5 Location of discontinuity 2.2.4 The Crust This is the upper most and thinnest layer of the earth. It forms the continents and the ocean beds and its thickness varies from 16 to 40 km. In the continental areas its thickness varies from 30 to 50 km and in the oceanic areas between 10 to 12 km. NSOU ? CC-GR-03 43 It constitutes less than I percent of earth's volume and 0.4 percent of its mass. Average density of crust is only 2.85 i.e. 2.85 times heavier than water. • Conrad Discontinuity: Transition zone between SIAL and SIMA. • Mohorovicic Discontinuity: Transition zone between the Crust and Mantle. • Repiti Discontinuity: Transition zone between Outer mantle and Inner mantle. • Gutenberg Discontinuity: Transition zone between Mantle and Core. • Lehman Discontinuity: Transition zone between Outer core and Inner core. Crust is composed of various kinds of rocks and minerals. In its upper most part we find sedimentary layer, though it is not continuous over entire surface of the earth. In the continental areas there is a layer of granitic masses just below the sedimentary cover while in the oceanic areas there is hardly sedimentary rock and mostly composed of basaltic masses. Crust is subdivided into two sub-layers. The upper layer is known as Sial and composed of mostly lighter rocks. It contains silica (Si) and aluminum (Al), that's why it is known as Sial. The lower layer is generally heavier and composed of rocks with Silica (Si) and Magnesium (Ma) and known as Sima. Generally speaking, the continents are made up of Sial and oceans are made up of Sima. Sial and Sima is divided by a discontinuity known as Conrad discontinuity.

The temperature of the crust increases with depth. reaching values typically in the range from about 500°C to 1.000°C at the boundary with the underlying mantle. The

crust and tectonic plates are not the same. Plates are thicker than the crust and consist of the crust plus the shallow mantle just beneath it. 2.2.5 The Mantle The intermediate layer between the Crust and the Core is the Mantle. It occupies 83 percent of earth's volume and 69 percent of its mass. It is separated from crust by the Mohorovic discontinuity or Moho, according to the name of the scientist A Mohorovic. The mantle extends from Moho to 2900 km. It is a solid layer and is sub- divided into three layers - an upper mantle from Moho to 370 km, an intermediate mantle from 370 to 720 km and a lower mantle from 720 km to 2900 km. The mantle is composed of dense and rigid rocks which has predominance of minerals of magnesium and iron content. The upper part of mantle (70-700 km) is

NSOU ? CC-GR-03 44 known as Asthenosphere which is characterized by plastic flow and is the source region of most of the earth internal energy. Here convectional current is the dominant mode of heat transfer which causes the plate movement. The density varies from 3 to 3.5 in the upper mantle to about 4.5 to 5.5 in the lower mantle. The temperature increases with depth from 870 deg to 2200 deg C. Fig 2.6 : Velocity of P & S waves 2.2.6 The Core The inner most layer i.e. the core occupies 17 percent of earth's volume and 34 percent of its mass. The core-mantle boundary is defined by Weichart-Gutenberg discontinuity at 2900 km.The outer core extends from 2900 to 5144 km and inner core from 5144 to 6371 km i.e. centre of the earth. The outer core is considered to be a state of homogeneous liquid which is composed of mostly nickel and chromium while inner core is solid and is believed to contain metallic nickel and iron and therefore it is known as nife (ni + fe). So the density increases from 5.1 in the core-mantle boundary to about 13.1 in the centre of the earth. The temperature also gradually increases.

The temperature of the outer core ranges from 4400 QC in the outer regions to 6100 QC near the inner core.

NSOU ? CC-GR-03 45 Table 2.3 : Comparative study among different layers Density (g/cm 3) Thickness (km) Types of rock found Top Bottom 2.2 Silicic rocks 30 2.9 Andesite, basalt at base 3.4 Peridotite, eclogite, olivine, spinel, garnet, pyroxene Upper mantle 720 4.4 Perovskite, oxides 4.4 Lower mantle 2,171 5.6 Magnesium and silicon oxides 9.9 Outer core 2,259 Iron + oxygen, sulfur, nickel alloy 12.2 12.8 inner core 1,221 13.1 Iron + oxygen sulfur, nickel alloy Total thickness 6,404 Source: Anderson, Don L. (1989) : Theory of the Earth, Boston, Blackwell Publications. Low velocity zone A zone within the asthenosphere in the upper mantle that is defined on seismic criteria. It varies in depth between 50 and 250 km and represents part of the mantle that may be about 5% liquid. It transmits S-waves but both S- and P-wave velocities are reduced.

NSOU ? CC-GR-03 46 2.3 Isostasy : Models of Airy and Pratt

Isostasy is a fundamental concept in the geology where the lighter crust is floating on the denser underlying mantle. The term 'lisostasy' is derived from Greek words 'iso' and 'stasis' meaning "equal standing". However, the term 'isostasy' was first coined in geology in 1899 by the American geologist Clarence Dutton. According to him,

the concept of isostasy tries
to explain how different topographic heights can exists on the Earth's surface
and why. Isostasy occurs when the buoyancy force pushing the lithosphere up equals the gravitational force pulling it down. So, geologists think that the Earth's lithosphere floats on a plastic like upper part of the mantle, the asthenosphere. The effects of isostasy were first noticed near large mountain ranges. This principle can also be described as isostatic equilibrium.
Isostatic equilibrium is an ideal state where the crust and mantle would settle into in absence of disturbing forces. However, in reality
the waxing and waning of ice sheets; erosion, sedimentation, and extrusive volcanism are examples of processes that disturb
this Isostatic equilibrium. In the case of Earth movement, Isostatic equilibrium is associated with the balancing of forces due to different weights of landmasses in relatively close proximity. As for example, if a mountain range is rising and the sea bed is falling then it may be balanced as the weight of material removed by erosion from the mountain is deposited onto the seabed. Isostatic observations are important tools to study the Earth's geology, composition, structure and dynamics. 2.3.1 Concept Of Isostasy The idea of isostasy was first put forwarded by Leonardo Da Yinci in fifteenth century, wherein he had explained the balancing condition between the rises of mountain with the removal of materials. The development of isostasy further grew in eighteenth century, when the French scientist, Pierre Bouguer, who had attempted to determine the Earth's mean density by measuring the deflection of the plumb-line (vertical direction) by the mass of a nearby mountain. In 1735 Pierre Bouguer during his expedition of the Andes, noticed that towering volcanic peak of Chimborazo was not attracting the plumb line as it should have done. He thus explained the reason, that the gravitational attraction of the Andes is much smaller than that to be expected
NSOU ? CC-GR-03 47 from the mass represented by these mountains. Besides, he estimated that the ratio of density of crust to the mean density of the Earth for Chimborazo mountain in Ecuador is quite higher than the Quito mountain in Peru. This erroneous result indicated that the deflection of the vertical caused by the mountain was too small for its estimated mass. In the first half of the nineteenth century (1806-1843), the English geodesist George Everest (1859) carried out triangulation surveys in India. He took 160 km apart two stations - Kalianpur and Kaliana in the Himalayan base in India. He observed that the distance measured by triangulation between Kalianpur on the lndo-Ganges plain and Kaliana in the foothills of the Himalayas differed substantially. The difference of latitude between two stations as determined, on the one hand by astronomical methods and on the other by measurement (triangulation), was found to differ appreciably. Difference between two results amounted to 5.23 seconds is as given below— 1. Result obtained through triangulation method = 5°23' 42.294" 2. Result obtained through astronomical method =5°23'37.058" 3. Difference =5.236" According to him that discrepancy must have caused by errors in geodetic measure- ments. Fig. 2.7 General Concept of Isostasy The interpretation of this discrepancy was brought the fact that the enormous mass as well as huge attritional forces of the Himalaya were responsible. Latter on, an attempt was made by Pratt (1855) to estimate the amount of this attraction. He Ocean Ocean Faults Faults Crust and upper mantle Asthenosphere Asthenosphere
NSOU ? CC-GR-03 48 assumed that the mountain mass as a whole have an average density which is approximately 2.7 and his calculation sowed that the mountain should cause a much larger deflection of the vertical than they actually did. 1. Gravitational deflection at Kaliana=27.853" 2. Gravitational deflection at kalianpur=II.968" 3. Difference=15.885" Thus, the difference of 15.885" was in fact more than 3 times the observed deflection of 5.236" during the survey by Everest. Pratt's calculation pointed out another fact that the Himalaya was not exerting the attraction according to its enormous mass and the attraction of the mountain range on the plumb-line was So, scientists tried to believe that local excess of attraction, due to major relieffeatures, was compensated for by some deficiency of density below the surface. 2.3.2 Airy's Concept of Isostasy Sir George Biddell Airy (1801-1892) opined that the inner part of the mountain cannot be hollow, rather the excess weight of the mountains are compensated by the lighter materials below.
The crust of relatively lighter material (SIAL) is floating in
the substratum of denser material (
SIMA). As for example, Himalayan Mountains are floating in th.e
denser magma with maximum portion sunk in the magma in the same way as a boat floats in water.

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According to Airy "the great mass of the Himalayas was not only a surface phenomenon - the lighter rocks of which they are composed do not merely rest on the level surface of denser material beneath, but, as a boat in water, sink into the denser material." For example, an iceberg floats in water in such a way that for everyone part to be above water level, nine parts of the iceberg remain below water level. If we assume the
average density of the crust and the substratum to be 2.67 and 3.0 respectively, for everyone part of the crust to remain above the substratum, nine parts of the crust must be in the substratum. In other word, the law of floatation demands that the ratio of free board to draught is 1 to 9. At the same way, it is said that roughly 9 km height of the Himalaya must have a root in the substratum, which is 9 times more in length in substratum than the height of the Himalaya.
NSOU ? CC-GR-03 49 Based on this observation, Airy postulated
that 'if the land column above the substratum is larger, its greater part would be submerged in the substratum, and if
Fig. 2.8 : Sir George Biddell Airy (1801-1892) Fig. 2.9 : Isostatic compensation of topography by Airy model Fig 2.10 : Airy's Experiment (
Wooden piece have greater height, larger part of that wooden piece get submerged into the water and the other side the piece have lesser height, smaller part of that piece get submerged into the water).
Water Level Water Wooden Pieces of Uniform Density
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the land column is lower, its smaller part would be submerged in the substratum'.
According to Airy the density of different columns of the land (
plains, plateaus, mountains, etc.) remains the same. Hence, he proposed the idea of 'uniform density with varying thicknesses'.
It
means that the continents are made of rocks having uniform density, but their thickness or length varies from place to place. In order to prove this concept Airy took several pieces of iron of varying lengths and put them into a basin with full of mercury. These pieces of iron' sunk
up to
varying depths depending on their lengths. Same things happen if we take some wooden pieces of varying length and put them into a basin with full of water. •
Criticism of Airy's hypothesis
Though the concept of Airy commands great respect among the scientific community, but, it also suffer from certain defects and
faults. 1. Airy claimed that
every upstanding part must have a root below in according to its heights. Thus, the height of the Himalaya is 8,848 m on the land part then its root would be equivalent to 8,848 × 9=79,632m (according to free board to draught ratio as I to 9). But, the root is not 'possible to be at such a great depth, because the root material will automatically melt due to higher temperature found at that depth. In fact, interior
temperature increases with increasing depth at the rate of 1°C per 32m. 2.
According to Airy the density of different columns of the land (
e.g. mountains, plateaux, plains etc.) remains
the same. In other words, density does not change with depth, that is, 'uniform density with varying thickness.'
This
means that the continents are made of rocks having uniform density but their thickness or length varies from place to place. But, in
reality, it is absolutely wrong. Continents are made up of both igneous rocks of higher density as well as sedimentary rocks of lower density materials. 3. Airy suggested that blocks of the l ithosphere had a constant density of 2.7 g/cm 3 and floated in the asthenosphere of density 3.3 g/cm 3 . But it is not true in practical. The average density of oceanic crust is 3.0 g/cm 3 , while continental crust has an average of 2.7 g/cm 3 . Besides, About 60% of Earth's surface is currently occupied by oceanic crust.

NSOU ? CC-GR-03 51 4. Airy's model was based on the assumption of thin crust, but somewhere crust extends up to 70 -100 km. besides, this model was not in accord with the contraction theory of the earth. 2.3.3 Pratt's Concept Of Isostasy John Henry Pratt (1809-1871), a mathematician, proposed his hypothesis on isostasy balance in 1855, stating that the mountain ranges having low density masses extend higher level than other masses of greater density. According to his concept, there is a level of compensation, above which density varies from one column to another, but, there is no change in density below this level. So, according to Pratt, there is a difference in the density of rocks in the crust and at the heights of the crustal blocks/ columns are determined by their densities. As such, blocks made up of lighter material are at higher elevation than those consisting of denser material. Thus, the rocks constituting the elevated masses and depressed areas exert equal pressure at the level of compensation. So, the central theme of his theory may be expressed as "uniform depth with varying density".

Equal surface area must underlie equal mass along the line of compensation.

Fig. 2.11 : John Henry Pratt (1809-1871) J.H. Pratt's role is commendable i~connection with isostasy in India. During the survey of the Indo-Gangetic plain, carried out by Sir George Everest, the Surveyor- General of India, in 1855, the difference in latitude between Kalianpur and Kaliana (5.236 seconds of arc, corresponding to a distance on the ground of 168 m.) was

NSOU ? CC-GR-03 52 determined astronomically as well as by direct triangulation on the ground. A few years later Archdeacon Pratt explained the causes of this difference. Pratt found that the density of each higher part is less than a lower part. In other word, the

density of mountain is lower than the plateau, similarly, the density of plateau is less than the plain and density of plain is less than the ocean floor and so on. It means that there is an inverse relationship between

density and height of the relief. Pratt started studying the rocks of the Himalaya and its neighboring plains, when he was studying the difference of gravitational deflection of 5.236 during the geodetic survey of Kaliana and kalianpur. According to Pratt density only varies in the lithosphere, not in the pyrosphere and barysphere. Thus, Pratt's concept is related to the "law of compensation" not in the "law of floatation". According to him different relief features are standing only because of the fact that their respective mass is equal along the line of compensation because of their varying densities. Fig 2.12 : Airy Model (Various columns of lead, iron, antimony and zinc with different densities are put in a basin filled with mercury. There is variation in the height of columns with varying densities above the level of mercury, but inside the mercury they are in a line of uniform depth). Line of Compensation Mercury Lead Iron Zinc Antimony

NSOU ? CC-GR-03 53 • Criticism 1. Pratt does not believe in law of floatation, but, if we look minutely the concept of Pratt, than we can see that there is a glimpse of law offloatation indirectly. 2. Pratt does not believe in the concept of "root formation" but very close perusal of his concept on isostasy, does indicate the glimpse of such idea indirectly. 3. Even though Pratt does '}it support the root concept directly, but indirectly he seems to be In agreement with the concept of mountains having roots in the denser medium i.e. sima. 4. Level of compensation at about 100 km depth in the lithosphere is not supported by most of the geologist. 2.3.4 Other Theories • Theory of Hayford and Bowie Two American geodesists J.F. Hayford (1868-1925) and W. Bowie (1872-1940) have propounded their concepts of isostasy (1924) almost similar to the concept of Pratt. According to them there is a plane where there is complete compensation of the crustal parts. Densities vary with elevations of columns of crustal parts above this plane of compensation. According to them, the crust is composed of lighter material under the mountains than under the tloor of the oceans. Therefore, there is inverse relationship between the height of columns of the crust and their respecti ve densities. There is such a zone below the plane of compensation where density is uniform in lateral direction. The level of compensation is supposedly located at the depth of about 100 km. However, it is true that the views expressed by Hayford and Bowie were in close agreement with those of Pratt. Hayford and Bowie were able to prove that the anomalies in gravity relate directly to topographic features. • Concept of Heiskanen Finnish scientist W. A. Heiskanen (1895-1971) had an attempt to compromise between the Airy and Pratt models. This hypothesis says that approximately two- thirds of the topography is compensated by the root formation (the Airy model) and one-third by Earth's crust above the boundary between the crust and the b substratum (the Pratt model).

NSOU ? CC-GR-03 54 2.3.5 Global Isostatic Adjustment From the above discussion it is clear that, there is no complete isostatic adjustment over the globe or there is no single theory ofisostasy to explain isostatic balance of the surface configurations. One of the reason is that our earth is still behaving unstable and thus geological forces (endogenetic forces) coming from within the earth very often disturb such isostatic adjustment. According to an estimate Himalayan mountain are still rising at the rate of 0.5 cm per years under the process of isostatic recovery. The isostatic adjustment in these areas could not be achieved till now. Endogenetic forces and their tectonic effects are the causes of imbalance on the surface but nature always tries to make an isostatic adjustment with itself. Similarly, sometimes climatic changes occur at such an extensive global scale that there is accumulation of thick ice sheets on the land surface and thus increased burden causes isostatic disturbance. Besides, exogenetic forces are trying to eliminate the differences on the surface of the earth and in this process they are peeling off, transporting down to far tlung places, and depositing them. In this process, isostatic balance is maintained by the underneath tlowage of material by subsidence at the place of depojition and upliftment at the peeling of place in their proportion to the denudation. Thus, the process of redistribution of materials ultimately restores the disturbed isostatic condition to complete isostatic balance. 2.4 Summary This unit deals with the study of the sudden movements on the earth's the layering of the earth's interior and the concept of Isostasy. 2.5 Glossary 1. Asthenosphere: The layer below the lithosphere that is marked by low seismic-wave velocities and high seismic-wave attenuation. 2. Body wave: A seismic wave that can travel through the interior of the earth. P-waves and S-waves are body waves. 3. Core: The center of Earth, an area constituting about 16% of the planet's volume and 32% of its mass. Made primarily of iron and another, lighter element possibly sui fur.

NSOU ? CC-GR-03 55 4. Crust: The uppermost division of the solid Earth, representing less than I % of its volume and varying in depth from 3 mi. to 37 mi. (5-60 km). Below the crust is the mantle. 5. Earthquake: The sudden release of stored elastic energy caused by the sudden fracture and movement of rocks along a fault. 6.
Epicenter: The point on the earth's surface directly above the focus (
hypocentrei of an earthquake. 7. Foreshock: An earthquake that is smaller than. and precedes. a "mainshock". Forcshccks tend to occur in the same area as the main shock. 8. Gutenberg discontinuity: Discontinuity in seismic velocity that marks the boundary between the core and the mantle: named after seismologist Bene Gutenberg. 9. Island arc: Chain of islands above a subduction zone. 10. Lithosphcrc: The outer, rigid shell of the Earth above the Asthenosphere. It contains the crust. continents. and plates. 11. Love wave: A major type of surface wave having a horizontal motion that is shear or transverse to the direction of propagation (travel). It is named after A.E.II. Love, the English mathematician who discovered it. 12. Low-velocity zone: Any layer in the Earth in which seismic wave velocities are lower than in the layers above and below. 13. Magnitude: Magnitude is a measure of the amount of energy released during an earthquake. It may be expressed using the Richter scale. 14. Mantle: The main bulk of the Earth, between the crust and the core, ranging from depths of about 40 to 3470 km. It is composed of dense silicate rocks and divided into a number of concentric shells. Under Eastern Canada, it can be found at around 40 km depth. 15. Moho: The boundary between the crust and the mantle in the earth. This is a depth where seismic waves change velocity and there is also a change in chemical composi- tion. 16. Outer core: Outer liquid shell of the Earth's core, probably iron with some oxygen: inner radius. 1221 km, outer radius, 3480 km.

NSOU ? CC-GR-03 56 17. P wave: Also called primary, longitudinal, push, pressure, dilatational, compressional, or push-pull wave. P waves are the fastest body waves and arrive at stations before the S waves, or secondary waves. 18. Rayleigh wave: A type of surface wave having a retrograde elliptical motion at the Earth's surface. These are the slowest. but often the largest and most destructive, of the wave types caused by an earthquake. 19. Richter Scale: Magnitude is measured on the basis of ground motion recorded by an instrument and applying standard correction for the epicentral distance from recording station. It is linearly related to the logarithm of amount of energy released by an earthquake and expressed in Richter Scale. 20. Ring of Fire: 40,000-km-long region that surrounds the Pacific Ocean known for its 452 volcanoes and 90% of the worlds earthquakes. Also called the Circum-Pacific belt, this zone of earthquakes includes 81% of the worlds largest earthquakes. 21. S wave: Also called shear, secondary, rotational, tangential, distortional, transverse, or shake wave. These waves carry energy through the Earth in very complex patterns of transverse (crosswise) waves. These waves move more slowly than P waves, but in an earthquake they are usually bigger. 22. Seismic wave: Seismic waves are vibrations generated by sudden movements of rock. After earthquakes occur, the seismic waves propagate from the hypocentre to the surface of the Earth. 23. Seismograph: A very sensitive instrument used to record and measure earthquakes. 24. Seismologist: A scientist who studies earthquakes, seismic sources, and wave propaga- tion through the Earth. 25. Seismology: The study of earthquakes, seis 26. mic sources, and wave propagation through the Earth. 27. Shadow zone: The area on the Earth's surface protected from seismic wave arrivals. 28. Surface waves: Waves that move over the surface of the Earth. Rayleigh and Love waves are surface waves. 29. Geodesy: Geodesy is the science of accurately measuring and understanding the Earth's geometric shape, orientation in space, and gravity field. NSOU ? CC-GR-03 57 30. Gravity Anomaly: Gravity anomalies are the differences between the observed accel- eration of Earth's gravity and the values predicted from some model of how the gravity would be predicted to appear. 31. Gravity: Gravity is the force by which a planet or other body draws objects toward its center. The force of gravity keeps all of the planets in orbit around the sun. 32. Isostasy: The vertical readjustment of the surface of the earth due to the addition or removal of weight. Commonly associated with the advance and retreat of glacial ice. 33. Isostatic Adjustment: The movement of the solid part of the earth until it is in balance; also called Isostatic compensation. The prime example of Isostatic adjustment is the continents "floating" on the denser parts of the crust. 34. Isostatic Equilibrium: The shifting of the rock beneath the Earth's crust in response to theshifting in the weight above the Earth's crust. 2.6 Questions A. Short Type (within 200 words) 1. How the composition and structure of Earth' layers are different as you go deeper into Earth? 2. What are the key elements of the structure of the earth? 3. What are the 4 major layers of the Earth and the predominant elements in each layer? 4. What are the categories when Earth is divided according to its chemical composition? 5. What are body waves? Explain in brief. 6. Explain the direct sources of information about the interior of the earth. 7. Why do earthquake waves develop shadow zone? 8. Briefly explain the indirect sources of information of the interior of the earth other than those of seismic activity. 9. What are the effects of propagation of earthquake waves on the rock mass through which they travel? 10. What is Rayleigh wave? 11. What are the differences between the inner core and the outer core?

NSOU ? CC-GR-03 58 12. Why is the outer core liquid, while the inner core is solid? 13. Which is denser-continental crust or oceanic crust? and why? 14. What information do earthquakes give you about Earth's interior? 15. How do waves behave differently in Earth's interior? 16. What is Lehman Seismic Discontinuity? 17. Which layer of the earth's interior has the lowest density and why? 18. What is Mohorovicic discontinuity? 19. What is Gutenberg Seismic Discontinuity? 20. What can earthquakes tell us about the interior of the earth? 21. What is the difference between the epicenter and the focus of an earthquake. 22. What are seismic waves and what is the difference between a P-wave, an S-wave? 23. For each increase of magnitude by a factor of I, how much more energy is released? 24. Which of the scales is more accurate measure of the energy released by large earthquakes and why? 25. What is the difference between the Richter's scale and the Mercalli Scale? 26. How does ground shaking during an earthquake depend on such things as distance from the epicenter and type of bedrock? 27. What are the causes of tsunami waves? 28. What are P-wave and S-wave shadow zones and what do they tell us about the interior of the earth? 29. What is the significance of the P-wave shadow zone? How does it arise? 30. What is the significance of the S-wave shadow zone? How does it arise? 31. What is Low Velocity Zone? 32. Explain the effects of earthquakes. 33. What is Isostasy and how does it pertain to Earth's mountains? 34. What is the concept of Isostasy? 35. How does Isostasy affect the earth's crust?

NSOU ? CC-GR-03 59 36. How would you tell if an area is in isostatic equilibrium? 37. What is meant by isostasy? 38. Explain the concept of isostasy according to Airy. 39. Explain the concept of isostasy according to Pratt.. 40. What do you mean by Heiskanen isostasy Model? 41. What is the concept of Hayford and Bowie regarding Isostasy 42. What do you mean by Global Isostatic Adj ustment? 43. How much of a mountain is b~ow the surface? 44. Where different topographic heights are accommodated by changes in crustal thickness, in which the crust has a constant density? 45. Identify the major Criticism of Airy's hypothesis: 46. What do you mean by Isostatic Compensation. B. Long Type (within 600 words) 1. Explain the elastic rebound theory on the cause earthquakes with diagram. 2. What is the global distribution of earthquakes? What can we learn from patterns in this distribution? 3. Compare mantle with Core on the basis of temperature, pressure and geological composition 4. Describe mineralogical and seismological characteristics of mantle. 5. Compare among P wave, S wave and L wave generated by earthquakes. 6. Describe the tectonic causes of earthquakes. 7. Describe major earthquake belts and explain causes of such distributions 8. Explain different seismic discontinuities in the earth's interior. 9. Explain the isostasy concepts of Airy and Pratt 10. Distinguish between Pratt and Airy concept of isostasy 11. Describe the concept of theory ofisostasy historically. 12. Explain the isostatic adjustment by various experiments. Explain the views of Airy in this regard.

NSOU ? CC-GR-03 60 Unit 3 ?Plate Tectonics : Processes At Constructive, Conservative, Destructive Margins And Hotspots; Resulting Landforms Structure 3.0 Objectives 3.1 Introduction 3.2 Mechanism of Plate Tectonics 3.3 Plate Tectonic Activities 3.4 Triple Junction 3.5 Merits and Demerits of Plate Tectonic Theory 3.6 Summary 3.7 Glossary 3.8 Question 3.0 Objective ? To learn about the Plalte Tectonic Theory and the various boundaries. 3.1 Introduction

Plate Tectonic Theory is a comprehensive theory explaining the structure of the earth's crust and many associated phenomena viz. mountain building, folding and faulting, continental drift, vulcanicity, seismic events (earthquakes) etc. resulting Fig. 3.1 : Model of plate tectonics VOLCANIC ARC TRENCH OCEAN SPREADING CENTRE C O N T E N E N TA L PLATE TRANSFORM OCEANIC PLATE RIDGE CONTINENTAL LITHOSPHERE ROOT ASTHENOSPHERE BENIOFF ZONE SUBDUCTED SLAB 60

NSOU ? CC-GR-03 61 from the interaction of rigid lithospheric plates which move slowly over the underlying mantle. The rigid lithospheric solid landmass having a thickness of about 100 km composed of Earth's crust and some portion of upper mantle are technically called 'Plates'.

The term 'plate' was first used by Canadian Geologist John Tuzo Wilson in 1965. The whole mechanism of the

evolution, nature and motion and resultant reactions of plates is called' Plate Tectonics'. • History of the Concept The concept of plate tectonics was formulated in the 1960s. But the theory of plate tectonics was not created from scratch by a genius' mind. Like every scientific theory, it results from centuries of observations and compilation of many scientists' works like continental drift theory by Wegner (1912), seafloor spreading theory by Harry Hess (1960), convection current theory by Arthur Holmes (1944) and theory of Paleomagnetism (1956). According to them the Earth's lithosphere is composed of seven major plates and many minor plates. The seven major plates are the African plate. Antarctic plate, Eurasian plate, Indo-Australian plate, North American plate, Pacific plate and South American plate. Dan Peter McKenzie and Robert Ladislav Parker discussed in detail the mechanism of plate motions on the basis of Euler's Geometrical Theorem in 1967. Prof. Harry Hess (1960) elaborated the mechanism of Plate movement on the basis of the evidences of sea floor spreading. WJ. Morgan and Le Pichon elaborated the various aspects of plate tectonics in 1968. However, the theory of plate tectonics developed by geoscientists during early 1960s is often described as a most revolutionary concept in the history of Earth's science. It is now widely accepted that most complex geological riddles, past and present, are solved conveniently by the concept of plate tectonics. Major Plates Pacific Plate, North American Plate, Eurasian, African Plate, Antarctic Plate Australian Plate, South American Plate Minor Plates Carribbean Plate, Cocos Plate, Caroline Plate, Juan de Fuca Plate, Juan Fernandez micro Plate, Iranian Plate, South sandwich Plate, Myanmar Plate, Anatolian Plate, Nazca Plate, Nubian Plate, Philippines Plate, Okhotsk Plate, Scotian Plate, Eastern micro Plate, Somalian Plate, Arabian Plate, Solomon Plate, Fiji Plate, Bismarck Plate.

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NSOU ? CC-GR-03 62 3.2 Mechanism Of Plate Tectonics The driving force behind plate tectonics is the ‘convection current’ in the mantle where heat from the Earth’s interior causes currents of hot rising magma and cooler sinking magma to flow, moving the plates of the crust along with them. Actually, convection currents beneath the asthenosphere move the crustal plates in differerit directions. The source of heat driving the convection currents is radioactivity deep in the Earth’s mantle. Hot material near the Earth’s core rises and colder mantle rock sinks. Two plates moving together under the impact of thermal convective currents collide against each other and the plate boundary having relatively denser material is sub-ducted under the other plate boundary of relatively lighter materials. This subduction zone is also called Benioff Zone. The subduction of plate boundaries
causes lateral compressive force which ultimately squeezes and folds the sediments
and material of the margins at the plates and thus mountains are formed. Three types offorces are responsible for moving of the plates. 1. Slab Pull: This force occurs as a subducting plate sinks into the hot mantle beneath it. The process of a tectonic plate descending into the mantle is termed subduction. Slab pull occurs when an oceanic plate subducts into the underlying mantle. The subducting plate, usually basalt, is denser than the material it is subducting into, purely due to its difference in temperature. As the plate sinks into the mantle, it acts to pull the rest of the plate behind it. This force is considered by some to be the primary force driving plate motion at collision zones. However, there are some plates, where there is little or no subduction occurring such as the Antarctic Plate. 2. Ridge Push: Gravitational force that causes a plate to move away from the crest of an ocean ridge is called ridge push force. Ridge pu~ is induced by the pressure gradient at the ridge crest due to its higher elevation with respect to the surrounding oceanic lithosphere. Actually, newly-formed plates at oceanic ridges are warm, and so have a higher elevation at the oceanic ridge than the colder, more dense plate material further away. So, gravity causes the higher plate at the ridge to push away the lithosphere that lies further from the ridge. Ridge push is still considered to be
NSOU ? CC-GR-03 63 of significance, especially where there is little or no slab pull acting on the plate (e.g. the Antarctic Plate). Fig. 3.2(a) : Ridge push effects 3.2(b) : convectional current 3.
Mantle Convection: Mantle convection is the slow creeping motion of Earth’s
solid silicate mantle caused by convection currents carrying heat from the interior.Heat in the interior is generated from the radioactive decay of elements which creates molten rock called magma in the asthenosphere. Convection currents transfer heat from one place to another by mass motion of molten rock. The heat transfer function of convection currents drives the plates. Molten rock rises up from the bottom after becoming hotter and less dense from the heat of the earth’s core. As the rock loses heat into the earth’s crust, it becomes relatively cooler and more dense, sinking back down to the core and completes the path as convective cell. The mantle’s convective motions break the lithosphere into plates and move them around the surface of the planet. These plates may move away from, move by, or collide with each other. Rates of Plate Movement Plates move at rates of about a few centimeters per year. Rate of plate movement is estimated based on radiometric dating of ocean crust. By determining the age of a crustal sample, and knowing its distance from the MOR at which it formed, scientists estimate the rate of new ocean floor as well as movement of the plates. Today, measurement of plate motion is done by satellite imageries. Results from this methods are more accurate. Sometimes,
the rate of plate movement is determined by the bands of normal and reverse magnetic fields that parallel the mid-oceanic ridge. However, the rates are of considerable variation. For example, while the Arctic Ridge has the slowest rate (less than 2.5 cm/yr), the East Pacific
NSOU ? CC-GR-03 64 Rise in the South Pacific has the fastest rate (more than 15 cm/yr).
An interesting fact is that the movement of Indian plate from south to equator was one of the fastest plate movements in history. 3.3

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Plate Tectonic Activities There are three kinds of plate tectonic boundaries: divergent, convergent, and transform plate boundaries. 1. Divergent Boundary A divergent plate boundary occurs when two tectonic plates move away from each other. Divergent plate boundary is also called as constructive plate boundaries, spreading boundary, or accreting plate boundary. Along these boundaries, basaltic lava eject through long fissures from below. These basalt lavas are cooled and solidified and are added to the trailing margins of the divergent plates and thus new oceanic crust is continuously formed. i) Divergent Plate Boundary - Oceanic When a divergent boundary occurs beneath oceanic lithosphere, the rising convection current below lifts the lithosphere, producing a mid-ocean ridge. Effects that are found at a divergent boundary between oceanic plates include: a submarine mountain range such as the Mid-Atlantic Ridge; volcanic activity in the form of fissure eruptions; shallow earthquake activity; creation of new seafloor and a widening ocean basin. ii) Divergent Plate Boundary - Continental When a divergent boundary occurs beneath a thick continental plate, the pull-apart is not vigorous enough to create a clean, single break through the thick plate material. Here the thick continental plate is arched upwards from the convection current's lift, pulled thin by extensional forces, and fractured into a rift-shaped structure. As the two plates pull apart, normal faults develop on both sides of the rift, and the central blocks slide downwards. Earthquakes occur as a result of this fracturing and movement. The East Africa Rift Valley is a classic example of this type of plate boundary.

NSOU ? CC-GR-03 65 Fig. 3.3 : Different types of plate Movements 2. Convergent Plate Boundary Convergent plate boundary' is those Jtere two plates collide against each other. They are also known as 'consuming plate boundaries' or 'destructive plate boundaries'. Here the leading edge of one plate having relatively lighter material overrides the other plate and the overridden plate boundary of relative denser material is sub ducted or thrust into the upper mantle and thus a part of the crust in lost in the mental. This is why convergent plate margins are called destructive margins. There are three types of convergent boundaries. i) Oceanic/Oceanic Convergent Boundary When a convergent boundary occurs between two oceanic plates, one of those plates which are older and denser will subduct beneath the other. The subducting plate is, therefore, heated as it is forced deeper into the mantle, and at a depth of about 150 km the plate begins to melt resulting into the creation of magma. Magma chambers that reach the surface break through to form a volcanic eruption cone. In the early stages of this type of boundary, the cones will be deep beneath the ocean surface but later grow to be higher than sea level. This produces volcanic island chain. Sometimes, this boundary includes a seafloor trench marking the earthquake-rattled subduction zone. An example of an oceanic/oceanic convergent boundary is that between the Pacific and Mariana plates, which includes the Mariana Islands arc and a subduction zone encompassing the Mariana Trench, the deepest part of the World Ocean. Japan, the Aleutian Islands, and the Eastern Caribbean islands of Martinique, St. Lucia, and St. Vincent and the Grenadines are examples of islands formed through NSOU ? CC-GR-03 66 this type of plate boundary. Other features of an oceanic/oceanic convergent bound- ary are the forearc basin between the trench and the island arc and the backarc basin on the opposite side of the arc. Powerful earthquakes shake a wide area on both sides of the boundary. ii) Continent/Continent Convergent Plate Boundary In this type of convergent boundary, a powerful collision occurs between two continental plates. Since neither plate is stronger than the other, they crumple and are pushed up. In general, they prevent subduction since both of the plates have a density much lower than the mantle. Although, there may be a small amount of subduction where or the heavier lithosphere below the continental crust might break free from the crust and subduct. However, due to such collision, fragments of crust or continent marginal sediments might be caught in the collision zone between the continents, forming a highly deformed melange of rock. The intense compression can also cause extensive folding and faulting of rocks up to hundreds of kilometers into the plate interior. The classic example of a continental/continental convergent boundary is the rumpled overlap where the Indian Plate drives into the Eurasian Plate, a tectonic collision that has thrown up the greatest mountains in the world - the Himalayas - as well as the vast, high Tibetan Plateau to the west. The process is believed to have started more than 50 million years ago and this is continuing. The Alps also grew in similar fashion via the collision of the African and Eurasian plates. iii) Continent/Ocean Convergent Plate Boundary When a continental plate meets an oceanic plate, the thinner, denser, and more flexible oceanic plate sinks beneath the thicker, more rigid continental plate. This is called subduction. Subduction causes deep ocean trenches to form. The rocks pulled down under the continent begin to melt. As a result volcanic arc develops on the continental side of the boundary. Other important effect between an oceanic and continental plate collision includes shallow earthquake activity along the continent margin. Ocean trench develops immediately off shore of the continent and a l ine of volcanic eruptions develops at the cost of destruction of oceanic lithosphere. The western coastline of the United States is a classic example of convergent plate boundary where the Juan de Fuca oceanic plate is subducting beneath the North

NSOU ? CC-GR-03 67 American continental plate. The Andes Mountain Range of western South America is another example of a convergent boundary where the Nazca Plate is subducting beneath the South American plate. 3. Transform Plate Boundary Two plates sliding past each other in a horizontal direction forms a transform plate boundary. This boundary is also known as conservative plate boundaries. Lithosphere
is neither produced nor destroyed as the plates slide horizontally past each other.
This is the only type of plate boundary which does not produce volcanoes or mountains. The fracture zone that forms a transform plate boundary is known as a transform fault. Most transform faults are found in the ocean basin and connect offsets in the mid-ocean ridges. Transform boundaries and the resulting faults produce many earthquakes because edges of tectonic plates are jagged rather than smooth. As the plates grind past each other, the jagged edges strike each other, as a result a lot of stress builds up at the fault line. This stress is released in quick bursts in the form of an earthquake when the plates suddenly slip into new positions. These structures are so-called strike-slip faults. The San Andreas Fault in western US, the North Anatolian Fault in Turkey, the Dolores-Guayaquil Mega fault in the 3.4 : World major crustal plates
NSOU ? CC-GR-03 68 northern Andes are some examples of huge strike-slip faults transecting continental crust. The best-studied strike-slip fault is the San Andreas Fault in California. It is located at the boundary between the Pacific plate (moving northwest) and North American plates (moving southeast) and runs roughly 1,300 km through Northern and Southern California. This fault connects the Ejiilt Pacific rise in the South and the Explorer ridge in the north. Both are divergent boundaries. Along this fault, the Pacific Plate has been grinding horizontally past the North American Plate for ten million years at an average rate of about 5 cm/yr. 3.5 The well-known Transform Boundaries of Africa A volcanic "hotspot" is an area in the mantle from which heat rises as a thermal plume from deep in the Earth. Many hot spots are located in the middle of a lithospheric plate. High heat and lower pressure of this region facilitates melting of the rock. This melt, called magma, rises through cracks and erupts to form volcanoes. Often the hot spot creates a chain of volcanoes. The best example of a hot spot volcanic chain is the Hawaiian Islands. Hotspots of the lithosphere are, therefore, unique feature because it does not occur at the boundaries of Earth's tectonic plates, where other volcanism occurs. The mantle plumes that form hots pots are thought to be relatively stationary, while tectonic plates are not. Scientists believe that there are about 40 to 50 hot spots around the world. Most hotspots, also known as "mantle
NSOU ? CC-GR-03 69 plumes," occur beneath oceanic plates; Yellowstone, however, is a good example of a hotspot beneath a continental part of a plate. Fig 3.6 Hotspot region of the world 3.4 Triple Junction The point where three lithospheric plates meet is known as Triple Junction. It has been suggested that mantle plumes are responsible for the upward doming of the crust at these locations, producing a three- way radial fracture. There are roughly 50 plates on Earth with about 100 triple junctions among them. An example is the Red Sea, Gulf Aden and East African Rift Valley. For convenience, geologists use the notation R (ridge), T (trench) and F (fault) to define triple junctions. For example, a triple junction known as an RRR could exist when all jBree plates are moving apart. But most triple junctions combine two trenches or two faults — in that case, they are known as RFF, TFF, TIF, and RTI. A triple junction involving three ridges (RRR triple junction) is always stable, while a triple junction between three trenches (TIT) is almost unstable. A triple junction between two ridges and a transform fault (RRF) can only exist for a short instant in geological time, and decays immediately to two FFR stable plate junctions. They are important as they provide a tool to calculate kinematic evolution of plate boundaries and their motion cause significant reworking of lithospheric material. Plate boundary Subduction Zone Prominent hotspot Plate boundary zones in which demormation is defuse and boundaries are not well defined Source: USGC (pubs.usgs.gip)
NSOU ? CC-GR-03 70 However, in nature, the seven types of stable triple junctions are identified. These include: • RRR: These are located in the South Atlantic, the Indian Ocean, and west of the Galapagos Islands in the Pacific. • TTT: This type of triple junction is found in central Japan. One of the best example is the the' Boso Triple Junction' where the Okhotsk, Pacific and Phillippine Sea plates meet. • TTF: Only one of these types of triple junctions is identified off the coast of Chile. • TTR: This type of triple junction is located on Moresby Island, western North America. • FFR, FFT: The triple junction type is found at the San Andreas Fault and the Mendocino Transform Fault in the Western U.S. • RTF: This type of triple junction is found at the southern end of the Gulf of California. Fig. 3.7 : Different types of triple junctions (a) RRR triple junction (b) TTT triple junction (c) RRF triple junction surface area created area of plate C consumed area of plate B consumed surface area created transform fault ocean trench R = Ridges F = Transform Fault t = Trenches

NSOU ? CC-GR-03 71 3.5 Merits And Demerits Of Plate Tectonic Theory • Merits 1. The theory of plate tectonics was advanced in the 1960s and 1970s to establish new information about the earth's ancient history as well as real mechanism behind the drifting of the continents as proposed by Wegener. 2. Plate tectonics focuses fundamental concept of geosciences which integrates many branches into a single proposal and suggests some basic assumptions based on geology and paleontology. 3. Plate tectonics defines the movements and features of the Earth's surface now and in the past. However, the greatest worth of Plate tectonics theory is to focus the location of earth's most devastating geological events like earthquake and volcanism. 4. Plate tectonic theory is the unifying theory of geology and geo physics. It establishes a framework into which all

large-scale geological phenomena, like earthquakes, volcanoes, and the existence of ocean basins and continents are explained with reliability. 5. This theory first explains the age distribution of oceanic crust as well as magnetic information in rocks in the oceans. • Demerits A number of objections have been raised to the theory of plate-tectonics. Some of them are as follows: 1. There are weak evidences of thermal convection in the mantle, which is mainly considered as the driving force for plate motion. 2. As the volume of the earth is static, then rate of creation of new plate and destruction of plate would be the same. But, in reality divergent plate boundary is quite larger than the convergent plate boundary. 3. The pushing down of solid lithosphere into the mantle to a depth as much as 700 km following convectional current is difficult to imagine. It is also not answer- able that how a ridge over the rising limb of a mantle convection cell would be carried down on the descending limb of the same cell.

NSOU ? CC-GR-03 72 4. The plate tectonic theory is unable to give the explanation of all the mountain building process in the earth. There are certain mountain ranges, such as the Eastern highlands of Australia, Drekenburg mountain of South Africa and Sierra- Dalmar of Brazil which are not related to plate tectonics. 5. No adequate explanation exists for why only the Pacific plate sub-ducted and destroyed and other oceanic floor is being extended. The length of spreading zone (ocean ridges) is far higher than the subduction zone (ocean trench). The rate of construction is more than the rate of destruction. 6. The finding of Precambrian and Cambrian rocks near the crest of the Mid- Atlantic ridge contradicts the theory of plate-tectonics. According to the plate tectonic theory the rocks of the sea- floor cannot be more than five or ten million years old. Despite all these criticisms and limitations, plate tectonic theory is a revolu- tionary and comprehensive attempt which scientifically explains the present distribution and arrangement of the continents and ocean basin. It also provides as satisfactory explanation of the distribution of volcanoes and earthquakes. It has also confirmed the theory of Continental Drift and theory of sea floor spreading. 3.6 Summary Plate tectonic theory in a unifying theory of geology and geophysics. The age distribution of oceanic crust as well as magnetic information in locks is well explained. This unit well explains the boundaries of the crust. 3.7 Glossary 1. Asthenosphere: the soft, flexible upper layer ofthe mantle, on which the tectonic plates move 2. Convection currents: m0'jrment within hot fluids, when the heat source is on the bottom, such as in a boiling pot of soup on the stove. Convection currents happen because the hotter material is less dense and rises; when it reaches the surface, it cools

NSOU ? CC-GR-03 73 and becomes less dense, so it sinks. This rising and sinking creates a circular motion within the fluid. 3. Convergent plate boundaries: where two tectonic plates move toward each other. 4. Crustal plate: A rigid layer of the Earth's crust that is believed to drift slowly. 5. Destructive plate margin: Tectonic plate margin where two plates are converging and oceanic plate is subducted - there could be violent earthquakes and explosive volcanoes. 6. Divergent plate boundaries: where two tectonic plates move away from each other. 7. Hot spots: Where the Earth's crust is thin so magma is able to break through the surface, forming volcanoes 8. Paleomagnetism: An area of historical geology devoted to studying the direction and intensity of magnetic fields in the past, as discerned from the residual magnetization of rocks. 9. Plate: One of the huge sections which make up the Earth's crust. The plates are continuously moving. 10. Plate boundary: The place where two or more plates in the Earth's crust meet. 11. Plate margins: Boundaries between plates. 12. Plate tectonics: The theory that the Earth's crust and upper mantle (the lithosphere) is broken into a number of more or less rigid, but constantly moving, segments or plates. 13. Seafloor spreading: The process by which new oceanic crust forms when magma rises up and solidifies at the mid-ocean ridges. The newer crust pushes the older crust out to each side, which is why the age of the sea floor increases with distance away from the mid-ocean ridges. 14. Seismicity: The frequency and distribution of earthquakes in a certain area, recorded by seismographs 15. Subduction zone: A dipping planar zone descending away from a trench and defined by high seismicity, interpreted as the shear zone between a sinking oceanic plate and an overriding plate. 16. Subduction: Movement of the edge of one tectonic plate under another. Subduction takes place at convergent plate boundaries.

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NSOU ? CC-GR-03 74 17. Transform plate boundary: where two tectonic plates slip past each other, moving in opposite directions. 18. Triple junctions: At most three plates can come together at a point; this is called a triple junction. 3.8 Questions A. Short Type (within 200 words) 1. What is lithospheric plate? 2. What is plate tectonics? 3. Explain the mechanism of plate movement. 4. Discuss the activities at plate margins. 5. Describe the distribution of earthquakes and volcanoes with the help of plate boundaries. 6. Describe the plate motions along the Himalayan Mountains. 7. Provide two kinds of evidence that support the theory of plate tectonics 8. How does the San Andreas Fault relate with the plate tectonics? 9. What is the driving force behind the movement of litho spheric plates on the Earth's surface? About how fast do the plates move? 10. What type of Plate Boundary is causing the Pacific Ocean to shrink? 11. What are the characteristics of a Subduction Zone? 12. How does the movement of plates cause earthquakes? 13. Name the types of tectonic plates that are colliding at African rift valley. What feature is being formed and why? 14. Name at least three types of evidence that a hotspot lies below Yellowstone National Park. 15. How many major tectonic plates have scientists identified? 16. What is a volcanic hotspot? 17. How does volcanic hotspot relate with the plate tectonics? 18. How do volcanoes help to identify the locations of plates boundaries?

NSOU ? CC-GR-03 75 19. What happens to magma at divergent boundaries? 20. Name three areas where plate boundaries may be located. 21. Where are most divergent boundaries located and why? 22. What happens when two plates made of continentallithosphere collide? 23. What happens when two plates made of oceanic lithosphere collide? 24. How are transform boundaries different from other types of boundaries? 25. What is an example of a convergent boundary at South America? 26. What is an example of a divergent boundary in the mid-Atlantic? 27. What three mechanisms of Earth's convecting system work together to cause plate motions? 28. Explain how mantle convection moves lithospheric plates. 29. Describe the three types of plate boundaries and whether they are prone to earthquakes and volcanoes. B. Long Type (within 600 words) 30. What are the three types of plate boundaries and what type of geologic activity is found at each? 31. How does the theory of plate tectonics explain the locations of volcanoes, earthquakes, and mountain belts on Earth? 32. Discuss the geological activities at different plate margins with diagrams. 33. What force(s) drives plate tectonics? What are the different types of plate boundaries and what geological features do they create? 34. Describe how plate tectonics processes lead to changes in Earth's surface features. 35. Explain in brief the geological activities of the hotspot areas.

NSOU ? CC-GR-03 76 Unit 4 ? Folds And Faults—Origin And Types Structure 4.0 Objectives 4.1 Introduction 4.2 Eperiogenic Movement 4.3 Orogenic Movement 4.4 Folding 4.4.1 Definition and Characteristics 4.4.2 Anatomy of a fold 4.4.3 Causes of Folding 4.4.4 Classification of fold 4.4.5 Influence of folds on landform 4.5 Faulting 4.5.1 Anatomy of Fault 4.5.2 Causes of faulting 4.5.3 Classification of faults 4.5.4 Influence of fault on landform 4.6 Summary 4.7 Glossary 4.8 Questions 4.9 References 4.10 Questions 4.0 Objectives ? The learners will learn about the movements within the earth ? The folding and faulting within the earth 4.1 Earth Movements The crust of the earth is not stable everywhere. It is always changing. There are certain forces and movements which are always active in shaping the eath's crust. The forces which lead to change the surface are generally termed as diastrophism or earth movements. There are two types of forces working on the earth's crust, i.e. i) Endogenic Forces and ii) Exogenic Forces. 76

NSOU ? CC-GR-03 77 Earth Movements i) Endogenic Forces : Endogenic forces originate within the earth itself. They are related to the heat of the interior and the problems of isostasy. They are also known internal processes. Accordingly they are of two types—a) slow forces and b) sudden forces. Slow forces bring about subsidence and elevation. The sudden forces include within their scope the earth quake and the volcanic eruptions. Due to these sudden effects considerable changes take place in the crust of the earth i.e. all of a sudden the areas are elevated or submerged. The energy of Endogenic forces is mostly generated by radioactivity of the interior minerals along with

rotational, tidal friction and primordial heat from the origin of the earth.

This energy due to geothermal gradients and heat flow from within

induces diastrophism and volcanism in the

lithosphere.

All processes that move, elevate or build up portions of the earth's crust

Endogenic Processes Slow movements Sudden movements (Diastrophism) Volcanism Earthquakes Vertical Horizontal (Epeirogenic/ (Orogenic/ Continental building) Mountain building) Upward Downward Forces of Forces of Compression Tension (E.g. Fold mountains) (E.g. Fault mountains) come under diastrophism. They include : a)

Orogenic processes involving

mountain building through severe folding and affecting long and narrow belts of the earth's crust;

b)
Epeirogenic processes involving uplift or warping of large parts of the earth's crust.
ii) Exogenic forces : Exogenic forces are connected with the atmosphere and consequently are external / to the earth. The
forces which derive their strength from the earth's exterior or originate within the earth's atmosphere
are callejr as exogenic forces or external forces. The action of exogenic forces results in wearing down and hence they are considered as land wearing forces. Weathering, mass wasting, erosion, and deposition are the main exogenic processes. All the exogenic processes are covered under a general term- denudation, which means strip off or uncover. The elements of nature capable of doing these exogenic processes are termed as
geomorphic
NSOU ? CC-GR-03 78 agents The common agents are the wind, water, waves etc.
An agent is a mobile medium (like running water, moving ice, winds, waves etc) which removes,
transport and deposits earth materials. Gravity and gradients are the
two things which make these agents mobile. The
gravitational force acts upon all earth materials having sloping surface and tends to produce movement of matter in the down-slope direction. This creates stress and induces deformation to the particles. 4.2 Epelrogenic Movement The word 'epeirogeny' was coined by G. K. Gilbert in 1890 from the Greek word epeiros (which means mainland) and genesis (which means birth). However, later on, the trem is expressed as 'upheavals' or 'depressions' of land. The movement is caused by a set of forces acting along an Earth radius, such as those contributing to isostasy and faulting in the lithosphere. Eperiogenic movement
is strictly vertical movement of continent and it acts along the radius of the earth. So it
is also known as radial movements of the earth. • The Features of Epeirogenic Movements (a) The most characteristicfeature of the epeirogenic movement is that there is no crumpling ofthe rock-beds. The beds remain near~ horizontal. (b) These earth movements affect areas of wide areal distribution. Exogenic Processes slump debris slide rock slide earth flow mud flow debris avalanche landslides weathering mass movements erosion deposition Physical Chemical Biological slow mass movements rapid mass movements running water ground water glaciers waves and currents winds running water ground water glaciers waves and currents winds creep solifluction solution carbonation hydration unloading & expansion temperature changes & expansion freezing, thawing & froast wedging
NSOU ? CC-GR-03 79 (c) The periods of epeirogenic movements are quite large. (d) These movements are reversible In nature. The same area may undergo upheaval followed by subsidence and vice versa. (e) They affect the thickness of the sedimentary series, being formed, at the time of their operation. (f) Epeirogenic or continent forming movements act along the radius of the earth; therefore, they are also called radial movements. Their direction may be towards (subsidence) or away (uplift) from the center. The results of such movements may be clearly defined in the relief. • Examples i) Uplift Examples of Relief : Raised beaches, elevated wave-cut terraces, sea caves and fossiliferous beds above sea level are evidences of uplift. Several places which were on the sea some centuries ago are now a few kms inland. For example, Coringa near the mouth of the Godavari, Kaveripattinam in the Kaveri delta and Korkai on the coast of Thirunelveli, were all flourishing sea ports about 1,000 to 2,000 years ago. The Cantabrian Coast of Spain on the Bay of Biscay has raised beaches reaching over 275 m above the water in some places, caused by an uplift of the land. ii) Subsidence Examples of Relief : Submerged forests and valleys as well as buildings are evidences of subsidence. In 1819, a part of the Rann of Kachchh in Gujrat was submerged as a result of an earthquake. The Andamans and Nicobars have been isolated from the Arakan coast by submergence of the intervening land. A large part of the Gulf of Mannar and Palk Strait is very shallow and has been submerged in geologically recent times. 4.3 Orogenic Movement
Orogenic movement is horizontal movements of plates or it is also known as the mountain forming movements which acts tangentially to the earth surface.
Due to this process, the crust is severely deformed into folds.
In true sense, Orogeny creates compression force which acts towards a point from two or more directions resulting into mountain building process where crust is severely deformed into several types of folds. The word Orogeny has been derived from the
Greek word 'Oros' meaning mountain. The term was first introduced by the American geologist G.K. Gilbert in

NSOU ? CC-GR-03 80 1890 to describe the process of mountain building as distinguished from epeirogeny. An orogen or orogenic belt develops when a continental plate crumples and is pushed upwards to form one or more mountain ranges; this involves many geological processes collectively called orogenesis. The processes of orogeny can take tens of millions of years and build mountains from plains or from the seabed. The topographic hjight of orogenic mountains is related to the principle of isostasy, that is, a balance of the downward gravitational force upon an up thrust mountain range (composed of light, continental crust material) and the buoyant upward forces exerted by the dense underlying mantle. An orogenic event may be studied: (a) as a tectonic structural event, (b) as a geographical event, and (c) as a chronological event. So, Orogenic events cause distinctive structural phenomena related to tectonic activity. It affects rocks and crust in particular regions, and it happens within a specific period. Orogeny is usually accompanied by folding and faulting of strata, development of angular unconformities and the deposition of clastic sediments in areas adjacent to the orogenic belt. Orogenies may result from subduction, and the under thrusting of continents by oceanic plates, continental collisions, the overriding of oceanic ridges by continents. Earth movements Endogenetic Exogenetic Diastrophism Erosion Weathering Sudden movements Epeirogenic or Continent forming Orogenic or Mountain building Upward Downward Tension Compression Earth- quakes Physical Ice Volcanoes Chemical Biological River Water Sea Wind Underground Water

NSOU ? CC-GR-03 81 4.4 Folding 4.4.1 Definition And Characteristics Folds are expressed in the wave like bending of the layers of rocks without their discontinuity. This bending or crumpling of rocks into folds is conditioned by the property of solid bodies to undergo plastic deformations. Folds are, therefore, developed in the country-rocks whenever the region is subjected to severe pressure or stress. So folds are the wave like secondary curvature induced on a planner surface. The resulting form is made up of a series of alternate crests and troughs. However, folds are of various size and form and rarely occur as isolated feature. The consecutive crests and troughs may be hundreds of kilometers apart for an exceptionally large fold, while the smallest folds may have several crests and troughs within a span of a few centimeters only. 4.4.2 Anatomy Of A Fold In any fold there can be distinguished geometrical elements with the help of which its morphology can be described. The main geometrical elements offolds are limbs, axis, hinge, angle offold, axial plane etc. Fig 4.1: Anatomy of a Fold

NSOU ? CC-GR-03 82 i) Limbs are lateral parts of a fold, where the layers are inclined in one direction. Any two successive limbs together constitute one individual unit of fold. It is also known as flank. ii) Hinge is the line running through the points of maximum curvature of any of the beds forming fold. The area adjacent to the maximum curvature of a fold is known as hinge area. iii) Core of fold isthe inner part of the fold adjoining the hinge of fold. iv) Profile/Axial plane is an imaginary plane which divides the folds into two. equal halves as symmetrically as possible. The axial plane may be vertical, horizontal, inclined or even a curved surface. v) Fold axis is the line of intersection ofthe axial plane with the horizontal surface. vi) Angle of a fold is the angle formed by the imaginary continuation offold limbs till their intersection. It may vary between 0° and 90°. vii) Plunge of the fold is the angle the fold axis makes with the horizontal. Most of the folds have plunges and therefore known as plunging folds. viii) Height of the fold is the vertical distance between the hinges of the adjacent anticline and syncline. It is also known as the amplitude ofa fold. ix) Width of a fold is the distance between the axi al lines of two adjacent anticlines or synclines. 4.4.3 Causes Of Folding Folding may be either due to tectonic causes or due to non-tectonic causes. The tectonic folding may be due to anyone or more of the following mechanisms. (a) Folding due to Tangential Compression : Lateral Compression is believed to be the main cause for throwing the rocks of the crust into different types of folds. In general, this primary force is believed to act at right angles to the trend of folds under the influence of the tangential stresses, folding may develop in any of the three ways: flexural folding, flowage folding and shear folding. (i) Flexural Folding : It is that process of folding in which the competent or stronger rocks are thrown into folds due to their sliding against each other under the influence

NSOU ? CC-GR-03 83 of lateral compression. In flexural folding, the amount of slip depends on a number of factors such as: thickness 0 fthe layers, nature of the contact, distance from the hinge point and type of the rocks involved. (ii) Flowage Folding : During the compression, the viscous or plastic mass like rock such as clays, shales, gypsum and rock salt etc get buckled up and deformed at varying rates suffering unequal distortion. In such cases the thickness of the resulting fold does not remain uniform. (iii) Shear Folding : Folding, sometimes, is attributed to shearing stresses rather than simple compression. In such a process, initially, numerous closely spaced fractures develop in the rock. In the second stage, different amounts of displacement occur and finally, the rocks take up folded due to shearing stresses. (b) Folding due to Intrusions : Magma intrusion from beneath has been found to be the cause of up arching of the overlying strata. In this region, highly viscous magma may be forced up and, as a result, the overlying sedimentary host rocks are bodily lifted up to provide space for the rising magma. (c) Folding due to Differential Compression : During the stage of compaction in a basin of sedimentary formation, strata results in warping or folding of different types. Such folds are, however, totally dependent on the load from above and are attributed to superficial causes. These are, therefore, non-tectonic folds. 4.4.4 Classification Of Fold The forms of folds are highly varied. Their classification is based on a number of different features. • ACCORDING TO THE CURVATURE AND SHAPE : Folds may be divided into the following types based on curvature or shape of the fold. i) Antiform : An Antiform is a fold which is generally convex upwards. So, here the limbs commonly slope away from the axial plane. ii) Synform : Synforrn is a fold which is generally concave upwards. The limbs, in a Synforrn commonly slope towards the axial plane.

NSOU ? CC-GR-03 84 DOME AND BASIN The Antiform which has more or less equal length and width and dips in all direction away from a central region is known as dome. On the other hand, when it dips from all directions towards a central region is known as basin. However, beds folded in the form of domes or basins commonly exhibit circular or elliptical outcrops on a level surface. So, domes are like circular anticlines with the oldest strata exposed in the middle while basins are like round synclines, with the youngest strata exposed in the core. ANTICLINE AND SVNCLINE Anticline and Syncline are the most common form of Antiform and Synform respectively. In an anticline younger beds are found upwards and therefore, the older rocks constitute tie core. On the other hand in case of syncline younger beds are found towards the core or the centre of curvature of the fold. Anticlines and Synclines always occur in succession in any folded region. iii) Anticlinorium : A large anticline with a number of secondary folds of smaller size developed on it is known as Anticlinorium. It is formed when the horizontal cornpressive tangential forces do not work regularly. iv) Synclinorium : A large Syncline with a number of secondary folds of both syncline or anticline of smaller size developed on it is known as Synclinorium. v) Box fold : The fold which has large flat area at the crest or trough and therefore, looks like a box is known as box fold. • ACCORDING TO THE LIMB DIRECTION OR DIP DIRECTION According to the dip direction folds are said to be symmetrical, asymmetrical, rnonoclinal, overturned, isoclinal etc type. i) Symmetrical : A fold is said to be symmetrical when its axial plane is vertical and as a consequence either of the limbs has the same amount of dip. ii) Asymmetrical : If the axial plane of a fold is inclined and as a result limbs have unequal dip the fold is known as asymmetrical.

NSOU ? CC-GR-03 85 Distinction between Symmetrical & Asymmetrical fold Symmetrical fold Asymmetrical fold 1. When two limbs of a fold are almost 1. When two limbs of a fold are of equal length, the shape of the fold mot equal in length, shape & size assumes symmetrical one. it appears asymmetrical. 2. Axial plane is vertical 2. Axial plane is inclined 3. Limbs have same amount of dip 3. Limbs have unequal amount of dip iii) Isoclinal : If, in any fold, the limbs have the same amount of dip towards the same direction, as a consequence limbs are parallel to each other; the fold is described as isoclinal. In this case axial plane may be vertical or inclined and therefore they are termed as vertical isoclinal and inclined isoclinal respectively. However, in all isoclinal cases, the inter limb angle varies between 0° and 10°. iv) Over or Overturned : If the axial plane is inclined to a considerable amount and as a result one limb seems to be turned under another the fold is described as over or overturned fold. Here both the limbs dip towards the same direction. v) Recumbent : When a fold is very much overturned so that its axial plane is horizontal or very nearly so (0° to 10°) it is known as recumbent fold. Fig 4.2 Different types of fold

NSOU ? CC-GR-03 86 vi) Over thrust fold : In extreme cases, fracture may occur in the fold due to excessive pressure and as a result, the upper limb of the recumbent fold slides forward over the lower one along the thrust plane. This type of fold is known as over thrust fold. vii) Nappe : The over riding portion of the thrust that has moved a long distance (generally a mile or more) at low angle is called nappe. After long erosion, portions of a nappe may become isolated remnants called klippe. • ACCORDING TO THE INTERLIMB ANGLE Folds may be classified into gentle, open, closed or tight category based on interlimb angle. i) Gentle : If the inter limb angle ofa fold varies between 120° and 180°, the fold is known as gentle type. ii) Open : Open fold is one in which inter limb angle may vary between 90 ° and 120°. iii) Closed : If the interlimb angle of a fold is greater than 30° but less than 90° the fold is said to be closed one. iv) Tight : If the inter limb angle of a fold is less than 30°, it is described as tight fold. • OTHER CATEGORY Formation of some folds depend on different factors like nature of rocks, duration of the compressive forces, elasticity of rocks etc. the main varieties of such folds are as follows : i) Monocline : The fold in which beds are relatively tlat but appears to have been locally to exhibit higher dips is known as monocline fold. It is sometimes described as half a fold. It is form by vertical movement and generally found fault below monocline. ii) Plunge : In most cases the axes of simple folds are commonly horizontal. if the axis of the fold is no longer remain horizontal and slopes towards some direction, the fold is called plunging or plunge fold. However, the angle between the axis of the fold and the horizontal is known as the plunge. In anticline, plunge is directed towards nose and in syncline it is directed away from nose.

NSOU ? CC-GR-03 87 Fig 4.3 Plunging and Non-plunging fold iii) Fan : If, in any fold, both the limbs are overturned and therefore looks like a fan, is described as a fan fold. It may be anticlinal fan fold or synclinal fan fold. In this case the limbs of anticlines dip towards each other and the limbs of synclines dip away from each other.

iv) Chevron : A chevron fold is one in which the crest or hinges are sharp angular and limbs are of equal length and straight. Well developed, these folds develop repeated set of v-shaped beds. They develop in response to regional or local compressive stress. Inter-limb angles are generally 60 degrees or less. v) Drag : A drag fold is a minor fdfd formed either subsidiary to a main fold or along the side of a fault where the vertical displacement has made tlexures and puckers in the rocks on either side. They are generally asymmetrical in nature. vi) Doubly plunging : Folds do often plunge along two opposite directions and are then described as doubly plunging folds. 4.4.5 Influence Of Folds On Landform i) Ridge-Valley Topography : In the initial stage anticlines and synclines have come into existence with little erosional modification and the anticlines form mountain crests and syncline forms valley or troughs. Therefore, in a vast folded

NSOU ? CC-GR-03 88 area, anticlines and synclines show up as long linear parallel anticlinal ridges and synclinal valleys. This is known ridge and valley topography. Trellis drainage pattern generally develop in this area where consequent streams flow along the valley and subsequent streams join into the valley at almost right angles. ii) Inversion topography : In folded areas, the crest of the mountains or anticlinal ridge is a weak zone as the area shows maximum curvature. As a result, erosion opens up the anticline and rivers are developed. Further erosion of the anticlines by the rivers decreases its height and the eroded materials may deposit into the nearby synclinal valleys. Thus the synclinal structure of the mountain remains high, forming mountains while the anticlinal structure eroded by the river, forms a valley. This type of landform is known as inversion of relief. iii) Hogback and Cuesta topography : Hogbacks are the resistant remnant of eroded and folded layers of, rocks. It has linear sharp ridge on steep dipping sedimentary rocks, the opposite slope of which may be symmetrical in shape. They generally develop when dip angle of rock layers exceed 45°. Here dip anglel and erosional slope is more or less equal. While Cuesta is an asymmetrical ridge with long gentle slope (1° - 20°) corresponding to the dip of a resistant bed and a steep slope on the cut edges of the beds. This type of land form generally develops in an open fold areas. iv) Homoclinal ridge and Valley topography : Homoclinal ridge and valley are the most striking landforms encountered in areas of folded structure. Homoclinal ridges develop upon the dipping beds on the flanks ofanticlines and synclines while Homoclinal valley may develop when a belt of weak rocks lie between resistant beds. v) Zigzag ridge topography : If the axis of a fold does not remain horizontal for long distances the fold tapers to an apex where the limbs meet, typically in a V-shape. Such features are called plunging anticlines and plunging synciines. Sometimes, the ridges formed due to dissection of folds will not run parallel but converge in the direction of pitch of an anticlinal fold, and in the opposite direction in a syncline. This gives rise to a pattern of converging and diverging or zigzag ridges.

NSOU ? CC-GR-03 89 4.5 Faulting

A fault is a fracture in the earth's crust along which movement has taken place and where the rock strata on the two sides therefore do not match.

When the earth's crust bends folding occurs, but when it cracks, faulting
happens. So, in contrast with joints, faults are well defined cracks along which the rock masses on either side have suffered relative displacement. This displacement may occur in any direction and its magnitude may vary between wide limits. Faulting may be caused by tensional force or compressional force. Usually earth movements generate tensional forces that tend to pull the crust apart and faults are developed. 4.5.1 Anatomy Of Fault Like a fold a fault has different elements and definition of these elements is summarized below. i) Strike : The direction of the line along which an inclined bed of a fault intersects a horizontal plane is known as the strike of the bed. ii) Dip : Dip
of the fault is the angle between a horizontal surface and the plane of the fault.
It is measured in a vertical plane lying at right angles to the strike of the fault. It ranges in between 0° and 90°. iii) Hade : Hade is the angle which the fault plane makes with the vertical plane. It is commonly I determined by the subtraction of dip from 90°. iv) Fault plane : Fault plane is the plane along which the displacement takes place. The total displacement due to a fault is described as its net slip. Fig 4.4 : Anatomy of a Fault Sedimentary beds
NSOU ? CC-GR-03 90 v) Hanging wall and foot wall : In case of an inclined the two blocks are laying on both side of fault plane, and generally one of the di.!tocated blocks appears to rest on the other. The former is called the hanging wall and the later the foot wall. In simply, the part above the fault plane is known as the hanging Plane and the one below it is the foot wall. vi) Up thrown & down thrown side : In any fault one of the dislocated blocks appears to have been shifted downwards in comparison with the other. The former, therefore, is known as the down thrown side while the later up thrown side. vii) Throw & heave : The throw of a fault is the vertical component of the apparent displacement of a bed measured along the direction of dip of the fault. Similarly the horizontal component of the apparent displacement is known as heave or gape. 4.5.2 Causes Of Faulting Faults are generally caused under the influence of stresses acting upon the rocks of the crust of the earth from within. Any rock on or below the crust may withstand all the operating stresses up to a limit, which depends upon its cohesive strength and internal friction. But, when that limit is crossed by the operating stresses, the rock yields by fracturing or breaking along certain directions. After the development of these fractures, the blocks created along the fractures suffer sudden (or gradual) displacement along these fractures. The displacement may take place essentially along the fracture surface or in different directions and for different distances depending upon the magnitude of the operating stresses thus giving rise to different types of faults. So, both Tensional tectonic forces and shearing tectonic forces are responsible for faulting. Tensional tectonic forces pull in opposite directions in a way that stretches and thins the impacted part of the crust. Rocks, however, generally are stressed and broken rather than bending or stretching plastically, when subjected to tensional forces. Broken discrete blocks, called fault blocks, are then separated from each other by normal faults. In order to accommodate the extension of the crust, one crustal fault block slides downward along the normal fault relative to the adjacent
NSOU ? CC-GR-03 91 fault block. The direction of motion along a normal fault is opposite to that along a reverse or thrust fault. Anderson (1905, 1951) showed that the three major classes of faults (reverse, normal, and strike-slip) result from the three principal classes of inequality that may exist between the principal stresses. 4.5.3 Cassification Of Faults There are two main basis of classification of faults—Genetic and Geometrical. Sometimes faults are also classified on the basis of dip of the fault plane and the direction of relative movement of the rocks on its two sides. However, here all the classifications are discussed briefly. • GENETIC CLASSIFICATION i) Normal fault : A normal fau1t is one
in which the hanging wall has apparently moved down with respect to the footwall.
They are caused exclusively by the tensional forces and in these faults, the maximum stress is vertical. So they are called vertical fault or gravity fault or tensional fault. The fault plane is usually inclined at an angle between 45° and 90°. However, due to the incluned nature of the fault plane and downward displacement ofa part of the strata, normal faults cause an extension in the crust wherever they occur. Fig 4.5 : Types of Fault Reverse fault Normal fault Thrust fault Strike-slip fault

NSOU ? CC-GR-03 92 ii) Reverse fault : A reverse fault is one in which the hanging wall moves relatively over the footwall. They are regarded as a shear deformation under the conditions of compression ofthe earth's crust and the maximum stress is horizontal. In reverse faults, the fault plane is generally inclined between horizontal and 45 degrees although reverse faults with steeply inclined fault surface have been also encountered. Distinction between Symmetrical and Asymmetrical fold Normal fault Reverse fault 1. A normal fault is one in which the 1. A reverse fault is one in which the hanging wall has apparently moved hanging wall moves relatively over down with respect to the footwall. the footwall. 2. Normal faults are caused by 2. Reverse faults are caused by tensional force. compressional forces. 3. Normal faults generally cause 3. Reverse faults result shortening extension of surface area. of the surface area. 4. In normal fault vertical stress is 4. In reverse fault vertical stress is maximum while horizontal stress minimum while horizontal stress is minimum. is maximum. 5. The fault plane is usually inclined 5. The fault plane is usually inclined at an angle between 45° and 90°. at an angle between 40° and 0°. 6. A normal fault has a steep, 6. Reverse fault also produces steep straight fault scarp. With passing scarp but this will not stay for time there develops a prominent long and therefore there was no fault line scarp. prominent fault line scarp. 7. Normal faults are known as gravity 7. Reverse faults are known as thrust fault or tensional fault. fault or Compressional fault. Fig 4.6 : Anatomy of Normal and Reverse fault

NSOU ? CC-GR-03 93 iii) Thrust fault : Fault in which the hanging wall has moved up in relation to the foot wall and fault plane dipping an angle of less than 45° is known as thrust fault or low angle reverse fault. Over thrusts are those in which the initial dip is 10° or less and the net slip is measurable in terms of kilometers. While, in case of under thrusts the dip is also 10° or less and the foot wall side moved and pushed itself underneath the hanging wall. Fig 4.7 : Thurst fault iv) Nappe : Due to continuedjsorizontal movements and compressive force a large solid rock may move a long distance, preferably a mile or more at low angle over the underlying rocks either by over thrusting or recumbent folding. Such broken portion is known as nappe. Several examples of nappes are traceable in the vast fold mountains like Alps or Himalayas. • GEOMETRIC CLASSIFICATION i) Strike slip fault : The fault where displacement remains essentially parallel to the strike of the fault is described as the strike slip fault. So vertical displacement is almost nil. They are formed when there is strong horizontal movement along the fault plane. These are also known as transcurrent, transform or tear faults. In case of tear fault the strike of the fault is transverse to the strike of the country rock but the displacement is along the strike of the fault plane. When the displacement occurs to the left on the far side of the fault, the fault is known as left-lateral or sinistral faults while the displacement takes place to the right on the far side of the fault the fault is known as right-lateral or dextral fault. Nappe Thrust plare 100 Km

NSOU ? CC-GR-03 94 ii) Dip slip fault : Dip slip fault is a normal or reverse fault on which the only component of movement lies in a plane normal to the strike of the fault surface. Here vertical displacement is only found and there is no horizontal displacement. iii) Diagonal slip fault : A vertical or inclined fault where displacement occurs in any direction other than the direction of dip and strike of the fault plane is described commonly as a diagonal or oblique slip fault. Here both vertical and horizontal displacement occurs together. Fig 4.8 : Types of fault • BASED ON THE DIRECTION OF RELATIVE MOVEMENT OF THE ROCKS ON ITS TWO SIDES. i) Strike fault : A vertical or inclined fault that strikes parallel to the strike of the country beds (not parallel to the strike of the fault plane) is known as strike fault. the dip of the strata involved. Here fault line & strike of the country rocks are parallel to each other. ii) Dip fault : Dip fault is a vertical or inclined fault that strikes parallel with the dip of the strata involved (not parallel to the dip of the fault plane). Here strike of the fault plane & strike of the country rocks lie at right angle. iii) Bedding fault : A bedding fault is oriented essentially parallel to the bedding planes of the country rocks. it is, therefore, a special case of strike fault.

NSOU ? CC-GR-03 95 iv) Diagonal fault : The fault that strikes in any inclined direction with respect to the strike of the country rock is known as diagonal fault. • OTHER FAULTS i) Parallel fault : When there lie a series of fault having the same dip & strike parallel fault may develop. It may be vertical or inclined. Fig 4.9 : Parallel Fault ii) Step fault : If the successive blocks of parallel fault are downthrown more & more towards a particular direction, it looks like the steps in a staircase and sesulting structure is known as step fault. iii) Peripheral fault : Curved faults of more or less circular or arc like outcrop on a level surface are described commonly as peripheral fault. iv) Radial fault : When a number of faults radiate in different direction from a particular point, the structure is known as radial faults. Fig 4.9 : Step fault v) Hinge faults : Hinge faults are produced by rotational movement between two fault blocks where the displacement increases from zero to a maximum alone the strike.

NSOU ? CC-GR-03 96 vi) Pivot fault : In a pivot fault one block appears to have rotated about a point on the fault plane such that for part of its length the fault is normal with decreasing throw. TRANSFORM FAULT A large scale strike slip fault between or within crustal plates with displacement wholly or mostly in the horizontal plane is known as transform fault. They are largely found on the ocean floor. They cut across and offset the rift zones of mid oceanic ridges, throughout the world. The most important surface expression of transform faults are San Andreas fault, California fault, Alpine fault, Philippines fault etc. 4.5.5 Influence Of Fault On Landform i) Block Mountain and Horst : Block Mountain or Horst is the common features in a faulted region. Block Mountain may be formed by the up throwing of a block on one side of pair of parallel fault. Thus the up thrown block stands like a mountain and is known as Block Mountain. They are generally bounded by a fault scarp on one side & gentle slope on the other side. The mountain ranges of the Great Basin of the USA belong to this category. The Western Ghats in India, Sierra Nevada in USA etc are the characteristic example of Block Mountains. When the blocks are thrown up in between fault planes, these are known as Horsts. These horsts have scarp like slopes. In this case the central block is not only up thrown but the side blocks are also relatively down thrown so that the whole mass appears like a dome. The Black Forest Mountain in Germany, the Vosges in France, the Satpuras & Vindhyans in India etc are the common examples of Horsts. ii) Rift Valley or Grabben : A narrow block dropped down between two normal faults is a Rift valley. They are usually long & narrow. Tensional forces are generally responsible for the formation of such valley. A rift valley is known as Graben in German language. The Grate lakes of Africa, Dead Sea of Israel, the red Sea, the Rhine valley in Germany, the Normada & the Tapi valley in India are considered to be the examples of rift valleys.

NSOU ? CC-GR-03 97 iii) Ramp valley : Sometimes a rift valley may result from the forcing down of a central block along reverse fault. Such depressed valley between two reverse fault is known as Ramp valley. Some stretches of the Brahmaputra valley is considered to be the example of Ramp valley. iv) Fault scarp and fault line scarp : The steep topographic slope caused by faulting is known as fault I scarp. Normal fault gives rise to scarp which is rather steep and straight slope while reverse fault generally results fault scarp with oVjihanging cliff. As erosion proceeds, the cliff or scarp gradually disappears and irregularities of relief may rise along the line of the fault due to forces of erosion, leaving the actual fault line buried beneath sediments. This is known as fault line scarp. Fault line scarp generally develops in the second or third cycle of erosion. So the fundamental difference between a fault scarp and fault line scarp is that the former is produced by movement of the fault, whereas the latter is produced by differential resistance to erosion on either side of the fault line. There may develop two different types offault line scarp, such as: a) Resequent fault line scarp : When the soft rocks constitute the down thrown side of a fault scarp it continues to lower the ground and the new scarp facing in the same direction as in the original fault scarp. This is known as Resequent fault line scarp. b) Obsequent fault line scarp : When the hard rocks constitute the down thrown side and soft rocks the up thrown side of a fault scarp, the long continued erosion will produce reverse condition i.e. up thrown side will now become down thrown. Such a fault line scarp facing the opposite way to the original fault scarp is known as Obsequent fault line scarp. v) Composite fault scarp : According to cotton In 1917, composite fault scarp may develop in a faulted region where the scarp height is due partly to differential erosion and partly to fault movement. A typical example of such fault scarp is found in the northern portion of East Humboldt Mountain in USA. vi) Waterfall, spring and lakes : Sometimes fault develops in the river course as a result of earth's movement and with palsing time fault line scarp produces rapids or waterfall. Sometimes such faults may block river flow and develop lake. Sometimes, under ground water may come out along the fault plane and/ault scarp spring develop.

NSOU ? CC-GR-03 98 4.6 Summary The crust is not stable everywhere. There are various Endogenic and Exogenic forces that are operating with the earth's crust and hence folding and faulting taking place. 4.7 Glossary 1. Amplitude : Half the height of the structure measured from crest to trough 2. Arc length : The distance between two hinges of the same orientation measured over the folded surface 3. Axial surface : The surface containing the hinge lines from consecutive folded surfaces 4. Crest : The topographically highest point of a fold, which need not coincide with the fold hinge 5. Cross section : A vertical plane through a fold 6. Culmination : High point of the hinge line in a noncylindrical fold 7. Cylindrical fold : Fold in which a straight hinge line parallels the fold axis; in other words, the folded surface wraps partway around a cylinder 8. Depression : Low point of the hinge line in a noncylindrical fold 9. Fold axis : Fold generator in cylindrical folds 10. Hinge : The region of greatest curvature in a fold 11. Hinge line : The line of greatest curvature 12. Limb : Less curved portion of a fold 13. Non-cylindrical fold : Fold with a curved hinge line 14. Profile plane : The surface perpendicular to the hinge line 15. Trough : The topographically lowest point of a fold, which need not coincide with the fold hinge 16. Dip slip : Offset parallel to dip (up or down) 17. Faults : Deep cracks caused by movement of rock during earthquakes. Different rock types are often seen on each side of a fault. 18. Folds : Bending of rock layers caused by compression of rocks, usually as part of

NSOU ? CC-GR-03 99 mountain-building when tectonic plates collide. 19. Footwall : Block of rock below fault plane 20. Grabens : Down-dropped fault blocks. 21. Hanging Wall : Block of rock above fault plane 22. Horsts : Uplifted fault blocks. 23. Joints : Fractures in the rock which have opened up perpendicular to the walls (or faces), generally without any shearing of one side past the other 24. Low-angle fault : Dip 10-30 deg. 25. Normal Faults : Dip-slip fault in which hanging wall moves down relative to footwall 26. Oblique slip : Offset oblique to fault dip. 27. Reverse Faults : High-angle, dip-slip fault in which hanging wall moves up relative to footwall 28. Steep fault : High angle dip (60° - 80°) 29. Strike slip : Offset parallel to fault strike 30. Strike Slip Faults : Hanging wall and footwall offset along strike of fault plane (neither up or down) 31. Strike slip : Left or right lateral 32. Thrust : Often low angle - offset up dip 33. Thrust Faults : Low-angle, dip slip fault in which hanging wall moves up. 4.8 Questions A. Short Type (within 200 words) 1. What is faulting? 2. How are Fold Mountains formed? 3. Discuss four main features of faulting 4. Explain three types of faults. 5. What are limbs? Explain it with the help of a diagram. 6. The orientation ofa plane in space is expressed by its attitude; a term consisting of two components, strike and dip. Define strike and dip.

NSOU ? CC-GR-03 100 7. Why do normal faults tend to be steeper than reverse faults? 8. How could dome-and-basin patterns form? 9. How does nappe form? 10. How does transform fault develop? 11. Which forces cause faulting and folding? 12. How Block Mountains are formed? 13. Explain the anatomy of the fold. 14. What is drag fold? 15. Distinguish between resequent fault line scarp and obsequent fault line scarp. 16. Distinguish between fault scarp and fault line scarp. 17. What do you mean by low angle and high angle fault? 18. How parallel fault is developed? 19. How does chevron fold form? 20. Distinguish between normal and reverse fault. 21. Explain major differences between fold and fault. 22. What is the difference between a strike-slip fault and a dip-slip fault? Use a simple diagram showing each. 23. What is the difference between symmetrical and asymmetrical fold. 24. Distinguish between thrust fault and reverse fault. 25. Distinguish between recumbent and overturned folds. 26. Draw and label a diagram depicting the different parts of a fault. 27. Define strike and dip of a fault. 28. Draw a cross-section of a fold labeling axial plane and limbs. B. Long Type (within 600 words) 29. What is a fault and what are the different types? 30. How are the different types offaults classified? 31. Define fold. Descri be different parts of a fold with diagram. 32. How fault is formed? Describe anatomy of a fault. 33. Classify fold based on axial plane and describe each with diagram.

NSOU ? CC-GR-03 101 34. Describe causes offolding and faulting. 35. Describe different landforms produced by folding. 36. Describe different topographic expressions developed by faulting. 4.9 References 1. Allaby A. and Allaby M. (eds.) (1999): A Dictionary of Earth Sciences" Oxford University Press: Oxford UK. 2. Anderson, D. L. (2007): New theory of the Earth. Cambridge University Press, Cambridge. 3. Barrell, J. (1914): The strength of the Earth's crust. VI. Relations of isostatic movements to a sphere of weakness - the asthenosphere, J. of Geology, 22, 655-683. 4. Beloussov, V. V.(1981): Geotectonics, Springer. 5. Billings. M.P. (1972): Structural Geology, 3rd ed. (Prentice-Hall, Englewood Cliffs. New Jersey). 6. Boyd, O. S., Jones, e. H. and Sheehan,

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Unit 5 ? Degradational Processes : Weathering, Mass Wasting and Resultant Landforms Structure 5.0 Objectives 5.1 Introduction 5.2 Types of Weathering 5.3 Controlling Factors of Weathering 5.4 Climate and Weathering 5.5 Differential Weathering/Rates of Weathering 5.6 Weathering of Major rock types 5.7 Products of Weathering 5.8 Topography related to Differential Weathering and Erosion 5.9 Degradational Processes : Mass Wasting 5.10 Types of Mass Wasting 5.11 Summary 5.12 Model Questions 5.0 Objectives ? T ? T ? T 5.1 Introduction Weathering is the breakdown and alteration of rocks at Earth's surface through physical and chemical reactions with the atmosphere and the hydrosphere. Joints and fractures facilitate weathering because they permit water and gases in the atmosphere to attack a rock body at considerable depth. They also greatly increase the surface area on which chemical reactions can occur. The major products of weathering are spheroidal rock forms, a blanket of regolith, and dissolved ions. Soil is the upper part 103 NSOU ? CC-GR-03 104 of the regolith—a mixture of clay minerals, weathered rock particles, and organic matter. Climate and rock type greatly influence the type and rate of weathering. Erosion is the physical
removal and transportation of weathered material by water, wind, ice, or gravity.

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Weathering is the physical disintegration or chemical alteration of rocks at or near the Earth's surface. Weathering process occurs at or near the Earth's surface and produce changes to the landscape that influences surface and subsurface topography and landform development. Weathering is the breakdown and alteration of rocks at Earth's surface through physical and chemical reactions with the atmosphere and the hydrosphere. By definition, weathering is different from erosion. Weathering involves only the breakdown of rock, whereas erosion involves the removal of debris produced by the breakdown. In reality, however, weathering and erosion are intimately involved with one another. Weathering disintegrates solid rock and produces loose debris. Erosion by running water, wind, and ice removes the debris and exposes fresh rock, which is then weathered, and the cycle continues. The results of weathering are seen everywhere, from the debris along hill slopes to decomposed monuments of antiq- uity. In weathering, rocks adjust and are altered to forms more stable at low pressure, low and fluctuating temperatures, and the chemical environment with abundant water that prevails at Earth's surface. Thus, metamorphic rocks and igneous intrusions are generally most susceptible to weathering. 5.2 Types of weathering Weathering, involves a multitude of physical, chemical, and biological processes, but three main types of weathering are recognized: (A) Physical weathering: Physical weathering is the mechanical fragmentation of rocks from stress acting on them. Physical (or mechanical) weathering breaks the rock mass into small particles. It is strictly a physical process involving no change in chemical composition. It is strictly a physical process involving no change in chemical composition. Ice wedging may be the most important type. Examples: exfoliation, frost wedging, salt wedg- ing, temperature changes, and abrasion. (B) Chemical weathering: Chemical weathering involves chemical reactions with minerals that progressively decompose the solid rock. Chemical weathering alters the rock by chemical reactions between elements in the atmosphere and those in the rocks. Most geologists believe that chemical weathering is most important in terms of total amount of rock breakdown.
NSOU ? CC-GR-03 105 The major types of chemical weathering are dissolution, carbonation, hydration, acid hydrolysis, and oxidation.In most places, however, the two processes work together, each facilitating the other, so that the final product results from a combination of the two processes. (C) Biological weathering is the disintegration or decay of rocks and minerals caused by chemical or physical agents of organisms. Examples: organic activity from lichen and algae, rock disintegration by plant or root growth, burrowing and tunnelling organisms, and acid secretion. Joints and fractures facilitate weathering because they permit water and gases in the atmosphere to attack a rock body at considerable depth. They also greatly increase the surface area on which chemical reactions can occur.The major products of weathering are spheroidal rock forms, a blanket of regolith, and dissolved ions. Soil is the upper part of the regolith—a mixture of clay minerals, weathered rock particles, and organic matter.Climate and rock type greatly influence the type and rate of weathering. 5.3 Controlling factors of Weathering A. Different types of Mechanical Weathering: 1. Block disintegration due to temperature change have great impact upon many rocks. Due to differential heating and repetition of expansion and contraction of outer rock layers due to diurnal range of temperature in the hot desert areas causes tension and stress which introduce parallel joints in the rocks. The rocks then are disintegrated along the joints and broken big blocks are dislodged from main rock mass and often fall down slope due to gravity. 2. Exfoliation due to unloading is a mechanical weathering process whereby the rocks which are buried under thick covers of overlying rocks are disintegrated, when they are exposed to the surface due to removal of superincumbent load, consequently the pressure in the rock is released along parallel alignments near the surface of the bedrock and layers or slabs of the rock along these alignments break off from the bedrock and move downhill by gravity. Often this phenomenon is called Sheeting (R. H. Jahns, 1943). Cambering process refers to fracturing of brittle sandstone beds along

NSOU ? CC-GR-03 106 vertical joints due to expansion caused by unloading of super incumbent load and consequent release of confining pressure (G. W. Bain, 1931 and C. D. Olier, 1969). Process of Spalling refers to the development of platy rock fragments, irregular shaped in the rocks due to unloading of super incum- bent load. 3. Exfoliation due to temperature and wind also called Onion Weathering refers to peeling off concentric shells of rocks due to combined actions of heat and wind in hot arid and semi-arid region. It is common in crystalline rocks where the outer shell of rocks become loose due to alternate expansion and contraction due to high temperature during day and low temperature during night respectively and these loosened shells are removed by strong winds. 4. Frost wedging is a mechanical weathering process caused by the freeze- thaw action of water that is trapped between cracks in the rock. This process gradually weakens, cracks, and breaks the rock through repetitive freeze- thaw weathering cycles. When water freezes, it expands and applies pressure to the surrounding rock forcing the rock to accommodate the expansion of the ice. 5. Granular Disintegration due to temperature changes is often not the dominant form of weathering, but instead temperature changes tend to accelerate other forms of weathering already occurring. This process is more common in desert climates because they experience extreme fluctuations in daily temperature changes. This gradual expansion and contraction of mineral grains weakens the rock causing it to break apart into smaller fragments or to fracture. Warmer temperatures may cause some minerals to expand, and cooler temperatures cause them to contract. Daily (diurnal) and seasonal temperature changes affect certain minerals and facilitates the mechanical weathering of bedrock. 6. Salt wedging is most common in drier climates, such as deserts. Salt wedging occurs when salts crystallize out of solution as water evaporates. As the salt crystals grow, they apply pressure to the surrounding rock weakening it, until it eventually cracks and breaks down, enabling the salt crystal to continue growing.

NSOU ? CC-GR-03 107 7. Abrasion occurs when rocks collide against each other while they are transported by water, glacial ice, wind, or gravitational force. During abrasion, rocks may also weather the bedrock surface they are coming into contact with as well as breaking into smaller particles and eventually individual grains. B. Different types of Chemical Weathering 1. Carbonation is a process by which carbon dioxide and rainwater or moisture in the surrounding environment chemically reacts to produce carbonic acid, a weak acid that reacts with carbonate minerals in the rock. The reaction creates new compounds which tend to be softer and weaker than the original parent rock material. Carbonation dominates the weather- ing of calcareous rocks (limestone and dolomites) where the main mineral is calcite or calcium carbonate ($CaCO3$). Calcite reacts with carbonic acid to form calcium hydrogen carbonate (Ca ($HCO3$)2) that, unlike calcite, is readily dissolved in water. This is why some limestone is so prone to solution. The reversible reactions between carbon dioxide, water, and calcium carbonate are complex. In essence, the process may be written: CaCO 3 + H 2 O + CO 2 + Ca 2+ ⇔ 2HCO 3 – This formula summarizes a sequence of events starting with dissolved carbon dioxide (from the air) reacting speedily with water to produce carbonic acid, which is always in an ionic state: CO 2 + H 2 O H + ⇔ HCO 3 Carbonate ions from the dissolved limestone react at once with the hydrogen ions to produce bicarbonate ions: CO 3 2– + H + ⇔ HCO 3 2– 2. Hydrolysis is a chemical reaction between H+ and OH- ions in water and the minerals in the rock. The H+ ions in the water react with the minerals to produce weak acids. An example of hydrolysis: Anhydrite ($CaSO4$) can absorb two water molecules to become gypsum ($CaSO4·2H2O$). Carbonic acid forms when rainwater combines with carbon dioxide in the atmosphere or the soil by the reaction:

NSOU ? CC-GR-03 108 $H_2O + CO_2 = H_2CO_3$ (water) (carbon dioxide) (carbonic acid) This acid may then react with calcite to form calcium and bicarbonate ions in solution. This reaction may be expressed as follows : $CaCO_3 + H_2CO_3 = Ca^{2+} + 2HCO_3^-$ (calcite) (carbonic acid) (calcium bicarbonate) Some silicate minerals may also dissolve, although not as readily as calcite. For example, pyroxene will slowly dissolve when it is in contact with acidic waters according to the following reaction : $MgSiO_3 + H_2O + 2H_2CO_3 = Mg^{2+} + 2HCO_3^- + H_4SiO_4$ (pyroxene) (water) (carbonic acid) (ions) (silicic acid) 3. Hydration is a process where mineral structure in the rock forms a weak bond with H20 which causes the mineral grains to expand, creating stress which causes the disintegration of the rock. Hydration often produces a new mineral compound that is larger than the original compound. The increased size expanse the rock and can lead to decay. Hydration can also lead to color changes in the weathered rock surface. 4. Oxidation occurs when oxygen and water react with iron-rich minerals and weaken the structure of the mineral. During oxidation the minerals in the rock will change colours, taking on a 'rusty', reddish- orange appearance. In this reaction, the iron in silicate minerals unites with oxygen to form the mineral hematite (Fe2O3). Hematite is deep red, and if it is dispersed in sandstone or shale, it imparts a red colour to the entire rock. Limonite [FeO(OH)] is another common weathering product. It is formed by oxida- tion combined with a reaction with water. $2Fe_2SiO_4 + 2H_2O + O_2 = 2Fe_2O_3 + 2H_4SiO_4$ (ilivine) (water) (oxygen) (hematite) (silicic acid) 5. Solution most commonly occurs on rocks containing carbonates such as limestone, but may also affect rocks with large amount of halite, or rock salt Solution occurs when minerals in rock dissolve directly into water. The most soluble natural minerals are chlorides of the alkali metals: rock salt or halite (NaCl) and potash salt (KCl). These are found only in very arid climates.

NSOU ? CC-GR-03 109 Gypsum (CaSO4.2H2O) is also fairly soluble, as is limestone. Quartz has a very low solubility. The solubility of many minerals depends upon the number of free hydrogen ions in the water, which may be measured as the pH value 6. Biochemical Weathering: Chelation:This is the removal of metal ions, and in particular ions of aluminium, iron, and manganese, from solids by binding with such organic acids as fulvic and humic acid to form soluble organic matter–metal complexes. The chelating agents are in part the decomposition products of plants and in part secretions from plant roots. Chelation encourages chemical weathering and the transfer of metals in the soil or rock. C. Biological Weathering 1. Secretion of acids -Some organisms, such as snails, barnacles, or limpets, attach themselves to rocks and secrete acid, acids that chemically dissolve the rock surface. 2. Burrowing and tunnelling organisms - Some animals may burrow or tunnel into rocks or cracks in rocks and cause the rock to break down and disintegrate. Small animals, worms, and other insects, often contribute to this form of biological weathering. 3. Rock disintegration by plant growth - The most common form of biological weathering is when plant roots penetrate into cracks and crevices of rocks and cause the rock to split or break into smaller particles through mechani- cal weathering. The presence of organisms growing, expanding, or moving across the surface of the rock also exerts a small amount of abrasion and pressure that gradually cause the mechanical weathering of the rock as the organisms extract various minerals. 4. Organic activity from lichen and algae and decaying Plants -The decaying of plant materials can also produce acidic compounds which dissolve the exposed rock. This bio-chemical weathering process leaches minerals from the rock causing it to weaken and breakdown.

NSOU ? CC-GR-03 110 5.4 Climate and Weathering Climate can also produce differential weathering responses for the same rock type. For example, limestone weathers more quickly in wet climates than dry climates Climate is the single most important factor influencing weathering. It determines not only the type and rate of weathering, but also the characteristics of regolith and weathered rock surfaces. Intense chemical weathering occurs in hot, humid regions and develops a thick regolith. Chemical weathering is minimal in deserts and Polar Regions. Climate is of major importance in weathering because rainfall, temperature, and seasonal changes all directly affect the style and rates of weathering. The influence climate has on weathering is apparent in the striking contrasts of the soil in the tropics, deserts, and polar regions In physical weathering, perhaps the most important temperature changes are the ones that produce continual cycles of freezing and thawing that result in repeated expansion of water ice in the rock and soil, and thus mechanical fragmentation. The rate of chemical reactions (and biological activity) also tends to increase as temperature increases. Commonly, a 10°C increase in temperature doubles reaction rates. The relative importance of various types of weatheringdepends on temperature and rainfall. This diagram shows that strong chemical weathering occurs where both temperature and precipitation are high. Physical weathering is strongest where the mean annual temperature is between –10° and 10°C and precipitation is between 25 and 100 cm. Weathering is at a minimum where annual precipitation is below 25 cm.

NSOU ? CC-GR-03 111 Climate controls the type and extent of weathering because of the combined effects of precipitation, temperature, and vegetation. Weathering is most pronounced in the tropics, where precipitation, temperature, and vegetation reach a maximum. Conversely, a minimum of weathering is found in deserts and Polar Regions, where these factors are minimal. 5.5 Differential weathering / Rates of weathering The differences in rates of weathering due to different types of rocks, textures, or other characteristics are referred to as differential weathering. Some rocks are harder than other rocks, and will weather slower than softer rocks. Weathering rates will not only vary depending on the type of weathering process, whether it is mechanical, chemical, or biological, but they will also vary depending on the rock material that is being weathered. The rate at which weathering processes decompose and break down a solid rock body depends on three main factors:

NSOU ? CC-GR-03 112 (1) Susceptibility of the constituent minerals to weathering, (2) Climate, and (3) The amount of surface exposed to the atmosphere. A consideration of the rate at which weathering proceeds, is a good way to review its controlling factors. Rates of weathering can be calculated by measuring the amount of decay on rock surfaces of known age. Tombstones, ancient buildings, and monuments, for example, provide datable rock surfaces for estimating rates of weathering. These studies show that in some climates, several centimetres of rock can be decomposed in a few decades, whereas the same rock remains unaltered in other climates. 5.6 Weathering of Major rock types

The weathering of rocks is influenced by a number of variables, such as the mineral composition, the texture of the rock, and the climate in which weathering occurs.

Differential weathering is a result of differences in the rates of weathering. Weathering is influenced by so many factors that it is difficult to make a meaningful generalization concerning the weathering of specific rock types. Limestone, for example, may weather and erode into a soil-covered valley in a humid climate, whereas the same formation forms a cliff in an arid climate. Similarly, well-cemented quartz sandstone may be extremely resistant to weathering, whereas sandstone with high clay content is likely to be soft and weak and weather rapidly. Table : Weathering Reactions For Common Minerals Original General Weathering Dissolved Residual Mineral Formula Reactions Ions Minerals Gypsum CaSO 4 •2H 2 O Dissolution by water Ca, SO 4 Halite NaCl Dissolution by water Na, Cl Olivine (Mg.Fe) 2 SiO 4 Oxidation Fe oxides Dissolution by acid Mg, Fe Pyroxene Ca(Mg, Fe)Si2O6 Oxidation Fe oxides Dissolution by acid Mg, Fe, Ca Amphiboles NaCa(Mg, Fe) 5 AlSi 7 O 22 (OH) 2 Oxidation Fe oxides Partial solution by acid Na, Ca, Mg Clay Plagioclase NaAlSi 3 O 8 to CaAl 2 Si 2 O 8 Partial solution by acid Na, Ca Clay

NSOU ? CC-GR-03 113 K-feldspar KAlSi 3 O 8 Partial solution by acid K Clay Muscovite KAl 3 Si 3 O 10 (OH) 2 Partial solution by acid K Clay Biotite K(Mg,Fe) 3 AlSi 3 O 10 (OH) 2 Oxidation Fe oxides Partial solution by acid K.Mg Clay Quartz SiO 2 Resists dissolution Calcite CaCO 3 Dissolution by acid Ca Dolomite CaMg(CO 3) 2 Dissolution by acid Mg, Ca Pyrite FeS 2 Oxidation SO 4 Fe oxides Relative susceptibility to weathering varies widely among common minerals found at Earth's surface. Minerals at the top of the diagram react to form minerals near the bottom that are stable at low temperatures and pressures and in the presence of abundant water and oxygen. The ultimate weathering products of many rocks are clays, quartz, and oxides of aluminium and iron.

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NSOU ? CC-GR-03 114 5.7 Products of weathering The major products of weathering are: (1) rock bodies modified intospherical shapes; (2) a blanket of loose, decayed rock debris, known asregolith, of which soil is an important part; and (3) ions in solution. 5.8 Topography related to Differential Weathering and Erosion If resistant rocksare found in the center of a syncline, they will eventually createa topographic high regardless of the structural downfold. Weakrocks, even when forming an anticline, are too easily attacked byweathering and erosion to exist in the landscape as a topographichigh for very long. Variation in rock resistance to weatheringcanyon base, ancient resistant metamorphic rocks have produceda steep- walled inner gorge. The topographic effects of differentialweathering and erosion tend to be more prominent and obviousin landscapes of arid and semiarid climates. In these dry environments,chemical weathering is minimal, so slopes and varyingrock units are not generally covered under a significant mantle ofsoil or weathered rocks. In addition, vegetation typically does notmask the topography in arid regions as it does in humid regions.Another example of differential weathering and erosioncan be seen in the Appalachian Ridge and Valley region of the eastern United States. The rock structure hereexerts a strong and often highly visible influence on theappearance of landforms and landscapes. Given sufficienttime, rocks that are resistant to weathering and erosiontend to stand higher than less resistant rocks. Resistant rocks stand out in the topography as cliffs, ridges, ormountains, while weaker rocks undergo greater weatheringand erosion to create gentler slopes, valleys, andsubdued hills.An outstanding example of how differential weatheringand erosion can expose rock structure and enhanceits expression in the landscape is the scenery at Arizona'sGrand Canyon. In the arid climate ofthat region, limestone is resistant, as are sandstones andconglomerates, but shale is relatively weak. Strong andresistant rocks are necessary to maintain steep or verticalcliffs. Thus, the stair-stepped walls of the Grand Canyonhave cliffs composed of limestone, sandstone, or
NSOU ? CC-GR-03 115 conglomerate,separated by gentler slopes of shale. At the consists of sandstone, conglomerate, shale and limestone foldedinto anticlines and synclines. These folds have been erodedso that the edges of steeply dipping rock layers are exposed asprominent ridges. In this humid climate region, forested ridgescomposed of resistant sandstones and conglomerates stand up to700 meters (2000 ft) above agricultural lowlands that have beenexcavated by weathering and erosion out of weaker shales andsoluble limestones. 5.9 Degradational Processes : Mass Wasting INTRODUCTION Mass wasting is the downslope translation of weathered and bedrock materials under the influence of gravity. Tectonics, local geology, and weathering intensity all contribute to the generation of materials susceptible for movement. These hillslope processes deliver material to a stream that ultimately carries the eroded debris to the sea. There have been many classification schemes utilized to describe these pro- cesses, some more complex than others. In general terms, useful classification is based on the process involved and the knowledge that processes can, and often do, change during a single event. Thus, a useful process-based classification includes a range of processes and responses. Styles of mass wasting includes falls, slides, flows, and creep where the primary differences between these are fluid content, size and amount of material in transport, and rate. Falls occur in areas where steep outcrops, hills, or mountains contain bedrock formations that are fractured and dip in a favorable attitude to promote slope failure by falling blocks. Once a block is released, it can break into smaller pieces as it bounces to the bottom of the slope. It can also become fluidized by either air or water and end up as a debris flow. The slope at the base of a rock fall area typically is mantled by a pile of debris referred to as talus. In semi-arid terrains, weathered rock, soil, and other surficial deposits built up through time are often released during heavy rainfall (or triggered by seismic shaking) and begin to move as a mass. Downslope, fluid content increases and the debris becomes a flow and often is channelized in stream channels. Particles in transport vary (by source area) and range from boulders and rock to flows having the properties of wet cement. In mountain

NSOU ? CC-GR-03 116 terrains, alluvial fan deposits present at the base of the slopes record several episodes of flows. The morphology of the fans are similar to a delta from a major river where each flow event proceeds down the steepest channel. The fan aggrades through time and shifts to flow through other channels as the surface of the fan changes through time. Mass wasting is the downhill movement of rock and soil material due to gravity. The term "landslide" is often used as a synonym for mass wasting, but mass wasting is a much more broad term referring to all movement downslope. Technically, landslide is a general term for faster mass wasting where the regolithmoves. Unconsolidated fragments of rock located on top of the bedrock are called regolith. This loose material along with overlying soils are often what typi- cally moves during a mass wasting event, but bedrock can move (rock topples) or a more liquid-driven movement can occur in mudflows. Movement by mass wasting can range from slow to rapid where it can be dangerous, such as during debris flows. Areas with steep topography and rapid rainfall, such as the California coast, Rocky Mountain Region, and Pacific Northwest, are particularly susceptible to hazardous mass wasting events. This chapter discusses the fundamental mechanisms driving mass wasting processes, types of mass wasting, examples and lessons learned from famous mass wasting events, how mass wasting can be predicted, and how people can be protected from this potential hazard. Slope Strength Fig :Forces on a block on an inclined plane (fg = force of gravity; fn = normal force; fs = shear force).

NSOU ? CC-GR-03 117 Mass wasting occurs when a slope is too steep to remain stable with existing materials and conditions. Slope stability is ultimately determined by two principal factors: the angle of the slope and the strength of the underlying material. In the figure, a block of rock situated on a slope is being pulled down toward the Earth's center by the force of gravity (fg). The force of gravity is, for the most part, constant on the Earth's surface (small variations exist that depend on the local elevation and the density of the underlying rock). The gravitational force acting on a slope can be divided into two components: one pushing the block down the slope (the shear force or driving force, fs), and the other pushing into the slope (the normal force orresisting force, fn), producing friction. The relationship between shear force and normal force is calledshear strength. For the block to move, the shear force has to be greater than the normal force; that is, the driving force has to be greater than the resisting force (friction). When the normal force is greater than the shear force, then the block does NOT move downslope. However, if the slope becomes steeper or if the earth material is weakened, causing the shear force to exceed the normal force, then downslope movement can occur. Fig : Change in force vectors as the slope angle increases. As slope increases, the force of gravity (fg) stays the same and the normal force decreases while the shear force proportionately increases. In the above figure, the force vectors change as the slope angle increases. The gravitational force doesn't change, but the shear force increases while the normal force decreases. The steepest angle at which rock and soil material is stable (and will NOT move downslope) is called the angle of repose and is measured from horizon- tal. When a slope is at the angle of repose, the shear force is in equilibrium with NSOU ? CC-GR-03 118 the normal force. If the slope becomes just slightly steeper, the shear force exceeds the normal force, and the material starts to move downhill. The angle of repose varies for all materials and slopes depending on many factors such as grain size, grain composition, and water content. The figure below shows the angle of repose for sand that is poured into a pile on a flat surface. The sand grains cascade down the sides of the pile until coming to rest at the angle of repose. At that angle, the base and height of the pile continue to increase but the angle of the sides remains the same. Fig :Angle of repose in a pile of sand. The shear strength of a slope also depends on the water content of the material. Water can significantly change the shear strength of a particular slope. Water is located in porespaces, which are empty air spaces in sediments or rocks between the grains. For example, assume a dry sand pile has an angle of repose of 30 degrees. If water is added to the sand, the angle of repose will increase, possibly to 60 degrees or even 90 degrees, such as a sand castle being built at a beach. But if too much water is added to the pore spaces of the sand castle, then the water decreases the shear strength, lowers the angle of repose, and the sand castle collapses. Another factor influencing shear strength, are planes of weakness in sedimentary rocks. Bedding planes can act as significant planes of weakness when they are parallel to the slope and less so if they are perpendicular to the slope. At locations A and B, the bedding is nearly perpendicular to the slope and the bedding is relatively stable. At location D, the bedding is nearly parallel to the slope and the bedding is quite unstable. At location C the bedding is nearly horizontal and the stability is intermediate between the other two extremes. Additionally, if clay minerals form along bedding planes they can absorb water and become slick. When a bedding plane of shale (clay and silt) becomes saturated, it can lower the shear strength of the rock mass and cause a landslide such as at the GrosVentre Slide discussed below.

NSOU ? CC-GR-03 119 Factors That Control Slope Stability Mass wasting happens because tectonic processes have created uplift. Erosion, driven by gravity, is the inevitable response to that uplift, and various types of erosion, including mass wasting, have created slopes in the uplifted regions. Slope stability is ultimately determined by two factors: the angle of the slope and the strength of the materials on it. In Figure below a block of rock situated on a rock slope is being pulled toward Earth's centre (vertically down) by gravity. We can split the vertical gravitational force into two components relative to the slope: one pushing the block down the slope (the shear force), and the other pushing into the slope (the normal force). The Fig : Differences in the shear and normal components of the gravitational force on slopes with differing steepness are noticed. The gravitational force is the same in all three cases. In (a) the shear force is substantially less than the shear strength, so the block should be stable. In (b) the shear force and shear strength are about equal, so the block may or may not move. In (c) the shear force is substantially greater than the shear strength, so the block is very likely to move. [SE]
NSOU ? CC-GR-03 120 shear force, which wants to push the block down the slope, has to overcome the strength of the connection between the block and the slope, which may be quite weak if the block has split away from the main body of rock, or may be very strong if the block is still a part of the rock. This is the shear strength, and in Figure a, it greater than the shear force, so the block should not move. In Figure b the slope is steeper and the shear force is approximately equal to the shear strength. The block may or may not move under these circumstances. In Figure c, the slope is steeper still, so the shear force is considerably greater than the shear strength, and the block will very likely move. Fractures, metamorphic foliation, or bedding can significantly reduce the strength of a body of rock, and in the context of mass wasting, this is most critical if the planes of weakness are parallel to the slope and least critical if they are perpendicular to the slope. This is illustrated in Figure 15.3. At locations A and B the bedding is nearly perpendicular to the slope and the situation is relatively stable. At location D the bedding is nearly parallel to the slope and the situation is quite unstable. At location C the bedding is nearly horizontal and the stability is intermediate between the other two extremes. Fig :Relative stability of slopes as a function of the orientation of weaknesses (in this case bedding planes) relative to the slope orientations. [SE] Internal variations in the composition and structure of rocks can significantly affect their strength. Schist, for example, may have layers that are rich in sheet silicates (mica or chlorite) and these will tend to be weaker than other layers. Some minerals tend to be more susceptible to weathering than others, and the weathered products are commonly quite weak (e.g., the clay formed from feldspar).
NSOU ? CC-GR-03 121 TYPES OF MASS WASTING: Mass wasting events are classified based on the type of movement and type of material. Since there are several ways to classify mass wasting events, the USGS Figure and the table below show terms used in this classification. In addition, mass wasting types often share common morphological features observed on the surface such as the head scarp (commonly seen as crescent shapes on a cliff face), hummocky (uneven) surface, accumulations of talus (loose rocky material falling from above), and toe of slope covering existing surface material. Fig :Common terms for landslides. The types of mass wasting are summarized in Table below: Type of Movement Primary Material Type and Common Name of Slide Bedrock Soil Types Mostly Coarse- Mostly Fine- Grained Grained Falls Rock Fall — — Rock Avalanche Rock Avalanche — — Rotational Slide — Rotational Debris Rotational Earth (Slump) Slide (Slump) Slide (Slump) Translational Slide Translational Rock Translational Translational Slide Debris Slide Earth Slide Flows — Debris Flow Earth flow Soil Creep — Creep Creep
NSOU ? CC-GR-03 122 The three criteria used to describe slope failures are: ? The type of material that failed (typically either bedrock or unconsolidated sediment) ? The mechanism of the failure (how the material moved) ? The rate at which it moved The type of motion is the most important characteristic of a slope failure, and there are three different types of motion: ? If the material drops through the air, vertically or nearly vertically, it's known as a fall. ? If the material moves as a mass along a sloping surface (without internal motion within the mass), it's a slide. ? If the material has internal motion, like a fluid, it's a flow. Many slope failures involve two of these types of motion, some involve all three, and in many cases, it's not easy to tell how the material moved. Classification of slope failures based on type of material and type of motion [SE]: Failure Type Type of Material Type of Motion Rate of Motion Rock fall Rock fragments Vertical or near- Very fast (<10s m/s) vertical fall (plus bouncing in many cases) Rock slide A large rock body Motion as a unit Typically very slow along a planar (mm/y to cm/y), but surface (translational some can be faster sliding) Rock A large rock body Flow (at high Very fast (<10s m/s) avalanche that slides and then speeds, the mass of breaks into small rock fragments is fragments suspended on a cushion of air) Creep or Soil or other over- Flow (although Very slow (mm/y to solifluction burden; in some sliding motion may cm/y) cases, mixed with also occur) ice

NSOU ? CC-GR-03 123 Mass wasting: Movement Type and Primary Earth Material. Slump Thick deposits (m Motion as a unit Slow (cm/y to m/y) to 10s of m) of along a curved unconsolidated surface (rotational sediment sliding) Mudflow Loose sediment Flow (a mixture of Moderate to fast with a significant sediment and water (cm/s to m/s) component of silt moves down a and clay channel) Debris flow Sand, gravel, and Flow (similar to a Fast (m/s) larger fragments mudflow, but typically faster)

NSOU ? CC-GR-03 124 Rock Fall Falls are abrupt movements of rock that detach from steep slopes or cliffs. Separation occurs along existing natural breaks such as fractures or bedding planes, and movement occurs as free-fall, bouncing, and rolling. Falls are strongly influenced by gravity, mechanical weathering, and the presence of water. Rock fragments can break off relatively easily from steep bedrock slopes, most commonly due to frost-wedging in areas where there are many freeze-thaw cycles per year. If you've ever hiked along a steep mountain trail on a cool morning, you might have heard the occasional fall of rock fragments onto a talus slope. This happens because the water between cracks freezes and expands overnight, and then when that same water thaws in the morning sun, the fragments that had been pushed beyond their limit by the ice fall to the slope below. Fig :The contribution of freeze-thaw to rock fall [SE] Rock Slide A rock slide is the sliding motion of rock along a sloping surface. In most cases, the movement is parallel to a fracture, bedding, or metamorphic foliation plane, and it can range from very slow to moderately fast. The word sackung describes the very slow motion of a block of rock (mm/y to cm/y) on a slope. Rotational slides show movement along a curved rupture surface with a com- monly slow movement rate. Translational slides are movements along a plane of distinct weakness between the overlying slide material and more stable underlying material, and are often rapid. Slides can be further subdivided into rock slide, debris slide, or earth slides depending on the type of the material involved. The largest and fastest slides are called sturzstroms, or long-run-out landslides. A good example is the Downie Slide north of Revelstoke, B.C., which is shown

NSOU ? CC-GR-03 125 in Figure 15.9. In this case, a massive body of rock is very slowly sliding down a steep slope along a plane of weakness that is approximately parallel to the slope. Plate : The Downie Slide, a sackung, on the shore of the Revelstoke Reservoir (above the Revelstoke Dam). The head scarp is visible at the top and a side- scarp along the left side. [from Google Earth] Rock Avalanche If a rock slides and then starts moving quickly (m/s), the rock is likely to break into many small pieces, and at that point it turns into a rock avalanche, in which the large and small fragments of rock move in a fluid manner supported by a cushion of air within and beneath the moving mass. The 1965 Hope Slide was a rock avalanche, as was the famous 1903 Frank Slide in southwestern Alberta. The 2010 slide at Mt. Meager (west of Lillooet) was also a rock avalanche, and rivals the Hope Slide as the largest slope failure in Canada during historical times+ . Plate : The 2010 Mt. Meager rock avalanche, showing where the slide originated (arrow, 4 km upstream). It then raced down a steep narrow valley and out into the wider valley in the foreground. [Mika McKinnon photo, http://www.geomika.com/blog/ 2011/01/05/the-trouble-with-landslides/ Used with permission.]

NSOU ? CC-GR-03 126 Creep or Solifluction Soil creep is the imperceptibly slow downward movement of material caused by shear stress sufficient to produce permanent deformation in unconsolidated mate- rial. The very slow — mm/y to cm/y — movement of soil or other unconsolidated material on a slope is known as creep. Creep which normally only affects the upper several centimetres of loose material, is typically a type of very slow flow, but in some cases, sliding may take place also. Creep can be facilitated by freezing and thawing because, as shown in Figure , particles are lifted perpendicular to the surface by the growth of ice crystals within the soil, and then let down vertically by gravity when the ice melts. The same effect can be produced by frequent wetting and drying of the soil. A type of soil creep is solifluction, which is slow movement of soil lobes on low-angle slopes due to repeated freezing and thawing of soil in high-latitude (Arctic) cold locations. Creep is indicated by curved tree trunks, bent fences or retaining walls, tilted poles or fences, and small soil ripples or ridges.In cold environments, solifluction is a more intense form of freeze-thaw-triggered creep. Creep is most noticeable on moderate-to-steep slopes where trees, fence posts, or grave markers are consistently leaning in a downhill direction. Fig : A depiction of the contribution of freeze-thaw to creep. The blue arrows represent uplift caused by freezing in the wet soil underneath, while the red arrows represent depression by gravity during thawing. The uplift is perpen- dicular to the slope, while the drop is vertical. [SE]

NSOU ? CC-GR-03 127 Slump Slump is a type of slide (movement as a mass) that takes place within thick unconsolidated deposits (typically thicker than 10 m). Slumps involve movement along one or more curved failure surfaces, with downward motion near the top and outward motion toward the bottom. They are typically caused by an excess of water within these materials on a steep slope. Fig : A depiction of the motion of unconsolidated sediments in an area of slumping [SE] Mudflows and Debris Flows When a mass of sediment becomes completely saturated with water, the mass loses strength, to the extent that the grains are pushed apart, and it will flow, even on a gentle slope. This can happen during rapid spring snowmelt or heavy rains, and is also relatively common during volcanic eruptions because of the rapid melting of snow and ice. (A mudflow or debris flow on a volcano or during a volcanic eruption is a lahar.) If the material involved is primarily sand-sized or smaller, it is known as a mudflow, such as the one shown in Figure. Flows are mass wasting events in which the material is mixing internally, sometimes with abundant water, and moving at rapid speeds with long runouts at the slope base. Flows are commonly separated into debris flow (coarse material) and earthflow (fine material) depending on the type of material involved and the amount of water.

NSOU ? CC-GR-03 128 Preventing and Delaying Mass Wasting As already noted, we cannot prevent mass wasting in the long term as it is a natural and ongoing process; however, in many situations there are actions that we can take to reduce or mitigate its damaging effects on people and infrastructure. Where we can neither delay nor mitigate mass wasting, we should consider moving out of the way. It is comforting to think that we can prevent some effects of mass wasting by mechanical means, such as the rock bolts in the road cut, or the drill holes used to drain water out of a slope, or the building of physical barriers, such as retaining walls. What we have to remember is that the works of humans are limited compared to the works of nature. Delaying mass wasting is a worthy endeavour, of course, because during the time that the measures are still effective they can save lives and reduce damage to property and infrastructure. The other side of the coin is that we must be careful to avoid activities that could make mass wasting more likely. One of the most common anthropogenic causes of mass wasting is road construction, and this applies both to remote gravel roads built for forestry and mining and large urban and regional highways. Road construction is a potential problem for two reasons. Fig :An example of a road constructed by cutting into a steep slope and the use of the cut material as fill. [SE]

NSOU ? CC-GR-03 129 First, creating a flat road surface on a slope inevitably involves creating a cut bank that is steeper than the original slope. This might also involve creating a filled bank that is both steeper and weaker than the original slope. Second, roadways typically cut across natural drainage features, and unless great care is taken to reroute the runoff water and prevent it from forming concentrated flows, oversaturating fill of materials can result. Apart from water issues, engineers building roads and other infrastructure on bedrock slopes have to be acutely aware of the geology, and especially of any weaknesses or discontinuities in the rock related to bedding, fracturing, or foliation. It is widely believed that construction of buildings on the tops of steep slopes can contribute to the instability of the slope. A more likely contributor to instability of the slope around a building is the effect that it and the changes made to the surrounding area have on drainage. 5.11 Summary The unit deals with the different types of weathering and the processes involved in mass wasting. It is important because it produces unconsolidated material from which soil is formed. 5.12 Questions Long question 1. What is denudation? Give a brief description about the various types of weathering with examples. 2. Define weathering and mass wasting. Describe the impact of mass wasting on landforms. 3. What are the process of chemical weathering? Discuss the importance of chemical weathering in the humid tropics? 4. Are different weathering processes basically dependent in climate? Support your answer with suitable examples. Short question 1. Distinguish between solifluction and soil creeping. 2. Distinguish between graular disintegration and exfoliation. 3. Distinguish between slump and slide. 4. Distinguish between hydrolysis and hydration.

NSOU ? CC-GR-03 130 130 Unit 6 ? Processes of Entrainment, Transportation and Deposition by different Geomorphic agents. Role of Humans in Land Development Structure 6.0 Objective 6.1 Introduction 6.2 Processes of Entrainment 6.3 Processes of Transportation 6.4 Role of Humans in Land Development 6.5 Summary 6.6 Questions 6.0 Objective ? To learn about the processes of entrainment and transportation. ? To study about the role of humans in land development. 6.1 Introduction Landforms evolve over a long period of cyclic and geologic time, inheriting the imprints of past process rates and/or process domains. The principles and methods of evaluating the signature of environmental change are highlighted here. The process-form relationships provide the building blocks also for the optimum utiliza- tion of the land resources of the earth, and quantitative assessment of the stability of geomorphic systems and the quality of environment. 6.2 Processes of entrainment In physical geography, entrainment is the process by which surface sediment is incorporated into a fluid flow (such as air, water or ice) as part of the operation

NSOU ? CC-GR-03 131 of erosion.For example,process of entrainment occurring at subfreezing temperatures. Entrainment mechanisms and emphasize that recent evidence from both physics and glaciology implies an active role for liquid water-dependent processes in subfreezing ice. Entrainment of rock fragments beneath cold glaciers can probably occur by creep (Sugden and John, 1976), but the high viscosity of ice makes this mechanism a difficult one for fine grained Particles Cold-based glaciers can actively entrain basal material. This provides a general mechanism for formation of dirty basal layers, and may in some cases be an important geomorphic process. Subfreezing entrainment is likely facilitated by interfacial water films, which also allow sliding and abrasion by cold glaciers. This process initiates the bursts of motion experienced by any particle and the size of the largest particle a stream can entrain under any given set of hydraulic conditions is thus called competence. It is very difficult to determine however for several reasons: 1. Particles are entrained by a combination of fluvial forces 2. Flow velocity is neither constant nor easily measured, and, 3. Sediment of the same size may be packed together differently. One method used to represent the flow conditions in competence relationships, is measuring the critical shear stress. It is proportional to the depth-slope product and can be expressed by the Du Boys equation for boundary shear: $\tau c = \gamma * R * S$ where τc = critical shear stress γ = specific weight of the water R = hydraulic radius S = slope Bank erosion is the process of entrainment that determine the type and magnitude of erosion that occurs on the channel floor. Fluvial entrainment promotes bank erosion in two ways: • Corrasion—shear stress generated by water flow–operates on all surfaces, and • Cantilevers—differential Corrasion produces overhangs which collapse. 6.3 Processes of Transportation Transportation is the movement of material across the Earth's surface by water, wind, ice or gravity. It includes the physical processes of traction (dragging),

NSOU ? CC-GR-03 132 suspension (being carried) and saltation (bouncing) and the chemical process of solution.During transportation, water preferentially carries away small particles in the process called washing. Wind does the same in the process called winnowing. The material not carried away may be left behind as a lag deposit or a pavement.Transportation and weathering are the two phases of erosion. Mass wasting is usually considered separately from transportation. Rivers transport material in four ways: Solution—minerals are dissolved in the water and carried along in solution. This typically occurs in areas where the underlying bedrock is limestone. Suspension—fine light material is carried along in the water. Saltation—small pebbles and stones are bounced along the river bed. Traction —large boulders and rocks are rolled along the river bed. PROCESSES OF DEPOSITION Deposition is the processes where material being transported by a river is deposited. Deposition occurs when a river loses energy. This can be when a river enters a shallow area (this could be when it floods and comes into contact with the flood plain) or towards its mouth where it meets another body of water.Rivers flood on a regular basis. The area over which they flood is known as the floodplain and this often coincides with regions where meanders form. Meanders support the formation of flood plains through lateral erosion.When rivers flood the velocity of water slows. As the result of this the river's capacity to transport material is reduced and deposition occurs. This deposition leaves a layer of sediment across the whole floodplain. After a series of floods, layers of sediment forms along the flood plain.Larger material and the majority of deposition occur next to the river channel. This is the result of increased friction (with the flood plain) causing the velocity of the river to slow and therefore rapidly reduce its ability to transport material. This leaves a ridge of higher material next to the river channel on both banks of the river known as a levee. If entrainment of sediment represents a threshold of erosion, a similar threshold must exist when sediment in transport is deposited. A long episode in which less sediment leaves the bed than is returned, results in a distinct period of aggradation.

NSOU ? CC-GR-03 133 While a long episode in which more sediment leaves the bed than is returned results in a distinct period of degradation. Fluvial deposition is important to geomorphology in several ways. 1. On a long-term basis, continued deposition results in landforms that reflect distinct periods of geomorphic history–glacial chronologies. 2. On a short-term basis, deposition creates bottom forms such as dunes, bars, and riffle-pool sequences that are closely interrelated with channel pattern and the character and distribution of flow within the channel–ecological reconstructions. 3. Finally, short-term and long-term mechanics of deposition have implications beyond the boundaries of geomorphology–gold mining and contaminant plume migration. 6.4 Role of Humans in Land Development The physical environment of humankindis virtually in no part exemptfrom some kind of human influence, usually cascading through the system and actingback on human society itself. Therefore, it is a logical research objective to analyse the problems resulting from the above interactions in the most comprehensiveapproach possible. Now the individual disciplines of earth sciences, specializedon different spheres of the global environment, should devote more attention toresearch of that kind. Role of humans in land developmentstudieslandforms, their changes and impacts on other spheres of the global environment: • Firstly, today the human agent is equal in importance to other factors in the shapingof the Earth's landforms. Although the intensity of its influence dependson the energy released by human society, which is insignificant compared tothe endogenic forces of the Earth (tectonic movements, volcanic activity, earthquakes),it is not only commeasurable to the energy which drives most of theexogenic processes but even surpasses the effectiveness of some of them. • Secondly, geomorphologists have to study this problem since the geomorphicimpact of humans is growing exponentially. Exponential popula-
NSOU ? CC-GR-03 134 tion increaseinvolved higher demands and the energy made available to meet the demandsresulted in large-scale reworking of surface materials–at an even more rapidlygrowing rate. • Thirdly, human impact on the Earth's surface does not only influence other naturalsystems but have a reaction on itself as well to an ever-increasing degree. Therightful judgement that humans are the inhabitants (or sometimes victims) of anenvironment created (or modified) by themselves is also true for the geomorphicaction of humans. The subject of anthropogenic geomorphology is thedescription of the wide and ever-widening range of surface landforms, extremelydiverse in origin and in purpose, created by the operation of human society. By nowhuman action has established itself as one of the geomorphic agents. It is found that anthropogenic geomorphologycan also be interpreted more narrowly and widely but certainly in amore complex way. In a narrower sense, although all human constructions (buildings, industrialplants) modify the appearance of the landscape, they are not regarded as subjectsof geomor- phological investigation. Such artificial constructions contrastwith their environs in size or other properties and undoubtedly influence them. In a broader sense, the artificially created landforms have manifold influences on theenvironment (e.g. alterations in meso- and microclimate, biota, etc.). In addition,they may also modify natural processes. New geomorphic processes maybe initiated or active processes may be intensified or weakened or even inhibited.As a consequence, new landforms may be generated–not directly by humanactivities but they would have not formed or not formed in the manner theydid without previous human interference. Human geomorphic action may inducecascading environmental changes, whose study obviously lies within the scopeof anthropogenic geomorphol- ogy. The investigation of the impacts also coversthe geomorphic processes induced by the objects which were excluded fromanthropogenic geomorphological research above. The inevitable complexity of anthropogenic geomorphology derives from thecharacter of natural systems and human activities. Humans interfere with thesesystems, including geomorphological ones; from outside and thus necessarilydisturb the natural order (dynamic equilibrium) of the processes, which

NSOU ? CC-GR-03 135 hasevolved over timespans of various lengths. Man-made landforms are alien to thelandscape and through establishing new geomorphological conditions, humansdrastically upset the equilibrium. With the appearance of such landforms– ifthey are not used anymore and not maintained by humans–tendencies towards anew equilibrium begin to show. For the society it means uncertainty or occasionallyeven a threat. On the one hand, it is not easy to predict either thedirection of transforma- tion or the nature of the new equilibrium. Both may bedeleterious not only for society but also for other natural systems. On the otherhand, in the first period of the relaxation time necessary to reach a new equilibrium,changes are rather rapid and may even lead to disastrous consequences. An obvious aspect is to classify role of human in land developmentaccording to the characterof the human activity. Here another general principle of dynamic geomorphologyis applied. Since landforms are usually produced by interplay of differentprocesses, it is not always easy to distinguish the contribution of the individualprocesses in the resulting landscape. The following fields where the role of human activities has been identified are as follows: • Mining—The processes involved and the resulting landforms are usually called montanogenic. • Industrial impact is reflected in industrogenic landforms. • Settlement (urban) expansion exerts a major influence on the landscape over ever increasing areas. The impacts are called urbanogenic. • Traffic also has rather characteristic impacts on the surface. • As the first civilizations developed, highly advanced farming relied on rivers; water management (river channelization, drainage) occupies a special posi- tion in anthropogenic geomorphology. • Agriculture is another social activity causing changes on the surface. Agrogenic impacts also include transformation due to forestry. • Although warfare is not a productive activity it has long-established surface impacts. • In contrast, the impacts of tourism and sports activities are rather new fields of study in anthropogenic geomorphology.

NSOU ? CC-GR-03 136 6.5 Summary Entrainment is the process by which surface sediment is incorporated into a fluid flow. These hrechanises are dealt in the unit along with the processes of transpor- tation. The role of humans in Land development is also highlighted. 6.6 Questions Long question 1. What is sediment entrainment? 2. What factors contribute in the transportation of sediments? 3. What are the three ways that sediments can be transported?

Unit 7 ? Development of River network and Landforms on Uniclinal and Folded structures Structure 7.0 Objective 7.1 Introduction 7.2 Inversion of Relief 7.3 Uniclinal/Homoclinal/Monoclinal Structure 7.4 Summary 7.5 Model Questions 7.0 Objective ? To help the learners to learn about the river network and landforms 7.1 Introduction FOLDED STRUCTURE Folds are warps in rock strata during ductile deformation. They are three dimensional structures ranging in size from microscopic crinkles to large domes and basins that are hundreds of kilometers across. Most folds develop by horizontal compression at convergent plate boundaries where the crust is shortened and thickened. Broad, open folds form in the stable interiors of continents, where the rocks are only mildly warped. Almost every exposure of sedimentary rock shows some evidence that the strata have been deformed. In some areas, the rocks are slightly tilted; in others the strata are folded like wrinkles in a rug. Small flexures are abundant in sedimentary rocks and can be seen in mountainsides and road cuts and even in hand specimens. These warps in the strata are called folds and are a manifestation of ductile deformation in response to horizontal compression. This kind of deformation is also called contraction. Large folds cover thousands of square kilometers, and they can best be recognized from aerial or space photographs or from geologic mapping. Like faults, folds form slowly over millions of years, as rock layers gradually yield to differential stress and bend. Folds are of great economic importance because they commonly form traps for oil and gas and may control 137

NSOU ? CC-GR-03 138 localization of ore deposits. Consequently, it is of more than academic interest to understand folds. Fold Nomenclature. Three general types of folds are illustrated in the Figure below. They are: An anticline, in its simplest form, is up arched strata, with the two limbs (sides) of the fold dipping away from the crest. Rocks in an eroded anticline are progres- sively older toward the interior of the fold. Synclines, in their simplest form, are down folds, or troughs, with the limbs dipping toward the centre. Rocks in an eroded syncline are progressively younger toward the centre of the fold. Monoclines are folds that have only one limb; horizontal or gently dipping beds are modified by simple step like bends. Monoclines Anticline Synclines Overturned anticline and syncline For purposes of description and analysis, it is useful to divide a simple fold into two more-or-less equal parts by an imaginary plane known as the hinge plane. The hinge marks the region of maximum curvature in the fold.The line formed by the

NSOU ? CC-GR-03 139 intersection of the hinge plane and a bedding plane is the hinge line, and the downward inclination of the hinge line is called the plunge. A plunging fold, therefore, is a fold in which the hinge line is inclined. In most folds, the hinge plane is not vertical but is inclined, and the fold is overturned and one limb is steeper than the other direction the hinge plane is rotated from vertical indicates the direction the rocks were displaced. In other words, movement is toward the steep limb. Fold Belts: Where contraction is intense (typically in orogenic belts at conver- gent plate boundaries), the rock layers are deformed into a series of tight folds in a Angle of plunge Hinge Hinge plane Anticline Angle of plunge Synclines Hinge Hinge plane

NSOU ? CC-GR-03 140 long linear belt. The internal geometry of many fold belts is not exceedingly complex. In many ways, the folds resemble the wrinkles in a rug. However, complexity in the outcrop patterns of fold belts results from erosion, so folds may be difficult to recognize on aerial photographs without some experience in geologic observation and interpretation. The diagrams above illustrate a fold belt with plunging folds and its surface expression after the upper part has been removed by erosion. The outcrop of the eroded plunging anticlines and synclines forms a characteristic zigzag pattern. The nose of an anticline forms a V that points in the direction of plunge and the oldest rocks are in the centre of the fold. The nose of a syncline forms a V that opens in the direction of plunge, and the youngest rocks are in the center of the fold. Together, the outcrop pattern, the strike and dip of the beds, and the relative ages of the rocks in the center of the fold make it possible to determine the structure's subsurface configuration. Thrust faults commonly form in association with these contractional folds. Intense deformation in the cores of some mountain ranges produces complex folds. Some folds are refolded. Such structures commonly exceed 100 km across and can extend through a large part of a mountain belt. A B C

NSOU ? CC-GR-03 141 The Figure above illustrates the geometry and surface expression of a large complex fold. Figure A is a perspective drawing of a single bed in a typical complex fold. This overturned fold is a huge anticlinal structure with numerous minor anticlines and synclines forming indentations on the larger fold; Figure B shows the fold after it has been subjected to considerable erosion, which has removed most of the upper limb. Note the cross section of the structure on the mountain front and the outcrop pattern compared with that in Figure A. The topographic expression of complex folds is variable. They usually are expressed in a series of mountains as shown in Figure C. Complex folds are common in the Swiss Alps , but they were recognized only after more than half a century of detailed geologic studies. They are also common in the roots of Ancient Mountain systems and thus are exposed in many areas of the shields. An excellent example of an orogenic belt is the Zagros Mountains of southern Iran. The fold belt is only a small part of the Alpine Himalaya chain that extends from southern Europe and across southern Asia. Domes and Basins: In contrast to fold belts at convergent margins, the sedimen- tary rocks covering much of the continental interiors have been only gently warped into broad domes and basins many kilometers in diameter. Although these flexures in the sedimentary strata are extremely large, the configuration of the folds is known from geologic mapping and from information gained through drilling. The nature of these flexures and their topographic expression are illustrated in Figures below. A B

NSOU ? CC-GR-03 142 The form of a single bed warped into broad domes and basins is here. If erosion cuts off the tops of the domes, the surface exposure of the layer looks like the one shown in Figure B.The deformed layers in both domes and basins typically have circular or elliptical outcrop patterns. There is a major difference, however. The rocks exposed in the central parts of eroded domes are the oldest rocks, whereas the rocks exposed in the centers of basins are the youngest.The rule of Vs is also a useful tool to interpret the structure of domes and basins. Thus, for domes the Vs point away from the center and for basins they point inward. A classic example of a broad fold in the continental interior is the large dome that forms the Black Hills of South. Resistant rock units form ridges that can be traced completely around the core of the dome, and non-resistant formations make up the intervening valleys. How these broad domes form is still enigmatic. Their circular shapes and distance from convergent margins are puzzling. Many could have formed by multiple periods of deformation. For example, gentle east-west contraction far from an active convergent margin, followed by north-south contraction related to a different plate margin, could produce a series of broad domes and intervening basins. Diapirs: Some domes and basins also could form by vertical adjustments caused by density differences in the crust or upper mantle. Many small domes, are associated with buoyant rise of material that is less dense than the overlying rock. For example, in thick sequences of sedimentary rocks, beds of salt may deform and rise as a diapir, a streamlined body shaped somewhat like an inverted teardrop. Plugs of salt may rise and pierce overlying sedimentary strata to form salt domes. The deformed sedimen- tary beds are faulted and typically dip away from the center of the structure. The Salt layer Deformed strata

NSOU ? CC-GR-03 143 white mass in the lower right part of the figure below is a salt dome that has reached the surface to flow like a glacier. The movement of salt has modified the seafloor south of the Mississippi delta on a grand scale, with subsidence basins and domes pockmarking the seafloor. Topographic Expression of Folded Strata: Processes and forms of eroded structural folds A. Anticlinal Ridge: structural anticline mirrored in surface form of a ridge or hill: (1) "Unbreached" anticline: resistant folded layers un-dissected along axial plane of fold (2) "Breached" anticline: folded layers along axial plane of fold are incised by erosion and down-cutting streams. B. Anticlinal Valley: Breached anticline-structural anticline eroded in form of topographic valley along axis of fold (1) Result of easily eroded lithologies along axial plane of fold. (2) Topographic Inversion- sense of structural relief opposite of that of topo- graphic relief. e.g. Anticlinal Valleys, Synclinal Ridges C. Synclinal Valley: sense of structural relief = sense of topographic relief D. Synclinal Ridge: topographic ridge formed along axis of syncline E. Non-plunging Fold Patterns (1) Parallel sets of hogbacks oriented symmetrical about fold axis (a) Anticlines: oldest strata exposed along axis (b) Synclines: youngest strata exposed along axis (2) Scarp face and dip slope relations apply as above F. Plunging Folds and "Zig-Zag" Mountains: Plunging Folds result in alternat- ing V or Zig-Zag shaped topography (a) Plunging Anticlines: Homoclinal ridges converge to apex in direction of plunge and "V" of pattern points down plunge (b) Plunging Synclines: Homoclinal ridges diverge in direction of plunge, converge in "up plunge" direction and "V" of pattern points up plunge.

NSOU ? CC-GR-03 144 Trellis drainage patterns typically develop where sedimentary rocks have been folded and then eroded to varying degrees depending on their strength. The Rocky Mountains of B.C. and Alberta are a good example of this, and many of the drainage systems within the Rockies have trellis patterns. Trellis drainage patterns look similar to their namesake, the common garden trellis. Trellis drainage develops in folded topography like that found in the Appalachian Mountains of North America. Down- turned folds called synclines form valleys in which resides the main channel of the stream. Short tributary streams enter the main channel at sharp angles as they run down sides of parallel ridges called anticlines. Tributaries join the main stream at nearly right angles. 7.2 Inversion of Relief Inversion of relief in folded structure is a unique phenomenon which causes reverse sequence of topographic features. Inversion of relief occurs in the folded structure having sym-metrical folds having alternate sequence of anti-clines and synclines and simple formation (fig.). With the initiation of fluvial erosion under the process of cycle of erosion after the folding of sedimentary rocks longitudinal master consequent streams (strike streams) and tributary consequent streams following slope direction are originated in the synclines and dip slopes of the anticlines respec-tively. The master consequent flows in the syncline from higher slope towards lesser gradient. The streams originating on the flanks of the anticlines (dip slopes) join the master consequents as tributary streams. These tributaries are called as transverse consequents or lateral consequents which develop their valleys through headward erosion of the anti-clines. With time, the crests of anticlines are breached and subsequent streams develop along the axes of anticlines. These subsequent streams continue to deepen their valleys due to maximum vertical erosion of anticlinal crests because of maxi-mum tension on crests with the result synclinal master consequent streams are eliminated and anti-clinal streams become master streams. This process results in the formation of valleys in the place of anticlines and ridges in the place of synclines. Thus, the previous topographic feature of original anticlines and synclines are reversed by the formation of synclinal ridges (in place of original

NSOU ? CC-GR-03 145 anticlines) and anticlinal valleys (in the place of original anticlines) due to prolonged denudation and the process of inversion of relief is completed. Fig. : Inversion of Relief 7.3 Uniclinal/Homoclinal/Monoclinal Structure In structural geology, a uniclinal / monoclinal / homoclinal structure (from old Greek: homo = same, cline = inclination), is a geological structure in which the layers of a sequence of rock strata, either sedimentary or igneous, dip uniformly in a single direction having the same general inclination in terms of direction and angle. A homocline can be associated with either one limb of a fold, the edges of a dome, NSOU ? CC-GR-03 146 the coast-ward tilted strata underlying a coastal plain, slice of thrust fault, or a tilted fault block. When the uniclinal strata consists of alternating layers of rock that vary hardness and resistance to erosion, their erosion produces either cuestas, homoclinal ridges, or hogbacks depending on the angle of dip of the strata. On a topographic map, the landforms associated with homoclines exhibit nearly parallel elevation contour lines that show a steady change in elevation in a given direction. In the subsurface, they characterize by parallel structural contour lines. Unicline and Uniclinal are obsolete and currently uncommon terms that are defined and have been used by geologists and geomorphologists in an inconsistent and contradictory manner. Topographic Expression of Tilted Strata a. Homoclinal Structure: Homo = same, Cline = inclination; homoclinal struc- ture = uniformly tilted beds (1) Differential Erosion Processes: Strike and dip of homocline provide preferred directions of weakness, and hence preferred directions of stream orienta- tion (a) Selective Headward Erosion: cuts “strike valleys” along non-resistant rock layers (b) Resistant Strata: “strike ridges” standing above valleys (c) Net Result: Topography of parallel ridges (resistant strata) and valleys (non- resistant strata) (2) Homoclinal Ridges: erosionally - resistant “strike ridges” in tilted rock terrain a. Asymmetric Cross-Sectional Ridge Profile i) Scarp Face: more steeply inclined “bed” face ii) Dip Slope: topographic slope formed along dip-plane or bedding plane of resistant unit (scarp faces < steepness than dip slopes) b. Cuestas: homoclinal ridges formed in gently tilted homoclinal sections >25- 30 o dip c. Hogbacks: homoclinal ridges formed in more steeply tilted homoclinal sections <30-40 o dip

NSOU ? CC-GR-03 147 d. Homoclinal Stream Shifting: as initial streams begin cutting rock on newly formed homoclinal surface, down-cut the more easily eroded layers (e.g. shale) along strike. (1) Vertical Limit of Downcutting: underlying resistant bed (2) Dip-slope forces streams to “shift” laterally down dip laterally carving the more easily eroded strata e. Erosional Retreat of Homoclinal Ridge: (1) Scarp-face Retreat: because scarp faces are higher angle than dip slopes, the scarp face is more energetically eroded over time. Scarp face retreats laterally in down-dip direction. (2) Homoclinal Shifting: homoclinal valleys migrate laterally in down-dip direc- tion, and vertically along dip slope (3) V-shaped Notches (a) where streams incise homoclinal ridges perpendicular to strike, via headward erosion, V-shaped notches are cut through the scarp face. (b) Law of V’s: In the case of a v-shaped notch, the apex of the “V” points down dip in the direction of dip. Thus, monoclinal structures are those in which the strata dip in one direction, but displays local steepening and flattening of dip along “monoclinal flexures”. The major drainage patterns that develop in these structures are:

NSOU ? CC-GR-03 148 a. Consequent: stream patterns formed synchronously as beds are tilted, and drainage flows in direction of dip. Stream courses are “consequence” of initial slope of surface. b. Subsequent: stream pattern developed in accordance to erosional resistance of folded or tilted strata. Form “subsequent” to structural deformation c. Antecedent: streams maintain stream course (pattern) that was established prior to structural deformation (unaltered by deformation patterns) for e.g. Susquehana River cutting through Valley and Ridge near Harrisburg. 7.4 Summary This unit gives the leasuers a vivid picture of the folded structure innession of relief and the landforms formed therby. 7.5 Questions Long question 1. Discuss the different types of landforms developed in folded topography. Illustrate your answer with suitable sketches. 2. Discuss the different types of landforms developed in Uniclinal structure. Illustrate your answer with suitable sketches. 3. Describe the development of landforms in a terrain of folded structure. Short question 1. Discuss any two typical landforms present in an area of uniclinal structure. 2. Discuss any two typical landforms presend in an area of folded structure. 3. Distinguish between a hogback and a cuesta.

Unit 8 ?Landforms on Igneous Rocks with Special Reference to Granite and Basalt Structure 8.0 Objectives 8.1 Introduction 8.2 Landforms on Granite 8.3 Granitic Rocks and Associated Landforms 8.4 Landforms on Basalt 8.5 Differences Between Basalt and Granite 8.6 Summary 8.7 Questions 8.0 Objectives ? The learners will learn about the various landforms formed on igneous rocks. 8.1 Introduction Landforms resulting from igneous processes may be related to eruptions of extrusive igneous rock material or emplacements of intrusive igneous rock.In broader sense, igneous rocks are of two types i.e. Intrusive and Extrusive. A. Intrusive Igneous rocks crystallize below Earth’s surface, and the slow cooling that occurs there allows large crystals to form. As the Intrusive Igneous rocks are made of magma that cools and solidifies, as a result they are coarse grained. Intrusive rocks are in the different forms
according to the shape and size of the intrusive body and its relation to the other formation into which it intrudes. Typical intrusive formations are

batholith (very large igneous intrusion), stocks, laccoliths (Igneous intrusion with depressed central region), sills (horizontal layer which runs parallel to rocks) and dikes (vertical layer of solidified magma between two rocks). Intrusive Igneous rocks that form at depth within the crust are termed plutonic (or abyssal) rocks and are usually coarse-grained. Intrusive igneous rocks that form near the surface are termed hypabassal rocks and they are usually medium-grained. Hypabyssal rocks are less common than plutonic or volcanic rocks and often form 149

NSOU ? CC-GR-03 150 dikes, sills, laccoliths, loppoliths, or phacoliths .Examples of intrusive igneous rocks are diorite, gabbro, granite, pegmatite, and periodite. B. Extrusive Igneous Rocks erupt onto the surface, where they cool quickly to form small crystals. Some cool so quickly that they form an amorphous glass. These rocks include andesite, basalt, pumic, rhyolite, and tuff.

Hence such rocks are smooth, crystalline and fine-grained. Basalt is a common extrusive igneous rock and forms lava flows, lava sheets and lava plateaus. Some kinds of basalt solidify to form long polygonal column. The Giant causeway in Antrim, Northern Ireland is an example.

Deccan plateau of India is also basaltic plateau. Magma is stored below the surface in reservoirs called magma chambers. It creates and follows paths called conduits to the surface. This network is often referred to as the volcano's plumbing system. These networks can cover vast areas.When magma cools and solidifies in these spaces, Intrusive or plutonic igneous rocks are formed deep beneath the Earth's surface. Intrusive features like stocks, laccoliths, sills, and dikes are formed. If the conduits are emptied after an eruption, they can collapse in the formation of a caldera, or remain as lava tubes and caves.The mass of cooling magma is called a pluton, and the rock around is known as country rock. Slow cooling over thousands to millions of years allows large visible crystals to form. Common igneous rock types include granite, gabbro, and diorite. Large plutons can form along convergent tectonic plate boundaries. 8.2 Landforms on Granite Granite is a common acidic plutonic igneous rock whose major mineralogical components include quartz, alkali feldspar (K–, Na–feldspar), plagioclase (Na–Ca– feldspar) and mica. The petrological definition of granite refers to rocks in which quartz accounts for 20-60 % and plagioclase 10-65 % of the sum quartz?+?alkali feldspar?+?plagioclase. Outcrops of granitic rocks represent around 15 % of the continental area. They are particularly common in the tectonically stable shield areas (cratons) of the continental lithospheric plates and in recent orogenic areas affected by uplift and erosional un-roofing. Granite is one of the most common rocks found on earth and is associated with landforms vastly different from those found in karsts regions and different climatic zones tend to produce different granite landforms due to their distinct climate regimes.

NSOU ? CC-GR-03 151 Formation of Granite:Granite, one of the intrusive igneous rocks was formed from the solidification of granitic magma. When granitic magma is viscous and moves slowly, it seldom travels far enough to reach the surface but solidifies underground to form granitic plutonic structures such as batholiths (that form core of mountains). Since the rock is usually relatively more resistant to weathering and erosion than the surrounding rocks, it will be exposed after denudation (erosion). As it is formed underground under high pressure and heat, it is prone to the weathering process of pressure release. Chemical composition of granite: made up of 25-35% quartz, <50% feldspar, and other minor minerals such as mica. Feldspar and biotite are chemical unstable and are susceptible to hydrolysis, therefore, although rock is resistant to mechanical weathering due to its physical strength, it is prone to chemical weathering and will be weathered easily in humid climate. When feldspar reacts with water, KOH and alumino-silica acid is produced. The former is carbonated and removed in solution while the latter is broken down into clay minerals (kaolinite) and silicic acid (removed in solution). Therefore, granular disintegration will occur when feldspar is reduced to kaolinite clay while unaltered quartz remains as sand particles, forming a mass of Gruss (A loose accumulation of fragmental products formed from the weathering of granite). At a more advanced stage of weathering, the regolith will crumble in residual debris. Embedded within the residual debris are unweathered and rounded corestones due to selective weathering along joints to produce blocks and their subsequent weathering by spheroidal weathering. Rock texture of granite: Granite is characterised by large crystals that make it phaneritic, which is due to the slow solidification of granitic magma that takes place deep within the crust due the high temperature and pressure that that causes it to cool slowly. Therefore, there is ample time for crystallisation to take place and the large crystals that form leads to the development of large minerals. Rock Structure of granite: Granite is high in secondary permeability since it possesses numerous joints, including shrinkage joints and sheet joints, which encour- ages selective weathering along these lines of weaknesses. Where these joints intersect at right angles, block disintegration will result, followed by spheroidal weathering and the formation of corestones.

NSOU ? CC-GR-03 152 Plate 8.1: Fractured granite bedrock is exposed along Globe Wash in the Providence Mountains. 8.3 Granitic Rocks and Associated Landforms Weathering and erosion in arid regions underlain by granitic bedrock produce unique characteristic landforms. Spheroidal weathering is a form of chemical weath- ering in which concentric shells of decayed rock (ranging from a few millimetres to a couple meters) are successively loosened and separated from a block of rock. In the subsurface, groundwater penetrates along fractures and causes the chemical break- down of rock along surfaces. Sharp corners at the intersection of fractures tend to break down first. In this manner, blocks of granitic bedrock (or other rocks that do not have layers or bedding) tend to become rounder as weathering proceeds. In humid regions, spheroidal weathering of granite typically occurs in the subsurface. In contrast, in arid regions the rate of chemical weathering is slow relative to the rate of surface erosion. As a result, in granitic terrains knob-shaped outcrops and spheroidal blocks accumulate on the surface. In the Mojave region, granite typically breaks down to form fairly uniform quartz- and feldspar-rich, coarse-sandy sediment compared to other rock types. In addition, many of the major pediment areas in the Mojave National Preserve have granitic bedrock. This is probably directly related to the more-or-less uninform weathering and erosion characteristics of large, homoge- neous granitic intrusions.

NSOU ? CC-GR-03 153 Plate 8.2: The characteristic rounded boulders and knob-shaped outcrops throughout the Granite Mountains formed as a result of spheroidal weathering and erosion of fractured granite. Plate 8.3: Large granitic intrusions of Cretaceous age are the bedrock of Kessler Peak in the southern Ivanpah Mountains. A Joshua-tree forest blankets a pediment surface in the foreground. This view is along Cima Road east of the Teutonia Mine area. Landform Development in the Humid Tropics: Due to the high temperatures and high precipitation through the year, chemical weathering far exceeds the rate of transportation processes such as rain wash, creep and fluvial action. Therefore, deep regolith layers known as saprolite builds up over millions of years, completely masking the solid rock underneath over wide areas.

NSOU ? CC-GR-03 154 Landform development in the seasonally humid tropics: In this area, regolith is less thick than in the humid tropics as during seasonal drought, rainfall amount is reduced and the rate of chemical weathering, and thus regolith formation, is retarded. A higher degree of surface run-off and erosion occurs during the wet season, leading to removal of the regolith layer, as at the end of the dry season, there are less dense vegetation and more exposed earth where rainwash process is more effective. the rate of regolith formation by chemical weathering therefore lags behind that of regolith removal by erosion processes. When surface erosion outpace weathering, regolith layers will decrease in thickness or be removed altogether. Basal surface of weath- ering will also be revealed(whole or part) at the land surface and contributes to landform development. Landforms include Tors, and Inselbergs. Tors: Tors aresmall hills or heaps of boulders, 4 to 20m high, rising abruptly from the surrounding gentle ground surface, which are abundant in places like Zimbabwe and Uganda. Linton(1955) suggests they are formed when subterranean chemical weathering widened the joints in between the blocks of granite in the tropics, and water would have attack the edges of the blocks, widening the joints and forming ever-shrinking corestones. As the amount of weathered material built up, transportation processes would have removed it, eventually exposing corestones as an upstanding mass of boulders. Inselbergs: Inselbergs aresteep-sided, isolated hills that rise abruptly above the surrounding plains and show much variety in scale and morphology. It includes ruware, bornhardts, blocky inselbergs and castle koppies. Formed by etch planation (theory). Inselbergs are very durable landforms, as they comprise mainly of unjointed rock cores, and are virtually indestructible. Bornhardt: Bornhardts aremost common form of inselberg that are characterised by great height exceeding 300m and possess nearly vertical or even overhanging sides. The rounded summit and thick rock sheets are determined by massive sheet jointed in the rock produced by pressure release. These rock sheets may curve down sharply at the dome margin to form major vertical joints and they normally range between 0.5 to 1.5m in thickness although sheets as thick as 10m have been observed. However, some evidence suggests that sheeting may be a superficial phenomenon, with 4-5 layers enclosing a solid and unjointed core of great durability.

NSOU ? CC-GR-03 155 Blocky inselbergs: Blocky Inselbergsresemble large scale tors which may exceed 300m in height that develop when rectangular jointed is dominant, which guided weathering. Ruware: Ruwares are whale-back dome which possesses smooth convex sur- faces that are low and dome-shaped. They are incipient (initial stage) inselbergs formed in the early stage of development and may grow in height to become a Bornhardt. Castle Koppies: Castle Koppies arelow, irregular hills formed when inselbergs are subjected to prolonged sub-aerial weathering and collapse. Etchplains and the Etchplanation theory: Land surfaces which have been subjected to one or more phases of deep weathering, followed by partial or complete removal of regolith cover. Theory that suggests that inselbergs standing in isolation above etchplains are product of downwearing processes, due to climatic change. During pluvial periods, weathering is concentrated where joints are numerous and closely spaced, which is followed by an interpluvial period when rate of erathering is reduced, causing vegetation to degenerate, and allows more effective surface wash to strip the unprotected regolith. Since the basal surface of weathering is undulating due to the different rates of weathering of granite(result of presence of irregularly- spaced joints in the rock), this active removal or regolith will expose the smooth and elongated ruware for up to 15m or more in height. When a number of pluvial and interpluvial periods alternate, the ruware will become progressively higher with each cycle of weathering and stripping, as the rate of weathering of the expose ruware lags behind that of the plains, due to the fact that bare rock inselbergs shed rainwater rapidly and dry out in the tropical sun is therefore resistant to chemical weathering. Simultaneously, areas marginal to the domes receive increments of water, and thus, the weathering process is accentuated in the etchplains. This result in a more undulating basal surface of weathering that gives rise to taller inselbegs after the regolih is stripped off during the next interpluvial period. 8.4 Landforms on Basalt Basalt is an extrusive igneous rock that is very dark in colour. It is the most common type of rock in the Earth's crust and it makes up most of the ocean floor. It

NSOU ? CC-GR-03 156 is made of many dark coloured minerals such as pyroxene and olivine. Basalt also contains some light coloured minerals such as feldspar and quartz, but the amounts are small. Basalt is a very common dark-colored volcanic rock composed of calcic plagioclase (usually labradorite), clinopyroxene(augite) and iron ore (titaniferous magnetite). Basalt may also contain olivine, quartz, hornblende, nepheline, orthopyroxene, etc. Basalt is a volcanic equivalent of gabbro. Basalt is usually black or dark gray and relatively featureless. It is composed of mineral grains which are mostly indistinguishable to the naked eye. Basalt may also contain volcanic glass. Basalt may contain phenocrysts (larger crystals within fine-grained groundmass) and vesicules (holes that were filled by volcanic gases). Black colour is given to basalt by pyroxene and magnetite. Both of them contain iron and this is the reason why they are black. So this is iron again which is responsible for the coloration of basalt. Plagioclase, volumetrically usually the most important constituent, is mostly pale gray in colour. Basalt is a major rock type that occurs in virtually every tectonic setting. Basalt is clearly the most common volcanic rock on Earth and basaltic rocks (including gabbro, diabaseand their metamorphosed equivalents) are the most com- mon rocks in the crust 2 . Basalt is also common on the Moon and other rocky planets of the Solar System. Basalt is the original constituent of the crust from which almost all other rock types have evolved. Basalt forms when mantle rocks (peridotite) start to melt. Rocks melt incongruently. It basically means that melt that forms has a different composi- tion from the source rocks. Of course, it can only happen if rocks melt only partially, but this is exactly what happens in the upper mantle. It melts partially to yield basaltic magma which is less dense and rises upward to form new oceanic crust in mid-ocean ridges or volcanoes and intrusives (dikes, sills) in many other tectonic regimes. Basalt is the source rock of other more evolved volcanic rocks like dacite, rhyolite, etc. Typically, you can't see most of the mineral crystals without using a microscope because quick cooling prevents large crystals from forming. Basalt forms when lava reaches the Earth's surface at a volcano or mid ocean ridge. The lava is between 1100 to 1250° C when it gets to the surface. It cools quickly, within a few days or a couple weeks, forming solid rock. Very thick lava flows may take many years to become completely solid.

NSOU ? CC-GR-03 157 Subaerial basalt forms lava flows or pyroclastic fields and cones. Two main types of basaltic lava flows are Aa lava and Pahoehoe lava.Aa lava has rough rubbly irregular crust while Pahoehoe is smooth. Lava crust of Aa type is broken into pieces while Pahoehoe retains its continuity. Both lava flow types are massive beneath the crust and this massive interior may be columnar. Columns are separated from each other by narrow cracks which form because cooling basaltic magma contracts. Cracks start to form at the surface and propagate deeper as lava cools. Submarine basalt usually forms pillows. Pillow basalt forms as a result of very rapid cooling. Outer part of forming pillow cools very quickly in contact with cold seawater while the interior still fills with molten lava. Basalt mostly forms lava flows because it is among the least viscous magma types and therefore does not generate explosive volcanic eruptions, but sometimes pyroclastic material is formed when magma contains more volcanic gases. Basaltic rocks can be thrown out of volcanic vents as lapilli (singular: lapillus) and volcanic bombs. Basaltic volcanoes are fed by dikes (planar intrusive rock bodies when solidified that cut through other rocks) and sills (similar to dike but generally parallel to pre-existing bedding planes). Plateau or Flood basalts are extremely large volume outpourings of low viscosity basaltic magma from fissure vents. The basalts spread huge areas of relatively low slope and build up plateaus. The only historic example occurred in Iceland in 1783, where the Laki basalt erupted from a 32 km long fissure and covered an area of 588 km2 with 12 km3 of lava. As a result of this eruption, homes were destroyed, livestock were killed, and crops were destroyed, resulting in a famine that killed 9336 people. A Shield Volcano is characterized by gentle upper slopes (about 5 o) and somewhat steeper lower slopes (about 10 o).Shield volcanoes are composed almost entirely of relatively thin lava flows built up over a central vent. Most shields were formed by low viscosity basaltic magma that flows easily down slope away from the summit vent. The low viscosity of the magma allows the lava to travel down slope on a gentle slope, but as it cools and its viscosity increases, its thickness builds up on the lower slopes giving a somewhat steeper lower slope.Most shield volcanoes have a roughly circular or oval shape in map view.Very little pyroclastic material is found within a shield volcano, except near the eruptive vents, where small amounts

NSOU ? CC-GR-03 158 of pyroclastic material accumulate as a result of fire fountaining events. Shield volcanoes thus form by relatively non-explosive eruptions of low viscosity basaltic magma. Basalt columns are caused by the rapid cooling of lava, about 90% of which is made of a kind of volcanic rock called basalt. As the rock cools, it contracts and cracks on the surface—those cracks then penetrate the ground and create long, geometric columns. This phenomenon is called columnar jointing. Fig 8.4: Basaltic lava flows of Kilauea volcano in Hawai'i. Fig 8.5: Aa lava in the foreground. La Palma, Canary Islands.

NSOU ? CC-GR-03 159 Fig 8.6: Pahoehoe lava (ropy lava). La Palma, Canary Islands. Fig 8.8: Pillow lava near Fasoula, Troodos ophiolite, Cyprus. Pillow lava is very common on Earth, but difficult to find because almost all of it is on the ocean floor. Examples can be found on land usually where former ocean floor is tectonically squeezed between two blocks of continental crust. Fig 8.7: Basalt columns. Giant's Causeway, Northern Ireland.

NSOU ? CC-GR-03 160 Fig 8.9: Scoriaceous lapillus from Etna, Italy. Despite being 5 cm in width it weighs only 15 grams because it is filled with gas bubbles (vesicules). Similar rock type with a felsic composition is pumice. Fig 8.10: Sometimes dikes are so close to each other that the whole outcrop is composed of them. These sheeted dikes in Cyprus once fed volcanoes on the ocean floor. Fig 8.11: Dikes are composed of basalt and diabase. Diabase is nothing more than coarse-grained basalt. Here is a contact between basalt (on the left) and diabase in Cyprus. The basaltic dike is fine-grained because it is younger and was chilled (it lost heat rapidly to the diabase dike on the right).

NSOU ? CC-GR-03 161 Fig 8.12: Columns in basalt are perpendicular to the cooling front. In this case it is evident that basalt formed a tube (filled lava tunnel). Such conduits are common phenomena in volcanic islands and provide a way for the volcano to enlarge itself because magma can flow great distances inside such thermally insulated tubes before solidifying. Tenerife, Canary Islands. Fig 8.13: Dikes and sills are often visible on the ground and may become notable landforms. Salisbury Crags in Edinburgh is basaltic sill. Metamorphism and weathering: Basalt is largely composed of minerals with little resistance to weathering. Hence, basalt as a whole also tends to disintegrate faster than granite and other felsic rock types. Magnetite is one of the most resistant common minerals in basalt and forms the bulk of heavy mineral sands. Other

NSOU ? CC-GR-03 162 minerals disintegrate and release their components to water as ions or form clay minerals. Iron and aluminum are among the least mobile ions and therefore tend to form laterite deposits enriched in these elements.Basalt metamorphoses to a number of different rock types, depending on pressure, temperature, and the nature of volatile compounds that react with minerals in basalt. Most common metamorphic rocks with basaltic protolith are chlorite schist, amphibolite, blueschist, and eclogite. Fig 8.14: Black sand forms in volcanic islands when quartz and biogenic grains are not available. Here is a basaltic cliff and black sand on La Palma, Canary Islands. 8.5 Differences Between Basalt and Granite Basalt is an igneous, volcanic rock that forms commonly in oceanic crust and parts of continental crust. It forms from lava flows which extrude onto the surface and cool. Its principle minerals include pyroxene, feldspar, and olivine. It is common both on Earth and other planetary bodies. Granite is an igneous plutonic rock which is very common in continental crust. It forms from subterranean magma chambers that cool and harden beneath the surface and then become exhumed and exposed at the surface. Basalt and granite are similar in the they are both igneous, silicate rocks and common on Earth. They also have numerous differences. Basalt is extrusive, mafic, and common throughout the Solar System whereas granite is intrusive, felsic, and common only on Earth. Although there are some similarities between basalt and granite, there are also significant differences between these two rock types.
NSOU ? CC-GR-03 163 ? Basalt is volcanic, or extrusive, forming at the surface, while granite is plutonic, or intrusive, forming beneath the surface. ? Basalt is mafic while granite is felsic ? Basalt is common on both Earth and other Solar System bodies such as the Moon and Mars while granite is only common on Earth and rare elsewhere in the Solar System ? Basalt can form in a few days to months, whereas granite plutons can take millions of years to cool and harden. ? Basalt is more common in oceanic crust while granite is more common in continental crust. Feature Basalt Granite Surface Location Extrusive Intrusive Composition Mafic Felsic Distribution Common on most Only common on silicate terrestrial Earth planetary bodies Formation time Days to months Millions of years Associated Crust Oceanic and continental Usually continental crust crust 8.6 Summary This unit deals with the landforms on igneous rocks and the various formation on granitic and basaltic landforms.
NSOU ? CC-GR-03 164 8.7 Questions Long question 1. Discuss the formation of landforms on basaltic lithology. 2. Discuss the formation of landforms on granitic lithology. 3. Describe the landforms produced in a granitic region under humid tropical climate.
Unit 9 ? Karst Landforms : Surface and Sub-surface Structure 9.0 Objectives 9.1 Introduction 9.2 Karst Topography 9.3 Karst Landforms 9.4 Depositional Landforms 9.5 Summary 9.6 Questions 9.0 Objectives ? To study about the Karst topography ? To study the Karst landforms and the depositional landforms 9.1 Introduction The term karst describes a distinctive topography that indicates dissolution (also called chemical solution) of underlying soluble rocks by surface water or ground water. Although commonly associated with carbonate rocks (limestone and dolomite) other highly soluble rocks such as evaporates (gypsum and rock salt) can be sculpted into karst terrain.Understanding caves and karst is important because ten percent of the Earth's surface is occupied by karst landscape and as much as a quarter of the world's population depends upon water supplied from karst areas. Though most abundant in humid regions where carbonate rock is present, karst terrain occurs in temperate, tropical, alpine and polar environments. Karst features range in scale from microscopic (chemical precipitates) to entire drainage systems and ecosystems which cover hundreds of square miles, and broad karst plateaus. Although karst processes sculpt beautiful landscapes, karst systems are very vulnerable to ground water pollution due to the relatively rapid rate of water flow and the lack of a natural filtration system. Limestone is an organically formed sedimentary rock consisting primarily of calcium carbonate in the form of the mineral calcite. Rainwater dissolves the 165
NSOU ? CC-GR-03 166 limestone by the following reaction: Calcite + Carbonic acid = Calcium ions dissolved in ground water + Bicarbonate ions dissolved in ground water.In its pure state, limestone is made up of calcite or calcium carbonate but where magnesium is also present it is termed as dolomite. Limestone is soluble in rainwater. 9.2 Karst Topography The degree of development of karst landforms varies greatly from region to region. Large drainage systems in karst areas are likely to have both fluvial (surface) and karst (underground) drainage components. As stated in the introduction, the term karst describes a distinctive topography that indicates dissolution of underlying rocks by surface water or ground water.Water falls as rain or snow and soaks into the soil. The water becomes weakly acidic because it reacts chemically with carbon dioxide that occurs naturally in the atmosphere and the soil. Rainwater seeps downward through the soil and through fractures in the rock responding to the force of gravity. The carbonic acid in the moving ground water dissolves the bedrock along the surfaces of joints, fractures and bedding planes, eventually forming cave passages and caverns. Karst topography is named

after the typical topography developed in limestone rocks of Karst region in the Balkans adjacent to
the Adriatic Sea. Karst topography includes typical landforms in
any limestone or dolomitic region, produced by the action of groundwater through the processes of solution and deposition.
Conditions for the Formation of Karst Topography The following conditions are required for a limestone to develop into karst topography: 1. A region with a large stretch of water-soluble rocks such as limestone at the surface or sub-surface level 2. Limestones should not be porous. 3. Complex patterns of joints in limestones are noticedand these rocks should be dense, thinly bedded and well jointed. 4. A perennial source of water and a low water table to allow the formation of conspicuous features. 5. Moderate to abundant rainfall to cause the solvent action of water i.e. solution of rocks
NSOU ? CC-GR-03 167 6. Thick strata of limestone (20 feet or more) 7. Karst topography does not develop in deserts. Erosional Processes: Solution Main reaction: CaCO 3 + H 2 O + CO 2 ⇒ Ca +2 + 2HCO 3 - calcite + water + carbon dioxide ⇒ calcium ion + carbonic acid Factors controlling the solution rate are Amount of dissolved CO 2 partial pressure of CO 2 in air increase CO 2 ⇒ increase quantity of CO 2 absorbed by water CO 2 higher in caves than open air CO 2 may be quite high in soil temperature: cooler water can dissolve more CO 2 than warmer water at a given CO 2 biological processes: decaying humus is important source of CO 2 Concentration Ca in solution mixing of unlike water masses, regardless of original saturation, results in under saturated solution under saturation promotes more solution may explain formation of caves just below water table where vadose & phreatic water mix Climate temperature, precipitation, biological activity runoff generation is most important aspect of climate Resisting Framework Lithology: ideal conditions require limestone that is: fairly pure over 60% calcite for some karst over 90% calcite for fully developed karst very thick mechanically strong massively jointed
NSOU ? CC-GR-03 168 Structure: porosity and permeability porosity: percentage of pore spaces in a given volume of rock or soil primary porosity - intergranular voids; affected by: grain size distribution particle shape degree of packing secondary porosity: voids due to joints, faults, fractures or bedding planes promotes circulation by increasing permeability porosity important only if rocks are also permeable permeability: ease with which rock or soil transmits water Mechanism of erosion in Karst region In Karst regions,
rocks are permeable, thinly bedded and highly jointed and cracked.
Thus there is the general absence of surface drainage as the surface water has gone underground
After vertically going down to some depth, the water under the ground flows horizontally through the bedding planes, joints or through the materials themselves.
Rocks are eroded due to this downward and horizontal movement of water. It is through the chemical process of solution and precipitation deposition by surface water and groundwater, varieties of landforms are developed
in rocks like limestones or dolomites rich in calcium carbonate. 9.3
Karst Landforms The Karst landforms are results of the ground water erosion.
Water that occupies pores, cavities, cracks and other spaces in the crustal rocks in known as ground or underground water.
The main source of underground water is precipitation and melt- water which infiltrates in the rocks.
Slow moving ground water can dissolve huge quantities of soluble rock and carry it away in solution.
It dissolves limestone, rock
NSOU ? CC-GR-03 169 Erosional Landforms Sinkhole:
Small to medium-sized round to sub-rounded shallow depressions called swallow holes form on the surface of limestones through solution
where rainwater sinks into the limestone at a point of weakness. Sinkholes are a common feature in limestone/karst areas.
A sinkhole is an opening more or less circular at the top and funnel-shaped towards the bottom.
There is a great variation in sizes of Sinkholes with areas
from a few sq. m to a hectare and with depth from a less than half a metre to thirty metres or more.
These holes grow in size through continuous solvent action. They are also referred to as solution sinks Caves and Caverns:A natural cavity, chamber which leads beneath the surface of the earth generally in a horizontal or obliquely inclined direction. It may be in the Fig. 9.1: Karst Landforms salt, ad gypsum.
In some areas, it is the dominant agent of erosion and produces karst topography, which is characterized by sinkholes, solution valleys, and disappearing streams.The work of

ground water is however more significant in the regions of karst topography.Approximately 15% of the Earth's land area has developed karst topog- raphy with outsatanding examples found in Bosina, Crotia, southern China, Puerto Rico, Yucatan of Mexico, Florida, Australia, Mehalaya, Siberia.
NSOU ? CC-GR-03 170 form of a passage or a gallery. Most caves are formed in limestone rock, because it is easily dissolved by carbonation. Rainwater dissolves atmosphere carbon dioxide and forms a weak acid. It then percolates through the fractures and bedding plane, slowly dissolving and enlarging the opening plane, slowly dissolving and enlarging the openings. As cave grows larger, they become unstable and tend to collapse. Blind Valley: It is
a type of valley in karst topography. It may be occupied by a stream which disappeared underground
as the valley lower end as it approaches and enclosing rock well. Consequently, the valley looks like a dark valley. Tower Karst : Tower karst are steep, cone-shaped hills, In tropical areas, where dissolution is at a maximum because of the abundance of water from heavy rainfall, a particular type of karst topography known as tower karst develops. (e.g South China, Sumatra and Yucatan Peninsula) Uvalas: They are long, narrow to wide trenches, also referred to as Valley sinks. Several sinkholes and Dolines may merge together as a result of subsidence to form a large depression called an Uvala.Through solution and collapse, Dolines may coalesce and form Uvalas or valley sinks which are depressions up to several kilometers in diameters. Lapies/ Karren: These are grooved, fluted and ridge-like features in an open limestone field.
These ridges or lapies form due to differential solution activity along parallel to sub-parallel joints. Eventually, the lapie field may transform into smooth limestone pavements.
Fig 9.2: Caves and Caverns
NSOU ? CC-GR-03 171 Limestone Pavements: A limestone pavement is a natural karst landform consisting of a flat, incised surface of exposed limestone that resembles an artificial pavement. These are formed by the solvent action of underground water in the limestones, causing progressive widening and enlargement of joints and cracks in the trenches. The enlarged joints are called grikes and the isolated, rectangular blocks are termed as clints. Caves: Cave formation is prominent in areas where there are alternating beds of rocks (sandstone, shale, quartzite) with limestone or dolomite in between or in areas where limestones are dense, massive and occurring as thick beds.Water percolates down either through the materials or through cracks and joints and moves horizon- tally along bedding planes. Gradually, the limestone dissolves along these bedding planes resulting in the creation of long and narrow gaps called caves. Doline: They are also referred to as Collapse sinks. They are less common than sinkholes. They
might start as solution forms first, and if the bottom of a sinkhole forms the roof of a void or cave underground, it might collapse leaving a large hole opening into a cave or a void below.
Polje : It
is large depression in a karst region with steep sides and flat floor. It is drained by surface water sources. It is termed as open polje, but if drained by means of shallow holes, it is closed Polje.
A polije is a very large, flat-floored depression in the karst region.They are often formed by merging of several uvalas or partly due to faulting.They are commonly found in subtropical and tropical latitudes.Some of these may also appear in the temperate region. They may also be found in boreal regions, though very rarely.During the rainy season, parts of the floor which are at or near the water table may become temporary lakes.Drier areas are fertile. Usually covered with thick sediments, they are used extensively for agricul- tural purposes Natural Bridge: These are
erosional feature in karst topography. They are formed either due to the
collapse of roofs of caves or due to disappearance of surface streams.
Ponor: A ponor is a natural surface opening in the karst regions. They are found directly underneath the sinkholes. A ponor is kind of a portal where a surface stream or lake flows either partially or completely underground into a karst groundwater system.
NSOU ? CC-GR-03 172 Fig 9.3: Stalactite, Stalagmite and Limestone Pillars 9.4 Depositional Landforms Depositional landforms in karst region are developed due to the deposition of calcium carbonate. The calcium carbonate dissolved during the erosional process starts to precipitate when the water evaporates or when the solution is super-saturated.Stalactites, Stalagmites and Pillars are the most spectacular underground features, found in the limestone caves.
The mineral matter dissolved by groundwater can be deposited in a variety of ways. The most spectacular deposits are stalactites and stalagmites, which are found in caves. Less obvious are the deposits is permeable rocks such as sandstones

are the deposits in permeable rock such as sandstones and conglomerates. Here groundwater commonly deposits mineral matter as cement between grains.
The mineral matter dissolved by ground water
can be deposited in a variety of ways.The deposits are
known as "Dripstones". Some of the depositional landforms are given below:
NSOU ? CC-GR-03 173 Stalactites: Stalactites are the sharp, slender, downward-growing icicles of different diameters that hang from the cave roofs. Stalactites have a variety of forms. Their bases are normally broad which taper towards the free ends. The water carries calcium in solution and when this lime-charged water evaporates, it leaves behind the solidified crystalline calcium carbonate. Stalagmites: Stalagmites form due to dripping water from the surface or through the thin pipe, of the stalactite, immediately below it. Moisture dripping from the roof trickles down the stalactite and drops to the floor where stalagmites are formed due to deposition of calcium. Stalagmites may take the shape of a column, a disc, with either a smooth, rounded bulging end or a miniature crater-like depression. Pillars: Over a long period, the stalactite is eventually merged with the stalag- mite. Thus, the pillars or columns of different diameters are formed. 9.5 Summary The Karst landforms varies greatly from region to region, developed in limestone regrous. The depositional landforms are spectacular and are formed due to deposition of calcium carbonate. 9.6 Questions Long question 1. Discuss the characteristics of landforms developed in the region of limestone. 2. Discuss the landforms produced in a karst region. Short question 1. Explain the formation of the different types of dolines. 2. Distinguish between Uvala and Polije.
NSOU ? CC-GR-03 174 174 Unit 10 ?Glacial and Fluvio-glacial Processes and Landforms Structure 10.0 Objectives 10.1 Introduction 10.2 Classification of Glaciers 10.3 Glacial Erosional Processes 10.4 Glacial Erosional Landform Features 10.5 Glacial Transportational Landforms 10.6 Glacial Deposition 10.7 Glacial Depositional Landforms 10.8 Fluvio-glacial Processes and Landforms 10.9 Summary 10.10 Questions 10.0 Objectives ? The learners will learn about the various glacial erosional and depositional ? To learn about the fluvio-glacial processes 10.1 Introduction GLACIAL PROCESSES AND LANDFORMS Glaciers are thick masses of flowing/moving ice. Theyoriginate on land from the compaction and re-crystallization of snow, thus are generated in areas favoured by a climate in which seasonal snow accumulation is greater than seasonal meltinginPolar Regions and high altitude/mountainous regions. Glaciers shape the land through processes of erosion, transportation and deposition, creating distinct landforms. Snowfield is a region that displays a net annual accumulation ofsnow Snowline is an imaginary line defining the limits of snow accumulation in a snowfield above which continuous, positive snow cover
NSOU ? CC-GR-03 175 10.2 Classification of Glaciers Glaciers may be classified as per the following bases— A. Based on morphology and relationship with topography Confined glaciers: niche, cirque, and valley glaciers Transitional: ice field/transection glacier, piedmont and outlet glaciers Unconfined glacier: ice sheet and ice cap Floating glaciers: o Ice shelf: large unconfined floating glacier o Tidewater glacier: valley or outlet glacier terminating in the ocean B. Based on thermal regime warm-based or temperate (bed is at pressure-melting temperature) cold-based or "polar" (glacier is frozen to the bed; no basal meltwater) C. Based on Activity (related to mass balance) active (advancing or at equilibrium) undernourished (retreating) dead (no longer flowing) Different aspects of a Glaciers Glacier mass balance is the accounting of input and output or accumulation and ablation i.e. glacial budget Zones of accumulation: Sources are precipitation, wind deposition, ava- lanche and condensation (rime); surface of the (alpine) glacier is concave upward. Equilibrium line generally called snowline. Zone of wastage/ablation: melting (from below and above), sublimation, calving; surface of the glacier(alpine)is convex upward. Types of Glacial Flow: 1. Creep (ductile/plastic deformation) occurs at depths < 60m 2. Brittle deformation (typically occurs at depths > 60 m) 3. Basal sliding (requires basal water) 4. Regelation slip (subglacial meting and refreezing) 5. Subglacial flow (deformable bed)

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NSOU ? CC-GR-03 176 Rate of creep Glen's flow law (Flow rate = kT 3): strain rate is proportional to the cube of shear stress and increased with rising Temperature (K is the constant related to temperature and T is shear stress). Shear stress (T) = pghsinΘ (where p is the density of ice, g is gravity and Θ is the slope of the ice surface). Internal flow variations: It is due to internal stress caused by internal variation in flow and transport directions— Longitudinal (compressive and extensive) Lateral (converging and diverging) Extending flow causes ice to flow toward the bed compressive flow causes ice to flow towards the surface. 10.3 Glacial Erosional Processes Abrasion: As the glacier moves downhill, rocks that have been frozen into the base and sides of the glacier scrape the rock beneath. The rocks scrape the bedrock like sandpaper, leaving scratches called striations behind. Plucking/quarrying: Rocks become frozen into the bottom and sides of the glacier. As the glacier moves downhill it 'plucks' the rocks frozen into the glacier from the ground. Rafting: It is a process of sediment transport of large blocks. Subglacial meltwater erosion Rates of erosion will vary considerably but where: temperatures fluctuate around freezing point, where rocks are more jointed and faulted providing weaknesses, where slopes are slightly steeper leading to more rapid glacier movement (very steep slopes can lead to extended flow, a thinning of the ice and reduced erosive power, two or more glaciers meet and combine to give an increased depth of ice, ice moves by rotational flow in corrie glaciers leading to over-deepening of the hollow.

NSOU ? CC-GR-03 177 10.4 Glacial Erosional Landform Features Large-scale features of erosion by glaciers are : Glacial Troughs and Associated Landforms Troughs/U-shaped valleys (alpine and continental) and related features: A U- shaped valley has a flat floor and steep sides. Interlocking spurs eroded by the river are called truncated spurs. Hanging valleys are left by old tributaries. A ribbon lake may form in the river.In mountain environments, valley glaciers severely modify former river valleys to produce very deep, steep-sided, flat-floored U-shaped valleys or glacial troughs. Variations in rock resistance or locations where glaciers merge give rise to over- deepening of the valley floor and the formation of long, narrow ribbon lakes. Where over-deepening occurs along the coasts, deep sea fjords may form as sea- levels rise and flood the former glaciated valley. Along the sides of the glacial troughs are truncated spurs, rocky outcrops which form the ends of former interlocking spurs that have been eroded by the valley glacier. Tributary river valleys contain only small valley glaciers and due to the small amount of erosive power that they have, these valleys remain at a higher level and form hanging valleys, often with dramatic waterfalls where tributary streams re-join the main valley. In the glacial troughs post-glaciation, small misfit streams occupy the now enlarged valleys. Cirques (alpine): Cirques or a corrie is an armchair-shaped hollow found on the side of a mountain. This is where a glacier forms. In France corries are called cirques and in Wales they are called cwms. How does a corrie form? Snow collects in a sheltered hollow on the side of a mountain. This is usually on North-facing slopes in the northern hemisphere. The snow doesn't melt in the summer because it is high up, sheltered and cold. Every winter, more snow collects in the hollow. This becomes compacted and the air is squeezed out leaving ice. The back wall of the corrie gets steeper due to freeze-thaw weathering and plucking.

NSOU ? CC-GR-03 178 The base of the corrie becomes deeper due to abrasion. As the glacier gets heavier it moves downhill. The glacier moves out of the hollow in a circular motion called rotational slip. Due to less erosion at the front of the glacier a corrie lip is formed. After the glacier has melted a lake forms in the hollow. This is called a corrie lake or tarn. Fig 10.1: Cirque and associated erosional features. Arêtes—this is a narrow ridge of land that is created when two corries erode back towards each other Pyramidal peak—if three or more corries erode back towards each other, at the top of a mountain a pointed peak or Horn (alpine)is left behind Other features of erosion When a glacier moves downhill it erodes everything in its path through abrasion and plucking. Glaciers usually follow the easiest route down a mountain, which is often an old river valley. Steep back wall Crevasse Moraine builds as ice melts at the corrie lip Plucking Rotational slip Abrasion

NSOU ? CC-GR-03 179 Interlocking spursare created by a river are eroded at the ends by the glacier to create truncated spurs. After the glacier has melted it leaves a U-shaped glacial trough. Sometimes the glacial trough fills with water, called a ribbon lake. Old tributaries, which would have once fed into the valley are left suspended and are known as hanging valleys. Intermediate features: rochemoutonnee (asymmetrical) whalebacks (symmetrical) flybergs Small scale features of erosion (good directional indicators) Ice is capable of transporting huge quantities of rock. Some rocks fall on to the surface of the ice from the valley sides and are transported as supraglacial debris.Some material finds its way into the ice via crevasses to be transported as englacial debris.Where there is basal sliding, debris may also be picked up below the ice and be transported as subglacial debris.Glaciers that move relatively quickly and that transport large amounts of debris at the base, are capable of powerful physical erosion which can drastically alter the pre-glacial landscape.Chemical erosion, because of the low temperatures is relatively ineffectual.Weathering, in the form of frost-shattering (freeze-thaw) aids the erosion processes by providing a ready supply of broken rock debris.If this debris is incorporated into the sides and base of the ice, abrasion becomes active, sandpapering the rock surfaces to produce smooth, gently sloping landforms. Striations, scratches or grooves are found everyone on bare rock surfaces and are useful to indicate direction of glacier movement. Plucking is a process that is now regarded as only a minor erosion process as only a small quantity of already fractured rock is capable of being removed by ice which freezes to the rock surface and then moves forward, pulling out the loose blocks. Plucking produces jagged slopes to landforms. Roche moutonnees are large rock obstructions that have been smoothed by abrasion on the upstream side (stoss) but have irregular, jagged surfaces on the downstream side (lee) where plucking has occurred.

NSOU ? CC-GR-03 180 As glaciers move across the landscape, they come across large rock obstruc- tions such as volcanic plugs or particularly resistant rocks. These outstanding crags remain after glaciation and may protect a tail of softer material which slopes gently away from the crag on the leeward side. Edinburgh Castle stands on one of these crag-and-tail landforms. chattermarks,crescent gouges, etc. Characteristic glacial products rock flour and erratics Fig. 10.2: Small Scale Glacial Erosional Features. 10.5 Glacial Transportational Landforms

Glaciers move very slowly. As they move, they transport material from one place to another:

isolated/grouped chatter marks trough strise grooves whaleback roche moutonnees musche bruch lunate fracture crescentic gruge wedge striation arele rock drumlin aligned chatter marks

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As freeze-thaw weathering occurs along the edge of the glacier pieces of rock, which break off larger rocks, fall onto the glacier and are transported. Rocks plucked from the bottom and sides of the glacier are moved downhill with the ice. Bulldozing is when rocks and debris, found in front of the glacier, are pushed downhill by the sheer force of the moving ice. Rotational slip is the circular movement of the ice in the corrie. 10.6

Glacial Deposition Environments and Processes 1. Glacial - formed by the ice Subglacial release (shearing and/or melting) Ablation dumping pushing (glaciotectonic) mass-wasting 2. Glaciao - fluvial - deposited by braided glacial meltwater 3. Glacial marine/lacustrine - sediment carried by meltwater and deposited in a marine or lake environment 4. Aeolian - windblown and deposited sediment (e.g. loess) 10.7 Glacial Depositional Landforms Glacial Deposits -The name given to all material deposited by a glacier is called glacial till or boulder clay. A moraine is a glacially formed accumulation of uncon- solidated debris. Moraines often take the form of a belt of low hills composed of till. It is deposited directly from glacial ice. Deposited material creates a range of interesting features such as: Subglacial Deposits: Ground moraine: Ground moraine is nothing but a blanket of lodgement and ablation till. It is till deposited beneath a steadily retreating glacier that was lodged beneath the glacier and generally found behind the terminal moraine.

NSOU ? CC-GR-03 182 Wetland areas are often created in ground moraine which is a convenient way of identifying them from a topographic map. Erratics: These are rocks that have been deposited by the glacier. They are usually made of a rock type that would not be found in that area. This suggests that erratics can be carried a long way from an area of different geology. Drumlins: These are formed both by erosion and deposition. Glaciers can move moraine around in unusual ways which produce interesting features. Drumlins are mounds of deposited moraine. They have a steep side and a sloping side. They can be small or large. They are sometimes described as having 'basket of eggs' topography because of the unusual landscape they create. Composition: till and/or glacio-fluvial sediments Shaped like and inverted spoon; steep side faces up-ice Fig 10.3: Cross Section along the Moraine Marginal Moraines Form: ridge parallel (lateral) or perpendicular (end) to flow Process: dumping during a still stand, push during minor or major re-advance ice flow Stose end Lee slope Length Side profile Cross section Lowest point Middle point Highest point

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NSOU ? CC-GR-03 183 Types of Moraine: ? End moraines(terminal and recessional): Those forming at the leading edge of the glacierend moraine can be found. A terminal moraine is an end moraine that marks the furthest advance of the ice sheet. A recessional moraine and end moraine deposited when the ice sheet pauses during retreat. ? Lateral (alpine) or interlobate (continental):Often, uplands will cause an ice sheet to separate into lobes. Interlobate moraines form between lobes of the ice sheet. ? Lateral moraine - material deposited along both sides of the glacier. This moraine is usually made up of weathered material that has fallen from the valley sides above the glacier. ? Push moraine: If there is a major re-advance of the glacier or ice sheet, the end moraines are bulldozed forward to create push moraines. ? Medial moraine - material deposited in the middle of the glacier. This is caused by the lateral moraines of two glaciers when they meet. ? Recessional moraine: When there are long pauses in the deglaciation process, a series of recessional moraines, often smaller than terminal mo- raines, may form to mark the various stages of glacial retreat. Fig 10.4: Types of Moraine Lateral moraines Medial moraine Terminal moraine

NSOU ? CC-GR-03 184 10.8 Fluvio-glacial processes and Landforms Cold environments are subject to temperature fluctuations that can convert water to ice, and back again. When (melt)water is in its liquid state it can transform glacial environments through both erosional and depositional processes. Collectively these are known as ‘fluvioglacial processes’.Fluvioglacial landscapes are areas that are the result of the actions of glacial meltwater. The processes of fluvial erosion create a distinctive landscape with features unique to this environment. The landscapes can be categorised into contemporary and relic landscapes.Contemporary fluvioglacial landscapes are found in areas where glaciers currently exist: on the fringes of polar areas and in the many alpine environments, such as the Himalayas, the Rockies, South Island New Zealand, Iceland and the Andes. Erosional processes: There are four main types of erosion - Hydraulic Action—the sheer force of the water erodes the bed and banks of the meltwater channel. The meltwater will force air into fissures in the bed and banks of the channel resulting in pressure cavitation, causing material to be loosened. This material will then be carried away by the stream in times of high discharge to be deposited in an outwash plain. Abrasion—stones in transport within the water are thrown at the bed and the banks of the meltwater channel, eroding them. Where the bed and banks of channels are formed from soft rock or sediment, this process will occur rapidly. This process can over-deepen and widen the meltwater channel. Corrosion—where weak acids within the water react with the rocks, bed and banks of the channel. This erosional process will only take place when the rock type is affected by acids, such as limestone. Attrition—rock fragments in transport are thrown into one another during channel turbulence. This will reduce the size and smooth the shape of material. Material will change from angular glacial material to rounder, smoother material; evidence of fluvial erosion and subsequent deposition. Depositional processes: Deposition occurs when glacial ablation periodically reduces so meltwater streams have a smaller discharge. It also takes place with increasing distance from the ice front as meltwater load increases while energy input

NSOU ? CC-GR-03 185 is dispersed. When discharge decreases, so does velocity and the stream's energy is also reduced. Lower energy results in the meltwater stream depositing its load. Fluvial deposition is sorted, with the larger, heavier materials being deposited first and smaller materials further away, and fine materials at the furthest extent. Erosional landforms: Meltwater Deposits: As the glacier melts, the water carries fine material which is eventually deposited. All of the material moved by the glacial melt water is called glacial drift or glacial till. Glacial outwashes the sand and gravel deposited by the running melt water leaving the glacier. The material is sorted. The heavier particles of sand and gravel are deposited in the glaciated valley. The lighter, finer particles such as clay are deposited further away from the glacier and are deposited in the outwash plain. Meltwater channels: These form where the meltwater from a glacier follows a pre-existing river channel. The large volume of water released from the glacier has high levels of energy together with considerable load in the form of rock fragments released from the ice mass which results in rapid erosion taking place. The channels are over deepened, particularly by abrasion, to form meltwater channels. These may also take the form of glacial overflow channels. Moulin: A moulin is an erosional feature (rather than a landform) which occurs on the surface of a glacier. Meltwater erodes by abrasion through the ice creating this feature, which is a circular inlet down which meltwater enters the body of the glacier via deeply eroded vertical shafts. They are responsible for considerable quantities of meltwater flowing within the body of the glacier and contribute to many depositional fluvioglacial landforms. Depositional landforms: Outwash plains: These are formed in front of a glacier and are where material is deposited over a wide area, carried out from the glacier by meltwater. Discharge occurs from both the melting snout of the glacier and the emergence of meltwater streams from within the body of the glacier. The finest sediments are carried further away from the glacier. Coarser materials are deposited nearer to the snout of the glacier as the meltwater drops these first as its energy declines.It forms ahead of the terminal moraine as melt water from the snout of a glacier deposits stratified drift.

NSOU ? CC-GR-03 186 The outwash plain is a relatively flat surface that may be pock marked with depressions called kettles. If numerous kettles are present the surface is called a pitted outwash plain. Eskers: an esker is formed when there is a sub-glacial meltwater channel flowing within the body of the glacier and sediment is deposited within this channel. After the ice age when the glacier melts, a ridge of sediment is left behind representing where the previous meltwater tunnel deposits descended to the valley floor as the surrounding ice melted. It looks like a winding ridge that follows the general route of the glacier and consists of coarse sand and gravel and visually, may be likened to a medial moraine. Kames: These are accumulations of partially-sorted material found at the front of a melting or stationary glacier. These mounds build up in height as a glacier melts and meltwater streams carry material from within and under the glacier to be deposited immediately in front of the glacier into meltwater lakes. The lakes are often formed from dammed meltwater ponding up between the retreating glacier snout and terminal or recessional moraines. The deposition occurs as the meltwater flow loses energy upon emergence from the ice mass. The process continues and material is repeatedly deposited on top of the growing kame and may form a kame delta. Kame terraces are formed in a similar way but rather than in front of the glacier they are generated along the sides of the glacier. Meltwater streams flow along the convergence of the glacier's lateral edge and the valley side. They deposit material on the bed of their temporary channels which, when the glacier retreats fully, collapses to leave a ridge of partially sorted and rounded material to slump along the valley side. Kettle holes: Kettle holes are formed when large blocks of ice calve from the main glacier onto an outwash plain. As the glacier retreats the block of ice is left stranded. The ice then gets surrounded and possibly buried by subsequent meltwater deposits and outwash. Eventually, when the temperature increases and the ice block melts it leaves a large depression in the ground that the ice occupied. These are known as kettle holes. Where the depressions subsequently fill with rainwater, they are known as kettle lakes. Varves: Varves are successive layers of fine sediments deposited by meltwater streams into glacial lakes. During the summer months when discharge is higher, more NSOU ? CC-GR-03 187 sediments flow into the lake and deposits accumulate more rapidly. Coarse material in particular, such as sand and silt, flows into the lake during the summer melt and is deposited on the lake bed. During the winter where there is little or no discharge in meltwater streams, finer material and organic matter within the lake will sink to the bottom. This gives a distinct series of layers to the sediment. Fig 10.5: Fluvio-Glacial Landforms.

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NSOU ? CC-GR-03 188 10.9 Summary This unit deals with the Glacial and fluvio-glacial processes and landforms. The classification of glaciers are based on morphology. Glacial erosional processes such as abrasion, rafting, plucking are predominant in high latitudes. The transportational landforms are a result of freeze-thaw wealhering, rotational slip and buldozing. The stectacular glacial depositional landforms such as erratics, drumlins, marginal moraines, end moraines, etc. are found in the galcial regious. The fluvio-glacial processes act in areas that are the result of the actions of glacial melt water. 10.10 Questions Long question 1. Explain the various landforms produced by glacial erosion. 2. Explain the various landforms produced by glacial deposition. 3. Explain the various landforms produced by glacio-fluvial deposition. 4. Discuss the erosional features in a glaciated mountainous region. Short question 1. Describe different types of moraine. 2. Explain the formation of cirques and glacial steps. 3. Describe the different types of moraine. 4. Explain the formation of kame terraces and eskers. 5. How does an esker form? 6. What do you mean by glacial terrace? 7. How do glacial troughs and hanging valleys develop?

Unit 11 ? Aeolian and Fluvio-Aeolian processes and Landforms Structure 11.0 Objectives 11.1 Introduction 11.2 Forces involved in Aeolian geomorphic process 11.3 Factors affecting wind crosion 11.4 Erosional processes 11.5 Aeolian erosional and Depositional landforms 11.6 Fluvio-aeolian Landforms 11.7 Summary 11.8 Questions 11.0 Objectives ? To learn about the aeolian processes and landforms. ? To learn about the fluvio-aeolian landforms. 11.1 Introduction The word 'aeolian' is considered to be derived from the Greek word 'aeolus' meaningGreek god of the wind as well as 'aeolians' a Greek tribe.Thus the term aeolian refers to a geomorphic process that is created by moving air known as the wind. It produces varieties of landforms by erosion and deposition. Wind is an important geomorphic agent in arid environments and in other smaller areas where fine sediments are exposed to wind where surface cover is lacking, e.g., beaches, floodplains, deserts, soil disturbed by agriculture. Otherwise wind is not an important geomorphic agent due to its low density relative to rock: 1/2000 as opposed to 1/1.6 for water/rock. Given the buoyant force of water, little energy is required to keep sediment suspended, whereas in air only the finest sediments (dust) remain in suspension.It cannot develop any landscapes by itself but it requires some materials as tools (particles of sand, silt etc.). Aeolian processes, involving erosion, transportation, and deposition of sediment by the wind, occur in a variety of environments, including the coastal zone, and cold 189

NSOU ? CC-GR-03 190 and hotsemiarid and arid regions, along the borders of rivers andlakes, as well as over agricultural fields in many climates.Aeolian processes are responsible for the production of avariety of erosional landforms that range in scale from individual rocks (ventifacts)to larger and more complex landforms namely,yardangs, inverted relief, and defination basins. Inaddition, the wind is responsible for the emission and/ ormobilization of dust (mineral aerosols of silt and clay size) and the transport of this material to distant marine and terrestrial areas, where it contributes significantly to soil formation and the nutrient status of a variety of ecosystems. Major depositional landforms comprise deposits of loess (silt)and areas of sand dunes (sand seas and dunefields). 11.2 Forces involved in Aeolian Geomorphic Process Driving forces variations in atmospheric pressure wind blows down the pressure gradient erosion and subsequent deposition doesnot necessarily help wear landscape down; gravity is not a driving factor Resisting forces friction vegetation, micro- and macro-topography particle size cohesion and aggregation presence of crusts 11.3 Factors affecting wind erosion 1. Wind Velocity E = V 3 rho, where E is erosivity, V is velocity and rho is air density. Thus the erosivity of wind is an exponential function of wind velocity, i.e. if the wind velocity doubles, the wind is 8X more erodible or, if it triples, the wind is 27 times more erodible,that is why we observe massive wind erosion (dust) with a significant increase in wind speed. 2. Surface Cover An extremely important factor since there is no wind erosion on a vegetated surface.

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NSOU ? CC-GR-03 191 Wind velocity decreases exponentially near the ground and is theoretically zero on a natural (i.e. rough) surface; thus erosivity (V 3 is dramatically reduced). On a windy day, put your nose next to the ground and you will discover there is no wind; small birds and insects take advantage of this on windy days. The zone of little or no wind is called the laminar sublayer (or the boundary layer), the rougher the surface (e.g. taller the vegetation) the deeper the layer of laminar air flow (i.e. no turbulence to entrain and suspend sediment). There is no wind in the interior of a closed forest. 3. Grain Size Threshold erosional velocity is related to the square root of particle size. Thus when the threshold velocities for various particle size plot as a straight line when the particle size axis is on a square root scale. The threshold velocities are slightly lower for sand when impact among grains (saltation and creep) is taken into account. The fluid threshold velocities (wind shear) plot as two straight lines that slope down to converge at a minimum threshold velocity for coarse silt and fine sand (i.e. these are the most easily eroded grains)with smaller particle sizes grains tend to cohere when wet and resist erosion. Larger grains resist erosion by virtue of their greater size (mass). 11.4 Erosional processes A. Deflation: process of wind removing particles from the surface (entrainment) Lift: results from combination of wind velocity and turbulence. Threshold (critical) velocity is the function of particle size, cohesion. Turbulence changes in wind speed and direction. as turbulence increases, susceptibility of particles to lift increases. Bombardment: collision of moving particles with stationary ones or with solid surfaces. Abrasion is the collision with solid surfaces Drag: results from difference in force exerted on windward versus leeward side of particles, or difference in force exerted on top versus bottom of particles. It initiates sliding and rolling; doesn't lift particles off ground.

NSOU ? CC-GR-03 192 EROSION DEPOSITION TRANSPORTATION METHODS FEATURES METHODS CAUSES NATURE OF DEPOSITS Deflation Desert Pavement of lag deposits Corrasion or Cave rocks, Saltation Loss of Dunes Abrasion Mushroom Table Suspension velocity, Loess & Pedestal rock Rolling or settling of Ripples Yardang Traction heavy Ventifacts particles, rain Impact or Attrition WIND EROSION TRANSPORTATION AND DEPOSITION B. Abrasion (sand blasting) Impact of entrained sand grains against rock surfaces and other grains are— Yardangs—wind abraded ridges oriented with the prevailing winds and separated by abraded chutes that conduct windblown sand Ventifacts—are stones faceted (planed) by abrasion, with changing direction of dominant winds, different facets merge along sharp ridges to transform rounded stones to angular Ventifacts. Transportational process Suspension o held in air for extended time periods due to velocity and turbulence o particles smaller than ~ 0.1 mm; very fine sand, silt, clay Saltation o fine to medium sand; 0.1 to 0.5 mm o particles too large to stay in suspension for extended periods o hopping or bouncing motion saltating grains may bounce and become airborn again; more likely on hard, non-sandy surfaces

NSOU ? CC-GR-03 193 bombardment sets new grains in motion; increase in number of grains moved increases exponentially presence of saltating grains decreases near-surface wind velocity bombardment may allow entrainment below threshold velocity Creep: sliding or rolling o particles larger than ~0.5 mm o ~95% dune sand transportation occurs by saltation. Creep (Traction) o movement of coarse sand and pebbles (up to 6x larger than saltating grains) as they slide and roll impacting one another and transferring momentum o usually does not occur with velocities less than 4.5 m/sec Fig 11.1: Aeolian transportation Depositional Process Any obstruction to wind results in deposition. Deposition is caused due to reduction in velocity, increased load, Rain and function of particle size. Sorting of Deposits: The finest fraction is removed from the aeolian landscape as dust and accumulates elsewhere as loess.

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NSOU ? CC-GR-03 194 Saltating grains out distance the traction load, leaving a lag of creeping and non-transported grains. With exponential increase in sand transport with wind velocity, energy is quickly diverted from erosion to transport dissipating much of the wind energy. Thus wind velocity increases over barren rock surfaces, where sediment transports and the friction among saltating grains and with the stationary sand is not a factor. Sand is transported until friction over a rough surface (sand or vegetation) or an obstruction causes a decrease in wind velocity and deposition. Thereforeaeolian landscapes are characterized by a mosaic of 1) windswept and sandblasted surfaces, 2) stony lag deposits, 3) sand sheets or dune fields, and 4) loess sheets. Unlike other geomorphic processes wind does not result in the lowering of the landscape (denudation) towards an ultimate base level, rather sediment is usually just moved within a closed system in the direction of prevailing winds, unless it gets exported (e.g. transferred into a river). 11.5 Aeolian Erosional and Depositional Landforms Aeolian Landforms are formed by the erosion and deposition of windblown sediments. The sediments are generally sourced from deserts, glacial deposits, rivers, or coastal shorelines. Aeolian sediments are often composed of well- rounded, sand- to silt-sized particles that are weathered by wind abrasion during transport. Sediments are deposited when the velocity of the wind falls and there is not enough energy available to entertain and transport the sediments. Sands will begin to accumulate wherever they are deposited and often continue to move along the ground. Erosional Landforms Ventifacts: Ventifactsare formed by abrasion effect. These faceted rocks are Stones with flat surfaces, commonly distinguished by two or more flat faces meeting at sharp ridges, generally well-polished.shaped by abrasionThe windward face of the

NSOU ? CC-GR-03 195 rock is flattened and smoothened. If it has one smooth surface then it is known as EINKANTER and if three, then DREIKANTERS. Fig 11.2: Ventifacts Yardangs: Yardangsis anelongatedstreamlined ridges oriented parallel to wind direction. This remnant rock feature sculpted by abrasive action. It is composed of cohesive silts and clays, sandstone, or limestone. It is seen in regions with strong uni- directional winds. ManyYardangs were formed during dry, windy periods of Pleis- tocene. Fig 11.3: Yardangs Zeugen: Zeugen isa table-shaped area of rock found in arid and semi-arid areas formed when more resistant rock is reduced at a slower rate than softer rocks around it under the effects of wind erosion.

NSOU ? CC-GR-03 196 The main difference between a zeugen and an yardang are - o The yardang is smaller than a zeugen. o Yardangs are formed on vertical strata while zeugen on horizontal strata. o Yardangs are formed by deflation while zeugen by abrasion. o Yardangs are formed on vertical hard/soft layers of rock, while zeugen (this is its plural form) are formed on horizontal bands of hard/soft rocks giving it a more mushroom-like shape. The Great Sphinx of Giza has been sculpted in a yardang. Desert Pavements or Lag Deposits: Theseareformed by aeolian or fluvial processes, wherelarger stones set in or on a matrix of finer material. They are formed when wind carries finer, more lightweight particles such as sand away. Large particles are left behind and protected from further erosion – desert pavements. They are also called as desert armor and the areas covered with large sized rocks are called Hamadas. Fig 11.4: Desert Pavement Mushroom Table and Pedestal Rocks:They areisolated rocks from which the base has been partially cut by the undercutting of the wind. Deflation Basinsor deflation hollows or blow outs: These are depressions formed from barren unconsolidated material. They are formed by eddy air currents. It measures from few centimetres to several kilometres across, with a depth up to 10m.

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NSOU ? CC-GR-03 197 Oasis: In geography, an oasis (plural: oases) is an isolated area of vegetation in a desert, typically surrounding a spring or similar water source. Oases also provide habitat for animals and even humans if the area is big enough. The location of oases has been of critical importance for trade and transportation routes in desert areas. Depositional Landforms Ergs (sand seas):Theseare "sand seas" with vast sand sheets.They cover 1/4 - 1/ 3 of the area of true deserts. The largest sandy deserts overlie poorly consolidated sandy bedrock. Rub'al Khali in Saudi Arabia is world'slargest sand sea. Nebraska Sand Hills is largest in western hemisphere. Dune fields: smaller than ergs but contain significant number of dunes (e.g. coastal areas) Sand sheets: These are very subdued dunes and low relief. They also contain undulating sandy hills in sub-humid environments (e.g. large parts of the Great Sand Hills of Saskatchewan and the Sand Hills of Nebraska). Sand Shadow: These are accumulations of sand on either side of a fixed obstacle (e.g. shrub or tuft of grass). Sand Drift: Accumulation of sands are called Sand Drifts.In the lee of a gap between obstacles or in the still air at the base of an escarpment, are known as Sand Drifts. Loess: Most of the dust carried by dust storms is in the form of silt-size particles. Deposits of this windblown silt are known as loess. Loess is a homogeneous, typically non-stratified, porous, friable, slightly coherent, often calcareous, fine- grained, silty, pale yellow or buff, windblown (aeolian) sediment. It generally occurs as a widespread blanket deposit that covers areas of hundreds of square kilometers and tens of meters thick. Loess deposits are unusually fertile. They are also used for building construction. The thickest known deposit of loess, 335 meters, is on the Loess Plateau in China. Loess tends to develop into highly rich soils. Loess deposits are geologically unstable by nature, and will erode very readily. Takyrs:Takyrs are flat smooth clayey deserts, ranging in size from a few sq.m to several sq. kms. They develop as separate basins. A takyr is usually formed in a shallow depressed area with a heavy clay soil, which is submerged by water after seasonal rains. After the water evaporates, a dried crust with fissures forms on the surface. Wind is a major geological agent. It changes the landscapes of arid and semi-arid regions with new landforms. It is a highly dynamic system forming
NSOU ? CC-GR-03 198 unstable landforms. Wind created landforms are subjected to wind action again and again. Understanding of their movements and deposition is a basic requirement in earth sciences. Wind ripples: These are small sand ridges oriented perpendicular to prevailing winds.They are small sand waves with a wavelength of about 1 m, i.e. the typical path length of saltating grains. They are ephemeral and mobile, i.e. move, disappear and reform during wind storms. Ripples are commonly found on the windward slopes of sand dunes. Fig 11.5: Wind Ripples. Dune:Dunes areclassic aeolian landforms. They are either stable or advancing landform of windblown sand. It originates as a mound of free sand from a sandy surficial deposit (e.g. beach, weathering sandstone) or from a blowout. As the mound grows it develops the dune asymmetry characterized by a gentle windward slope and a leeward slip face at the angle of repose for sand. Some dunes with longitudinal shape have a ripple but several others of magnitude difference in size, and thus dunes are much less mobile and more persistent. Dunes migrate downwind as sand saltates up the windward face (i.e. ripples migrate), accumulates where the wind dies just over the crest, and then flows (mass wasting) over the slip face. The dunes are of various types. They are as follows:
NSOU ? CC-GR-03 199 1. Barchan Dune: o classic desert dune o crescentic in plan view, horns (cusps) project downwind and thus the head faces into the wind and the slip face is concave downwind o isolated, freely migrate across desert plains maintaining their form 2. Parabolic Dune: o Associated with vegetation, so form in sub-humid and semiarid environments (rather than arid) where vegetation is nearby (e.g. beaches, grasslands). o originate as a blowout, dune forms as the head of the dune at the downwind edge of the blowout develops the dune asymmetry and advances beyond the horns o stability of the sides and horns used to be attributed to vegetation but recent research (including P. David and S. Wolfe in Saskatchewan) suggest that water is a more important factor, so the stability of parts of a parabolic dune and the presence of vegetation are both related to water o Eventually deflation lowers the blowout to the water table or to an underlying stratum lacking sand (e.g. bedrock or stony clay till) and the dune becomes impoverished. 3. Transverse Dune: o linear, cuspate and forms perpendicular to the wind, with large sand supply and low winds o with stronger winds they evolve into barchans o usually occur on beaches, floodplain alluvium or erodible sandy bedrock rather than in dry deserts Fig 11.6: Barchan Dune Fig 11.7: Types of Dunes (A) Transverse dunes (C) Longitudinal dunes (B) Barchan dunes (D) Star dunes

NSOU ? CC-GR-03 200 4. Longitudinal or Seif Dune: o large (kms in length, ~ one km wide) linear forms parallel to the strong persistent winds o formed in dry subtropical deserts with irregular sand supply o separated by lag gravel o whaleback: a ridge of coarse sand left in the path of a migrating longitudinal dune 5. Star Dune: o Large pyramidal or star shaped dunes with three or more sinuous radiating ridges from central peak sand. o It has three or more slip faces and does not grow along the ground but does grow vertically. 11.6 Fluvio–Aeolian Landforms The interaction between fluvial and aeolian processes can significantly influence landforms. When rivers and sand dunes meet, the interaction of sediment transport between the two systems can lead to change in either one or both systems.There are six prominent fluvial-aeolian interactions. (1) Fluvial flow extends into the aeolian system until it is dammed by aeolian landforms; (2) interdune areas (overbank interdunes) upstream of aeolian dams, and alongside channels are flooded; (3) water erodes dunes alongside channels and interdunes; (4) flood waters deposit sediment in interdune areas; (5) fluvially derived groundwater floods interdunes (interdune playas); (6) wind erodes fluvial sediment and redeposits it in the aeolian system. Some of the distinctive fluvio-aeolian landform features are as follows: Rill: In hill slope geomorphology, a rill is a narrow and shallow channel cut into soil by the erosive action of flowing water. Gully: A gully is a landform created by running water. Gullies resemble large ditches or small valleys, but are metres to tens of metres in depth and width.
NSOU ? CC-GR-03 201 Fig 11.8: Gully Incision. Ravine: A ravine is a landform narrower than a canyon and is often the product of stream cutting erosion. Ravines are typically classified as larger in scale than gullies, although smaller than valleys. Badland Topography: In arid regions occasional rainstorms produce numerous rills and channels which extensively erode weak sedimentary formations.Ravines and gullies are developed by linear fluvial erosion leading to the formation of badland topography.Badland, area cut and eroded by many deep, tortuous gullies with intervening saw-toothed divides. The gullies extend from main rivers back to tablelands about 150 m (500 feet) and higher. The gully bottoms increase in gradient from almost flat near the main rivers to nearly vertical at the edges of the tablelands. Because the rocks are not uniform in character, differences in erosion result in stair- step profiles. The joining and separating of the gullies cause many isolated irregular spires, small flat-topped buttes, or mesas, and produce a landscape of jagged, fluted, and seemingly inaccessible hills.Badlands develop in arid to semiarid areas where the bedrock is poorly cemented and rainfall generally occurs as cloudbursts. The dry, granular surface material and light vegetation is swept from the slopes during showers, leaving the gullies bare.The term badland was first applied to a part of southwestern South Dakota, which French-Canadian trappers called the mauvaisesterres
NSOU ? CC-GR-03 202 pour traverser (the "bad lands to cross"); later it was applied to other areas with similarly eroded topography. Example: Chambal Ravines. Bolsons: The intermontane basins in dry regions are generally known as bolsons.Bolson, (from Spanish bolsón, "large purse"), a semiarid, flat-floored desert valley or depression, usually centred on a playa or salt pan and entirely surrounded by hills or mountains. It is a type of basin characteristic of basin-and-range terrain. Playas: Three unique landforms viz. pediments, bajadas and playas are typically found in bolsons.Small streams flow into bolsons, where water is accumulated. These temporary lakes are called playas.After the evaporation of water, salt-covered playas are called salinas. Pediments: In form and function there is no difference between a pediment and an alluvial fan; however, pediment is an erosional landform while a fan is a constructional one. A true pediment is a rock cut surface at the foot of mountains. Inselberg An island mountain of resistant rock rising from the softer more easily eroded rocks of the plain Oasis Site of a surface aquifer (water bearing rock) Salt pan (playa) Site of a former or occeaional lake Alluvial fan Formed where a wadi or canyon meets the lower ground—a bajada is formed where these fans coalesce Plateau A large flat area with steep cliffs and narrow valleys Wadi A dry gully or riverbed eroded by occasional flash floods Barchan or crescent dune Mesa A portion of the plateau isolated from the main plateau Butte An isolated tower, a remnant of the plateau Pediment A shallow slope at the foot of a steep slope or cliff Fig 11.9: Fluvio – Aeolian Landforms
NSOU ? CC-GR-03 203 Bajada: A Bajada, (Spanish: "slope",) also spelled Bahada is a broad slope of debris spread along the lower slopes of mountains by descending streams, usually found in arid or semiarid climates. A bajada is often formed by the coalescing of several alluvial fans. Such coalescent fans are often mistaken for erosional landforms known as pediments. The repeated shifting of a debouching stream from one side of a fan to the other spreads the sediment widely and almost uniformly. As the sediment eventually grows together, the slope may extend outward from the mountain front to a distance of several kilometres. A bajada is usually composed of gravelly alluvium and may even have large boulders interbedded in it. The slope is usually less than 7°. In humid climates, landforms of this nature are usually referred to as piedmonts. Thus, they
are moderately sloping depositional plains located between pediments and playa.

Several alluvial fans coalesce to form a bajada. 11.7 Summary This unit deals with the different forces that are involved in aeolian geomosphic process. These processes occur in a variety of environments and are responsible for a variety of landforms. The interaction between fluvial and aeolian processes also influence landforms. Distinctive fluvio-aeolian features include rill, gully, ravive, badland topography, playas, bajada etc. 11.8 Questions Long question 1. Explain the various landforms produced by Aeolian erosion. 2. Analyze the evolution of landforms produced by the processes of Aeolian deposition. 3. Explain the various landforms produced by fluvio-aeolian erosion. 4. Give an account of the landforms developed by the depositional action of wind in hot deserts with suitable sketches. Short question 1. Explain the formation of zuegen and yardang. 2. Explain the formation of Inselberg. 3. Describe different types of dunes. 4. Distinguish between Corrosion and Corrasion. 5. Explain the formation of parabolic dunes and seifs. 6. What are the difference between a pediment and a bajada?

NSOU ? CC-GR-03 204 204 Unit 12 ? Models on Landscape Evolution : Views of Davis, Penck, King and Hack Structure 12.0 Objective 12.1 Introduction 12.2 W.M. Davis : The Geographical cycle 12.3 Walter Penck : Relating landforms to crustal movements 12.4 Model of lanscape evolution by L.C. King 12.5 John T. Hack : Time-independent model 12.6 Summary 12.7 Questions 12.0 Objective ? To learn about the various models of lands cape evolution. 12.1 Introduction The larger task of endogenetic forces is to create irregularities on the surface of the earth by volcanism, mountain building, etc. As soon as these end forms are exposed the various processes of weathering start working on them. Soon these are weathered, and in due course of time, the weathered products are transported by various agents. The whole period, during which erosion processes erode the new surface to sea level, is one cycle and since erosion plays an important role in it, it is called the cycle of erosion. The significance of the cycle concept is that it explains the sequential development of landforms in a temporal framework. Three views on the cycle of erosion are most important. These are of Davis, Penck and King. These views relate to the sequential development of landforms in an orderly fashion during which the slope also evolves in a variety of ways. Thus, these cycles, while describing the development of landforms, also give information about the evolution of slopes. 12.2 W.M. Davis: The Geographical Cycle The first model of landscape evolution to gain widespread acceptance within the discipline was remarkably influential and persistent but no longer dominates research

NSOU ? CC-GR-03 205 thinking like it did, but still used as a teaching tool and residual influence reflected in the way geomorphologists cling to cyclical models. W.M. Davis was geography professor at Harvard University. He wrote about his model from 1880-1938. Like his contemporaries in natural science he was strongly influenced by Charles Darwin (On the Origin of the Species) and Charles Lyell (Principles of Geology), although used evolution as a notion of history (inevitable progress or change over time) rather than a process and took a deterministic rather than probabilistic view of evolution like Darwin. Thus Davis aspired to a deductive, theoretical, genetic model of landscape evolution. The concepts of structure, process and time were his theoretical framework: Structure was regional and considered as an initial condition (beyond the scope of his model). Process was the sum of weathering and transport rather than specific processes or mechanisms, although since his cycle was based on the assumption of a normal climate, i.e. humid temperate fluvial processes were predominant. Fig 12.1: Stages of valley Development. Young Mature Old Initial surface Base-level of erosion Fig 12.2: The geographic cycle of Davis.

NSOU ? CC-GR-03 206 Time was the central theme, but time in the sense of landscape development relative to the completion of the entire geographical cycle, i.e., extent of landscape development or stage. Davis assumes that each landscape has definite life history. As soon as a landmass emerged,erosional agents start their works on it andfinally take it to ultimate featureless surface.Newly uplifted landmass been called initial surface upon which erosion starts.For the purposes of demonstrating his cycle concept in the mostsimple and persuasive away, Davis imagined as an initial form a mass of land uplifted from beneath the sea by earth movements. The Stage of Youth Davis assumed that the up lift the land took place very rapidly, sothat the processes of denudation were able to act almost from the starton what was in effect, a stable mass.If the climate were sufficientlyrainy, as would normally be thecase in humid temperate lands, a system of rivers would quicklydevelop on the emerged land surface,this would comprise a numberof consequent streams whose directions of flow and velocities (andthus erosional capabilities) would be determined by the gradients ofthe initial surface. From the stage of infancy, these streams would cut rapidly downwards, and would in duecourse from deep valleys. On these stops, weathering and slumping would operate, but at quite a slow rate compared with the speed of river for a long period the valley profiles would be approximatelyV-shaped except in areas of complex geologicalstructure where stepped profiles would be developed.Throughout this stage, parts of the initial land – surface would bepreserved on the watershed between the consequent streams, Ininfancy the extent of this initial surface would be considerable butwould be gradually diminished later in the youthful stage as the valleyside slopes experienced retreat and as tributary streams began toextend their valleys in to the interfluve areas by headword erosion. The Stage of Maturity: By the onset of this stage the deepening of the v- shaped valleyscharacteristic of youth would have been slowed down considerably. Through the formation of their valleys the various streams wouldthroughout youth have lowered their channels nearer and nearer to what Davis termed “the base – level of erosion” (which is normallythe level of sea into which the eventually flow, and below which cannoterode. In the process the longitudinal gradients of the streamswould have become ever gentler, stream velocities would havebeen reduced,and the streams would possess less and less energy touse in moving their loads and attacking their beds, In fact, Davis suggested that, early in the stage of maturity,

NSOU ? CC-GR-03 207 streams would attain acondition of grade of equilibrium, in which the entire energy of thestream is consumed in the movement of water and its load.The gentle meanders of the youthful streams responsible for theinter – locking spur supposedly typical of youthful valleys, wouldbecome wider and more pronounced, and at many points the valley – side slopes would be undercut and driven back, By the end of themature stage, slope angles in general would have been considerably reduced by the process of divide wasting and smoothly curving slopeprofiles with no major breaks, wouldDominate the landscape, An important result of divide wasting duringmaturity would be the reduction of relief, or in other words a decreasein the vertical height separating interfluve summits and valley floors. The Stage of Old Age: By this stage the processes of landscape evolution would havebecome extremely slow in operation. This running down of the cyclewould have resulted from the gradual reduction of river gradients andan associated decline of stream energy and the continued lowering inangle of valley – side slope so that creep and wash would become lessand less active and mantle of slope detritus, impending mechanicalweathering, would be extensive By comparison with youth andmaturity the stage of old age would therefore be extremely protracted. River would continue to broaden their valleys by meandering soproducing near – level valley floors over which during times offlooding alluvium would be deposited to give broad flood plains. Bythe end of old stage the relief would assume the form of a very gentle undulatingplain,termed, by Davis a “ peneplain “ standing only alittle above the base level of erosion. Above the peneplain a fewisolated hills, as yet unconsummated by divide wasting, wouldremain. Such residuals were referred to by Davis as “monadnocks”. Evaluation Since the time of Davis, some geomorphologists have agreed thatthe peneplain should be regarded as purely theoretical landforms, onthe ground that the conditions of stable base level needed for thecompletion of a full cycle of erosion cannot have persisted for asufficiently long period of time. There is certainly much evidence toshow that gentle earth – movements, involving both elevation anddepression, are taking place today, and during the organic periods of the past crystal instability must have been greater. Another argument is that, when a landmass is under – going erosion, itwill tend to experience continuousuplift, simple because the unloadingwill initiate compensatory isostatic movements, As a result riverswill always be incising their valleys, and attainment of the peneplainstage will be postponed indefinitely, It is true that in an area perfectly preserved surfaces of peneplanation do not exist at or nearpresent sea level.

NSOU ? CC-GR-03 208 Interruptions to the Cycle of Erosion: Based on the concept of geomorphology " complexity ofgeomorphic evolution is more common that simplicity ", it can besaid that multicyclic evolution of landscapes is more common that theyhave superimposed upon it youth – full features as a result of theinterruptions of cycle (like climatic change and sea level fluctuationsand rejuvenation) Rejuvenation—Dynamic rejuvenation may be caused byepeirogenic uplift of a landmass with accompanying tilting andwarping. Such movements may be rather localized and associatedwith neighbouring organic movements, or they may be, as thought bysome, would wide in nature. Localized down tilting, warping orfaulting of a drainage basin will result in streams which now havetransporting power in excess of that required for transport of theirloads. 12.3 Walter Penck : Relating Landforms to Crustal Movements The best known manifestation of Penck's model is the retreating slope profile, where evolution of the profile is controlled by rate of output (river erosion) at the base and rate of uplift of the land. He was able to deduce various slope profiles for different combinations of river erosion, uplift and rock resistance, by assuming that stronger rock requires steeper slopes for the same rate of denudation. He also modelled stream longitudinal profile as controlled by uplift, rock type and stream discharge. Another expression of his model was three categories of landform assemblage according to tectonic history (versus normal climate): great folding from lateral forces (orogenic) dome formation without folding (epeirogenic) stable regions Penck also envisaged three landscapes resulting from slow, intermediate and rapid rates of uplift. Morphologically, they were similar to Davis' old, mature and young stages, but whereas Davis ascribed morphology to age (time-dependent), Penck's model was largely time-independent based on tectonic history. Evaluation of Penck's model is hindered by its hurried writing, posthumous publication and confused representation in English, including misrepresentation by Davis who was defending his own ideas. Although there were important flaws and contradictions in Penck's

NSOU ? CC-GR-03 209 work, and it was poorly translated or misrepresented especially by adherents to the Davisian school, it was the one comprehensive alternative to the cycle of erosion and thus was a focus for contrary ideas, such as emphasis on process rate (both endogenic and exogenic) and greater attention to slope retreat. Fig 12.3: Penck's Model of Landform Development Upliftment and Erosion: Penck believes that upliftment takes place through different rate. He says that erosional activities and their agents will not wait for the final upliftment. As soon as any landmass comes above the sea level, the agents of erosion start their work and both these incident takes place together, but after some time upliftment will finish and degradation will continue until the land mass come to the ultimate base level or near to that when degradation is not possible. Penck says that from beginning to end. The rate of upliftment is not the same. In the beginning it is quick, then it becomes normal and at last with decreasing rate. So to express these three rates of upliftment Penck has three German terminologies. Aufsteitgendeentwikelung:- This is the first stage of upliftment in which within a short period the rate of upliftment becomes very high. Gleichforigecntwiekclung this is the middle one stage between the above two. Abstsigendecntwickelung:- in this stage it becomes very slow and in decreasing order. In this graph, it is quite clear that are two curves upper and lower. Here upper curves represent absolute height and that of lower Curve river valley. AB, CD EF and GH show the relief of different Stages. He has divided the whole process into five categories: LOWER CURVE UPPER CURVE ELEMENT

NSOU ? CC-GR-03 210 Fig 8.4: Graph of Penckian Cycle. Fig : The Penck model. (a) Diagram showing slope replacement (upper profile) caused by successive retreat of an infinite number of inclined valley bottoms leading to a smooth concave profile (lower concave profile). Penck envisioned an initially steep linear cliff (t0), being replaced by progressively more gentle slope segments (t1 – t3). First case– There is an increase in the height of landmass above the sea level. Upper curve is rising more than the lower curved which means the rate of upliftment is more than the rate degradation and this is why the relief is increasing Though the valley is being Eroded but interfluve summits or divided summits are not affected by this degradation. Second case–It is quite clear from the graph – as – upper curve AC and lower curve BD. Third case – In this case neither relief is increasing or decreasing nor erosional curve show increase or decrease. So both has same intensity that means all the new rise is cut down by the degradation agents and thus they are Parallel but constant it is shown on the graph by upper curve CE and lower curve DF. Fourth case – After the third case the uplift in the landmass is finished and now in this case down cutting and side cutting is prominent. So due to this reason both curve show the same rate of degradation in terms of absolute height and absolute valley bottom. So

NSOU ? CC-GR-03 211 both curves show parallel ongoing trend. It is shown in the graph by EG (upper curve) and FH (lower curve). Fifth case – In this case the downcutting decreased and the lateral cutting is still in operation which results the lowering of upper curve rapidly than the lower curve. Thus both curves come closer to one another. This means again there is no relief left that uplifted landmass and this is called endrumpf with a small elevation, also called featureless low land reached at the ultimate base level. Slope Replacement Theory of Penck Penck recognized concavo-convex hillslopes similar to what Davis was observing in eastern North America. However, the Penckian model for their origin was altogether different. Penck is the father of slope replacement as a mechanism for hillslopes evolution. Whereas Davis's hillslopes are transport limited and always covered with a creeping regolith mantle, Penck's hillslopes are predominantly weathering limited with little to no regolith cover, except, implicitly at their base where regolith transported downslope is allowed to accumulate. Originally steep and straight slope profiles weather parallel to them except for a small, step-like flattening at the base of the slope, the 'haldenhang', which is presumably controlled by the angle of repose of the hillslope debris. Retreat of the 'haldenhang' results in an even lower-gradient basal slope called the 'abflachungshang'. The process continues with successive 'abflachungshang' retreating, each leaving a basal slope of lower angle than itself. The integrated result is a concave-up slope that has replaced the original steep, straight slope. Penck went on to propose mechanisms of how the upper part of the concave profile would flatten to produce an upper slope convexity using arguments similar to those used by Gilbert (1909). 12.4 Model of Lan scape Evolution by L.C. King Lester Charles King (1907–1989) was an English geologist and geomorphologist known for his theories on scarp retreat. King's ideas are contained in his 2 books:- 1) Morphology of the Earth (published in 1960) and 2) Canons of Landscape Evolution (1953). King received his training from C.A Cotton in Davisian morphology,T.J.D Fair for the ideas of slope and Alex L. Du Toit for ideas on tectonics. Kings ideas are influenced by his observations in southern Africa. His ideas included some components from the model of Davis and Penck. He rejected some of these and introduced some completely new

NSOU ? CC-GR-03 212 ideas.He rejected the relationship between uplift and slope formed by Penck.He accepted the idea of structure- process and slope given by Davis but he changed the sequence in which process was placed first. Process for King meant the semi-arid environment.The semi-arid environment was suggested by king because in these type different types of river mass wasting and weathering process are important in addition to the work of river. His ideas represent a combination of Process, structure,crustal movement and mass wasting. Kings idea can be understood in terms of 3 components: 1) Slope element 2)Devel- opment of Hill slope 3)Epigene cycle of erosion Slope elements: King used four slope elements which were initially proposed by 'Wood'. Each element is semi-independent. Any one of the elements can be completely absent on a given slope. This is particularly true for free face. 1) Waxing slope: It is a convex segment at the crest of the slope. It is covered by weathered material. Transportation on the surface is dominated by soil creep. 2) Free face: It is similar to cliff proposed by Penck.It is bedrock out creep which retreats parallel to itself under the influence of weathering processes and uniform removal of material. However areas which do not have enough large relative relief, free face may not develop. 3) Debris slope: Its development is dependent upon free face. If free face is there, debris slope will be there and vice-versa. 4) Waning slope: It has a gentle concave profile. There may be bedrock or transported material covering eroded bed rock surface, when the eroded trans- ported debris cover such a surface it is known as pediment. Parallel retreat: Each of the upper parts of the slope retreats by the same amount and maintain the same angle. Therefore, the convexity, free face and debris slope all retain the same length. The concavity extends in length and becomes slightly gentler in angle. This is called pediment This type of evolution is called a parallel retreat. Pediplanation: He envisaged the parallel retreat of a single free face slope unit, leaving a broad, concave pediments sloping at an angle of 6-7 degree or less at its base. Gradually over time, pediments coalesce to form pediplains and this mode of landscape development, is therefore called pediplanation.

NSOU ? CC-GR-03 213 Development of Hill slopes: King rejected the climatic basis of landscape development and suggested that all landscapes are basically similar. He featured semi-arid climate as normal climate because acc.to him high propor- tion of earth surface have this type of climate and it has been dominant climate throughout the geological history of the earth. He accepted the division of tectonics movements by penck i.e. orogeny, epeirogeny and cymatogeny. Pedimentation was proposed as a basic process in hill slope development by king. Parallel retreat of slope results in emergence and expansion of a pediment which have a concave form. At an advanced stage of development these pediment on both sides of land mass join together.On this type of surface there are isolated erosional remnants. These are the Inselbergs, Bornhardt and Monadnocks. Inselberg, Bornhardt and Monadnocks: He theorized that once pediment surfaces have been formed, they persist with little change until the next phase of surface uplift promotes a new cycle of river incision and Fig: 8.8 Pediplanation cycle according to L.C. King. Youth Mature Old C B A Base Level of Erosion

NSOU ? CC-GR-03 214 escarpment retreat, which consumes existing pediplains and creates new ones. Like Davis, King envisioned impulsive uplift and long response times of landscape adjustment. He never accepted the Davisian concave-convex slope; he favouredPenck's view of concave hill slopes and slope replacement. On the basis of Penck's model he conclude that the landscape assumes the form of a series of nested, retreated escarpments. Epigene Cycle of Erosion The term epigene refers to the surface. Therefore the epigene cycle of erosion is related to water and wind, in addition to weathering and mass wasting. It doesn't include glacial, marine, volcanic and karst processes. King accepted the concept of stages (i.e. at continental scale, there are massive erosional surfaces forming large staircase) and rejected the concept of crustal movements for creating of slope for cycle. The initiation of landscape depends upon the mode of development of hill sides. There are 2 different modes of development of hill sides:- 1. (a) Valley formation through stream incision. (b) Formation of valley sides due to tectonic forces. 2. Gentle lifting towards the sea. Acc. ording to him development of landscape depends upon mode of stream incision. Development of landscape by stream incision— In this case valley sides are very steep because of uplift. The longitudinal profile of the river is broken by the development of knick points. The breaks in rivers beds form knick points. The river tries to remove or erode these knick points which recede in the upstream direction. River incision become important and youthful v-shaped valleys are formed. At this stage there can 2 variations. 1) A surface can be developed into a highly dissected plateau, for e.g. the Appalachian plateau around Pittsburgh. 2) The type of structure in a surface can provide different types of drainage pattern. Land development on tectonic forms His ideas on this aspect are based on his observation in coastal South Africa particularly Drakensberg mountains. The monoclinal warping results in continental scarps. These scarps are at right angle to the drainage lines.

NSOU ? CC-GR-03 215 The drainage line is the major agent for the removal of material created through the progress of a particular cycle. The erosional processes results in the retreat of these continental scarp. The removal of the material results in the parallel retreat of the scarps. Between two scarps is a cyclic landscape surface. Different epigene cycles produce different cyclic surfaces. At the base of each scarp there is a knick points. The knick point and scarp retreat at the same time. Two types of scarp can develop :- 1) Uniform wall like erosional scarp. 2) A scarp marked by dissection. The dissected part is generally located at upper elevation. In such cases the land is broken into a no. of hill slope segments. This is similar to the youthful stage after the youthful stage is over the slope experience parallel retreat.Due to this the areas of inter-fluvial divide are reduced or eroded. Evaluation of King's concept Lester C King's model of landscape evolution is similar to Davis' in that uplift is episodic and rapid in comparison with rates of denudation, and that the overall morphology of a landscape at any point in time is diagnostic of its evolutionary stages of development. King emphasized the role of erosion alone in the formation of pediment whereas Davis has emphasized both erosion and deposition in the formation of pediplains. His model is very comprehensive. His ideas of Cymatogeny are basically outside the scope of geomorphol- ogy. It is more related to plate tectonics and geo-physics. 12.5 John T. Hack: a Time-independent Model John T. Hack is the champion of time-independent model where landscape variability due to age is not modelled, but rather considered a source of variability in landscape from related to contemporary process. This approach assumes a dynamic equilibrium between contemporary surficial processes and the surface upon which they are acting. Hack chose dynamic equilibrium as his conceptual and methodological framework. He derived this perspective directly from G.K. Gilbert who worked in the western US, where the dramatic semiarid landscape seems youthful and dynamic. Hack applied dynamic equilibrium to reinterpretation of the Appalachian Mountains, the landscape that lead Davis to think in terms of change over time.

NSOU ? CC-GR-03 216 The goal of the theory of Hack is to explain the landscapes of any region of the earth's surface on the basis of present denudational processes operating therein and to demon- strate lithological adjustment to landforms (for which he presented examples from the Shenandoah Valley of the Appalachians, USA). The reference system of Hackian model is that 'geomorphic system is an open system which always tends towards steady state while his model may be stated as 'the shape of the landforms reflects the balance between the resistance of the under- lying materials to erosion and the erosive energy of the active processes.' The basic premise of Hackian model of landscape development is that'the land- scape and the processes that form it are part of an open system which is in steady of balance' (Hack, 1960). Hack further conceived the following reference systems on the basis of his basic assumptions— (i) 'There is balance between denudational processes and rock resistance'. (ii) 'There is uniform rate of down wasting in all components of landscapes.' (iii) 'Differences and characteristics of form are explicable in terms of spatial relations in which geologic patterns are primary consideration' (Hack, 1960). (iv) The processes (denudational) which operate today have carved out the land- scapes of the earth's surface. (v) 'There is lithologic adjustment to landforms'. Though J.T. Hack did not construct evolutionary model of landscape development directly but he did opine 'that evolution is also a fact of nature and that the inheritance of form is always a possibility' (Hack, 1960). Though he did not build a model of progressive changes in landforms through time with changing environmental conditions but he opined that 'landforms do experience changes with changing equilibrium conditions but these changes are not like Davisian evolutionary changes. Hack postulated the concept of variations in landscapes in relation to varying conditions of balance between rates of upliftment and erosion viz.- (i) The rate of upliftment is balanced with the rate of erosion. If there is rapid rate of upliftment and erosion, there are produced high reliefs. This condition
NSOU ? CC-GR-03 217 is maintained so long as the higher rate of upliftment and erosion remains constant. (ii) So long as the rate of upliftment increases, the relief also increases so that rate of erosion matches the increasing rate of upliftment. (iii) When the rate of upliftment becomes zero i.e. when upliftment stops, then relief also declines, though ridge and ravine topography is still maintained. Hack has opined that if the diastrophic movement is gradual and if it is balanced by the denudational processes (i.e. rates of upliftment and erosion are equal) then landscape, while changing from one form to the other, remains in equilibrium condition. On the other hand, if there is rapid rate of diastrophic movement, then relict landforms are preserved until new equilibrium condition is not attained. Hack also developed a 'continuous down wasting model' which though envisages tendency for dynamic equilibrium but it is not necessary that the dynamic equilibrium is in steady state. He himself admitted that 'though there is possibility for steady state but it is not possible in reality.' He further opined, 'that evolutionary models can be conceived on the basis of base level of erosion. In this context he considered three conditions of base level viz. (i) stable base level, (ii) positive (rise) change in base level and (iii) Negative (fall) change in base level. The basic features of dynamic equilibrium as applied to spatial relations within a drainage basin by Hack: all elements of the topography are mutually adjusted so that they are down wasting at the same rate. forms and processes are in a steady state of balance. differences and characteristics of form are explainable in terms of spatial relations in which geologic patterns are the primary consideration rather than a theoretical evolutionary development. Opposing forces (inputs and outputs) are in a state of balance where their effects cancel out to produce a steady state.
NSOU ? CC-GR-03 218 Attainment of a near time-invariant relief and mean elevation of a dynamic equilibrium landscape (a) attained over graded time during a protracted period of decay (cyclic time) and (b) attained as a flux steady-state between the input of rocks by tectonic processes and output by erosion. Hack also maintained that his model is not comprehensive, that time can also be invoked to explain landscape features, but it does apply to the entire range of spatial scales of interest to geomorphologists. Under dynamic equilibrium, landscapes evolve without obvious change, unless there is a change in energy inputs (climatic change, tectonism) or surface resistance. Examples of the latter include the denudation of surface materials to expose harder or softer materials, or the accumulation of coarse materials in valley bottoms. The consequent adjustment to these changes represents disequilibrium but does not conflict with the time-independent perspective. Hack argued like Penck that rates of uplift and erosion are linked, although he related erosion plus relief to uplift and rock resistance and had a thin database to support this relationship. Evaluation of dynamic equilibrium: The past usually is poorly or only partly known, thus a model based on current conditions has a definite advantage.

NSOU ? CC-GR-03 219 Mutual relationship with process geomorphology Time-independent is an end-member of the distribution of systems and system models; these are fairly easily identified (e.g. and under fit stream is time- dependent relative to valley form but time-independent with respect to channel form) However, it is not usually this easy to resolve the complex forms that represent both time-independent and time-dependent behaviour; attention to spatial and temporal scale help, for example time-independent behaviour is more likely at more local scales, and the influence of past processes is proportional to their intensity and inversely proportional to time elapsed since the event Dynamic equilibrium implies characteristic forms as opposed to relaxation forms Situations where form is not maintained include uplift exceeding rates of erosion or increasing relief controlled by difference in rock resistance (e.g., inversion of topography) When small segments of landscape evolution are sampled it becomes difficult or impossible to distinguish between dynamic equilibrium (trending mean), steady state (constant mean) and dynamic metastable equilibrium (two scales of oscilla- tions). Hack referred to both steady state and dynamic equilibrium; however a trending mean is much more likely in geomorphic systems. Dynamic equilibrium is more of a conceptual framework than a fully tested corroborated model, which will require much more extensive data bases. How- ever, it is a very useful framework in that the reduced role of time is replaced with an expansion of spatial variability and the integration of parts of landscapes. In this respect it is tied to a systems approach and the notion that systems move toward equilibrium at a rate proportional to their distance from it. Thus those far from equilibrium change quickly (time-independent) and thus near equilibrium change slowly (time-dependent). This systems perspective unites both the time-dependent and time-independent viewpoints. 12.6 Summary The models of lands cape evolution are dealt in this unit. The significance of the various models explans the sequential development of landforms. Three views of cycle of erosion are very important. NSOU ? CC-GR-03 220 12.7 Questions Long question 1. Give a critical account of Davis's normal cycle of erosionwith sketches. 2. Discuss the time independent model of Hack. 3. Explain critically the cycle of erosion concept as envisaged by King. 4. Explain critically the cycle of erosion concept as envisaged by Penck. 5. Explain the geomorphic ideas of J.T. Hack and point out how it is different from thecyclic concept of landform evolution. Short question 1. Discuss the concept of parallel retreat by Penck. 2. Briefly describe the concept of peniplain by Davis. 3. Briefly describe the concept of pediplain by L.C. King. 4. Distinguish between peneplain and pediplain. 5. Describe the four components of slope according to the model of L.C. King. 6. What is meant by 'interruption' of normal cycle of erosion?

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PREFACE In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. core, discipline specific, generic elective, ability and skill enhancement for graduate students of all programmes at Honours level. This brings in the semester pattern, which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. I am happy to note that the university has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade "A". UGC (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for U.G. programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English / Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisitioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor
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Netaji Subhas Open University Rural Development [GE-GR-11] Module - 1 Unit 1 ????? Defining Development 7-16 Unit 2 ????? Paradigms of Rural Development 17-32 Unit 3 ????? Need for Rural Development 33-47 Unit 4 ????? Rural Economic Base 48-60 Unit 5 ????? Rural Co-operatives and Agricultural Marketing 61-78 Unit 6 ????? Area Based approach to Rural Development 79-96 Module - 2 Unit 7 ????? Target Group Approach to Rural Development 97-108 Unit 8 ????? Provision of Services 109-134 Unit 9 ????? Rural Governance: Panchayati Raj System 135-151 Unit 10 ????? Rural Development Policies and Programmes in India 152-172 Unit 11 ????? Rural Infrastructural Development Programmes 173-189 Unit 12 ????? Rural Development Programmes for Women and Children 190-207 UG-Geography (HGR)
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NSOU ? GE-GR-11 7 MODULE –1 : Learning Objectives : The Learners will come to know the following topics in this Module : i) Definition and concept of development ii) The inter dependency of urban and rural sectors of the economy. iii) The concept of rural development. iv) The paradigm of rural development, including different theories and models. v) The need of rural development and related rural development approaches. vi) The agriculture and allied sector as a base of economy and pillar of rural development. vii) The role of rural cooperatives and agricultural marketing in rural development. viii) The approaches of rural development in different areas like, drought prone area. ix) Rural development programmes.

8 NSOU ? GE-GR-11 Unit 1 ????? Defining Development Structure 1.1 Introduction 1.2 Interdependences of Urban and Rural Sectors of the Economy 1.3 Questions 1.4 Suggested Reading 1.1 ????? Introduction Development is a process that creates growth, progress, positive change or the addition of physical, economic, environmental, social and demographic components. The purpose of development is a rise in the level and quality of life of the population, and the creation or expansion of local regional income and employment opportunities, without damaging the resources of the environment. Development is visible and useful, not necessarily immediately, and includes an aspect of quality change and the creation of conditions for a continuation of that change. The international agenda began to focus on development beginning in the second half of the twentieth century. An understanding of development was that the economic growth did not necessarily lead to a rise in the level and quality of life for population all over the world; there was a need to place an emphasis on specific policies that would channel resources and enable social and economic mobility for various layers of the population. Through the years, professionals and various researchers developed a number of definitions and emphasised for the term "development." Amartya Sen, for example, developed the "capability approach," which defined development as a tool enabling people to reach the highest level of their ability, through granting freedom of action, i.e., freedom of economic, social and family actions, etc. This approach became a basis for the measurement of development by the HDI (Human Development Index), which was developed by the UN Development Program (UNDP) in 1990. Martha Nussbaum developed the abilities approach in the field of gender and emphasized the empowerment of women as a development tool. In contrast, professionals like Jeffrey Sachs and Paul Collier focused on mechanisms that prevent or oppress development in various countries, and cause them to linger in

NSOU ? GE-GR-11 9 poverty for dozens of years. These are the various poverty traps, including civil wars, natural resources and poverty itself. The identification of these traps enables relating to political – economic – social conditions in a country in an attempt to advance development. One of the emphases in the work of Jeffrey Sacks is the promotion of sustainable development, which believes in growth and development in order to raise the standard of living for citizens of the world today, through relating to the needs of environmental resources and the coming generations of the citizens of the world. According to the World Bank, as many as half of the world's six billion inhabitants live on the equivalent of less than $2 per day, and about one-fourth of the world lives on the equivalent of less than $1.25 per day (Chen &Ravallion, 2008). Meanwhile, people in the 20 richest countries earn, on average, 39 times more than people living in the poorest 20 states (Milanovic, 2007).This indeed justifies the need for development. At the same time, the extent of world poverty has declined significantly during recent years. For example, the World Bank estimates that during 1981-2005 the percentage of people living on less than $1 per day was halved, decreasing from 52 percent to 26 percent during this period (Chen &Ravallion, 2008). These contrasting trends highlight both the problems and the progress associated with the process of "development." On one hand, development has resulted in serious inequities between states, whereby large number of the world's inhabitants are mired in poverty, especially in Africa, while inhabitants of the world's richest countries live in both relative and absolute luxury. Due to development trends, populations in poor countries are becoming wealthier over time; a process linked to globalization because countries in the developing world can raise their standards of living by integrating with highly developed states. The term "development" in international parlance therefore encompasses the need and the means by which to provide better lives for people in poor countries. It includes not only economic growth, although that is crucial, but also human developmentproviding for health, nutrition, education, and a clean environment. 1.2 ? ?? ?? ?? ?? ? Interdependences of Urban and Rural Sectors of the Economy Gandhi had a very clear perception of Indian villages. He started analysing the causes of poverty owing to the British Rule. In his words, "India lives in her seven and a half lakhs of villages". He believed India would have to live in villages, not in towns; in huts not in

10 NSOU ? GE-GR-11 palaces. He observed, "If village perishes, India will perish too." He was of the view that the country's progress lies in development of its villages and growth of rural economy, industry and rural skills. As India belong to

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one of the developing countries, it is apparent that there is a divide between urban and rural areas.

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Rural areas are located far away from services and job opportunities. Rural areas depend on urban areas for secondary schools, post and telephone, credit, agricultural expansion services, farm equipment, hospitals and government services. People in rural areas travel long distances to access services and job opportunities and this on itself have financial implications. As incomes from agriculture decrease, rural households are forced to develop new and more complex livelihood strategies that include both agricultural and non-agricultural income, including remittances from seasonal and permanent migrants (Simkins, 1983).

These migrants head towards urban areas for better living, job opportunities and social wellbeing and the process advocates for the rural urban interdependences that remains inevitable even in present day context.Villages get integrated into urban areas also. There are several reasons why villages have been changing.

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Of the 121 crore Indians, 83.3 crore live in rural areas while 37.7 crore stay in urban areas, as per the 2011 Census. The absolute increase in population is more in urban areas than in rural areas. The

level of urbanisation increased from 27.81 per cent in the 2001 Census to 31.16 per cent in the 2011 Census, while the rural population declined from 72.19 per cent to 68.84 per cent.
One noticeable issue in recent times is the rate at which people migrate from rural to urban areas. This has led to negative consequences like overpopulation in urban areas that has encouraged crimes and growth of slums.

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There exists an economic, social and environmental interdependence between urban and rural areas.

Rural-urban linkage generally refers to the growing flow of public and private capital, people (migration and commuting) and goods (trade) between the urban and rural areas.

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Adequate infrastructure such as transportation, communication, energy and basic services is the backbone of the rural-urban development linkage approach.

Urban food and nutrition security depends on strong links between urban and rural areas. But policymakers and urban planners often ignore this interdependence. There are two broad, often overlapping, categories of rural-urban linkages. “

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Spatial” links refer to the movement of people, goods, money, and information between urban and rural areas. “

Sectoral” links describe the interdependence between agriculture on the one hand and industry and services on the other. In the next two decades, three main issues related to rural-urban interdependence are likely to emerge: (1)

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Changes in land use around urban centers, from farmland to residential or industrial use; (2) Greater diversification of income sources in rural and urban areas, often involving people migrating or commuting between

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the countryside and urban centers; and (3) Changes in the direction and composition of internal migration.

A majority of the Indian villages still face constraints such as access to education, health care, drinking water, power, roads, etc. Against this background, adoption of especially villages in backward regions through preparation of Village Development Plans (VDPs) would go a long way in ensuring holistic and integrated development of the villages concerned. The objective of VDPs is to develop the selected village in an integrated manner. This would include economic development and other aspects of human development.

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It is now widely recognized that there exists an economic, social and environmental interdependence between urban and rural areas and a need for balanced and mutually supportive approach to development of the two areas. The discrete consideration of rural development as completely distinct from urban development is no longer valid.

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Since 1991, significantly greater access to information technology, better roads, improved education and changing economic realities has increased the movement of people, goods and services, waste and pollution and blurring the boundaries between urban and rural areas. The government has laid down policies that draw on urban-rural interdependencies. Such interdependence however still have a relatively limited impact on development practices. There liesa gap between development policy and tangible policy outcomes. Rural-urban developmental policies haven't produced as expected instead, regional economies, the goods and services required by the new economic activities stimulated by these policies come from private businesses. Many policies that attempt to draw on urban-rural linkages are often unsuccessful because they fail to reflect the true circumstances of the people

in those areas of problem (Lohnert, & Steinbrink, 2005). Gandhiji's vision to make Indian villages prosperous is possible through rural-urban interdependence. Gandhiji had an elaborate plan for labour-intensive production which would generate more employment opportunities and suit to the rural community. Regional development planning creates a better urban-rural balance and reduces migration pressure on urban areas. It is important for planners and policymakers to develop strategies based on the realities of people's lives in both urban and rural areas. This would reflect Gandhiji's vision of an ideal region that would be eco-friendly and sustainable for future generation. The decentralised economic units would thus facilitate the best possible use of local raw materials, talents and manpower; promote occupational equilibrium, ecological balance and cooperative living between urban and rural entities. In the field of agriculture, Gandhiji recommended cooperative farming which would save labour, capital, tools and provide employment to all

12 NSOU ? GE-GR-11 adult villagers. Gandhian economics approach places importance to means of achieving the aim of development and this means must be nonviolent, ethical and truthful in all economic spheres. So, he advocated trusteeship, decentralisation of economic activities, labour- intensive technology and priority to weaker sections. The 73rd and 74th amendments to the Constitution initiated the processes for introducing institutional arrangements for integrated development of settlements, areas and regions. So, these amendments provide for two types of committees, District Planning Committee and Metropolitan Planning Committee. These committees would ensure that the plans prepared by local bodies at the village and town levels are integrated and accommodated within the framework of 20 to 25-year perspective plans and 5-year economic development plans prepared at the national and State levels.The Institute of Town Planners, India in the year 1995 conducted a study to detail urban development plans formulation and implementation (UDPFI) guidelines. The purpose was to arrive at a methodology of plan preparation that would not only help prepare better master plans but also help achieve integrated development of rural and urban areas. Urban and Regional Planners being spatially trained to look into the multi-sector dimensions of development in an area would be preparing a spatial plan and would be achieving the objective of rural-urban integration.Rural communities are responsible for the stewardship of ecosystem services essential to human survival, such as clean air and water, flood and drought mitigation, pollution mitigation, biodiversity, and climate stabilisation. Metropolitan congestion is given some relief by smaller towns and cities that offer affordability, space and safety. Metropolitan areas provide the concentrated markets for rural goods and services. They are also the location of a wide variety of specialised services like healthcare, cultural activities and legal and financial services.

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Rural-urban interdependence relates to the joint or interactive relationship between urban and rural areas. The mutually beneficial correlativeness of urban and rural areas. Traditionally, rural and urban issues and planning have been typically seen as and dealt with separately. However, in recent years as urbanization and inequality increase, more sophisticated analyses of the linkages and interdependencies between rural and urban areas have emerged. The flows of people, goods, services, information and money typically provide strong and dynamic linkages between rural and urban areas. In many places these interdependencies have deepened since the market liberalization of the 1980s due to increased price risk, rising input prices relative to output prices, detrimental HIV/AIDS effects on labor and other asset availability, environmental deterioration and continuing farm sub-division at inheritance (Low, et al., 1999). Rural-urban interdependence

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important for poverty alleviation and sustainable rural development and urbanization. Strong linkages can improve the living conditions and employment opportunities of both rural and urban population. Domestic trade and the adequacy and efficiency of infrastructure are the backbone of mutually beneficial rural-urban relationships and of the success of the relationship between urban and rural areas (Bekker, 2000). Issues such as changes in land use around urban centers, from farmland to residential or industrial use; greater diversification of income sources in rural and urban areas, often involving people migrating or commuting between the countryside and urban centers; and changes in the direction and composition of internal migration are likely to emerge in the near future. The relationships or inter-linkages between urban and rural areas are not all positive or beneficial to both ends of the spectrum. Cities and their metropolitan extensions absorb productive agricultural land, exploit water resources, pollute the rural environment and act as sinks for urban waste. On the other hand, cities rarely expand and build up efficiently. There often remains extensive rural areas within cities and their metropolitan boundaries, giving rise to the phenomenon of urban villages with urban farming occupation and prevalence (Tacoli, 1998).

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Strategies and interventions by government to foster urban-rural interdependence are in the form of policies and they include the following: a) A rural-urban linkage development approach The government has engaged a number of strategies for upgrading urban-rural interdependence in the country. Provision of adequate infrastructure such as transportation, communication, energy and basic services is the backbone of the government's urban- rural development linkage approach. There is a positive relationship between adequacy of transportation infrastructure, ease of mobility and access to employment and enhancement of income. Adequate investments in infrastructure, particularly transportation infrastructure, also improve rural productivity and allow access to markets, jobs and public service by both men and women (Gete, et al. 2007). The high densities have obvious consequences in terms of the choice of transportation modes, living conditions, congestion and pollution. b) Local Economic Development Approach Local economic development offers local government, the private and not-for-profit sectors, and local communities the opportunity to work together to improve the local economy. LED has encompassed a range of disciplines including physical planning, economics 14 NSOU ? GE-GR-11 and marketing. It has also incorporated many local government and private sector functions, including environmental planning, business development, infrastructure provision, real estate development and finance. All these disciplines must work together to improve the local economy. The discrete consideration of rural development as completely distinct from urban development is no longer valid. Considering the positive impacts of this, it becomes clear that urban-rural interdependence will be greatly boasted as local produce will need improved transport infrastructure to be in place in order to access urban markets.

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This linkage will allow comprehending these areas as interdependent phenomena rather than as random disparities (Gete, et al. 2007). c) The National Infrastructure

Approach Investments in rural sectors would

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improve access to a number of facilities, including healthcare facilities, schools, roads etc. This

improves the interdependencies

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between urban and country areas by construction of ports, roads, railways, hospitals, schools and dams also contributes to faster economic growth. d)

Integrated Approach

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The Integrated urban space and public transportation programme aims at coordinating planning and implementation of public transportation, human settlement, economic and social infrastructure and location decisions into sustainable urban settlements connected by densified transport corridors. Such government projects enhance greatly the interdependence of urban and rural areas. Other potential solutions to initiate Urban-Rural interdependence : i) Spatial Reconstruction and Integration Spatial Reconstruction and integration is a local development priority aiming at eradicating the irregularities of

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spatial system that was created by past spatial policies where areas of severe poverty, limited economic opportunities, inferior forms of land tenure and limited social and engineering infrastructure, were far removed from employment opportunities and economic growth areas. Spatial integration must focus on improved rail and road linkage (transportation corridors and connectors) between concentrations of greatest need for development and areas of greatest economic potential (economic nodes), the provision of housing in localities within reasonable walking distance to public transport, this is to enhance accessibility to employment opportunities, social facilities and greater variety of goods and services. This may enhance urban-rural interdependence through enhanced regional accessibility (Okpala, 2003)

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ii) Strategic Development Concept In order to overcome the spatial distortions of apartheid, future settlements, economic development opportunities and infrastructure investments should be channeled to activity corridors and nodes that link with major growth centers or that have a potential to become major growth centers. The strategic development concept is based on nodes, corridors and precincts, which aim is to reconstruct and integrate the urban and rural landscape on regional scale into a more rational, cost effective and manageable structure (Diyamett, 2001)

besides being sustainable.

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iii) Rural Transportation Strategy Improved regional access via road, rail and air transportation is important to unlock the tourism potential, to ensure functional urban and rural integration and to enhance inter- and intra-municipal accessibility. Transportation strategies need to address issues such as the provision of integrated modal interchanges supported by infrastructure, shelters, amenities, footpaths and security facilities in all activity nodes, the provision of affordable basic access to transportation, reducing long walking and travelling distances, an Integrated Transport Plan to identify important linkages that need constant maintenance and upgrade (NIP, 2012). iv) Capacity building

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Efficiency of Policy Presented with a fast growing and dynamic economy, the government should ensure that all citizens benefit from economic growth. Implementing successful rural development and land reform in the country is however challenging and controversial. 1.3 ? ?? ?? ?? ?? ?

Questions 1. Define Development. Discuss the interdependence of Urban and Rural Sectors of Economy. 1.4 ? ?? ?? ?? ?? ? Suggested Readings

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pp. 147-166. Source: Essay UK - http://www.essay.uk.com/free-essays/international-relations-politics/ urban-rural-interdependence.php

NSOU ? GE-GR-11 17 Unit 2 ????? Paradigms of Rural Development Structure 2.1 Paradigms of Development 2.2 The Lewis Model of Economic Development 2.3 Big Push Theory 2.4 Gunnar Myrdal's Theory of Spread and Backwash Effects 2.5 Questions 2.6 Suggested Reading 2.1 ????? Paradigms of Development In an ever-changing context, where emerging issues raise questions for the development community on the way development processes have been and are being designed and supported, it is important to critically assess prevailing visions about development and adapt them, or even adopt alternative, more suitable approaches. As a contribution to this assessment, this paper attempts to sketch prevailing development paradigms, i.e. defined visions and related activities regarding the functioning and evolution of socio-economic systems. In general terms, "development" means an "event constituting a new stage in a changing situation"or the process of change per se. If not qualified, "development" is implicitly intended as something positive or desirable. When referring to a society or to a socioeconomic system, "development" usually means improvement, either in the general situation of the system, or in some of its constituent elements. Development may occur due to some deliberate action carried out by single agents or by some authority pre- ordered to achieve improvement, to favourable circumstances in both. Development policies and private investment, in all their forms, are examples of such actions. Given this broad definition, "development" is a multi-dimensional concept in its nature, because any improvement of complex systems, as indeed actual socio-economic systems are, can occur in different parts or ways, at different speeds and driven by different forces. Additionally, the development of one part of the system may be detrimental to the development of other parts, giving rise to conflicting objectives (trade-offs) and conflicts. Consequently,

18 NSOU ? GE-GR-11 measuring development, i.e. determining whether and to what extent a system is developing, is an intrinsically multidimensional exercise. What should be developed? Even if the development of a socio-economic system can be viewed as a holistic exercise, i.e. as an all-encompassing endeavour; for practical purposes, in particular for policy making and development management, the focus of the agents aiming at development is almost always on selected parts of the system or on specific features. Development is manifold like; 1. Economic development This has traditionally been seen as the first form of development. It has often been strictly associated with the concept of economic growth, in turn defined as an increase in the per capita income of the economic system. Indeed, growth defined in this way can be seen more as the result of an economic development process, i.e. the transformation of the structure of an economic system, rather than as a development process per se. Countless economists provided insights and proposed models to explain how economic systems develop (or should develop) to generate growth. Just to mention some milestones, it is worth mentioning the contributions of Shumpeter (1911), who suggested that economic systems evolve through subsequent disequilibria due to agents which introduce innovations, more than "developing" according to a pre-determined path. Ramsey (1928) set a model to maximise the consumption of future generations with endogenous savings, disutility of work and individuals with an infinite time horizon. Allais (1947) (and, later, P. Samuelson) set the first "overlapping generations model", where individuals have a finite time horizon but overlap with other individuals living longer. Solow (1956). 2. Human development The above-mentioned emphasis on the links between human capital and growth constituted a step towards a multi-dimensional concept of development, where knowledge is not only fundamental to economic growth but an end per se, as it generates empowerment, self-reliance and a general improvement in community and social relationships. Nowadays the concept of development encompasses a set of elements comprised in more than one of the above-mentioned qualifications, UNDP (2010).
NSOU ? GE-GR-11 19 3. Sustainable development The concept of "sustainable development" was first introduced by Brundtland (1987), who defines development as "sustainable" if it "

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meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable development

implies minimising the use of exhaustible resources, or at least, ensuring that revenues obtained from them are used to create a constant flow of income across generations, and making an appropriate use of renewable resources. This applies to energy (oil and oil products in particular) but also to fish stock, wildlife, forests, water, land and air. Land degradation, due to soil erosion and salinisation, persistent water and air pollution, depletion of fish stock and deforestation are all examples of consequences of non-sustainable activities. Soil conservation practices; Good Agricultural Practices (GAP) based on reduced use of energy, pesticides and chemicals; waste management and recycling, waste water treatment, use of renewable energy sources such as biomasses and solar panels, are frequently cited as techniques for sustainable development. The concept of sustainability has also been extended beyond environmental concerns, to include social sustainability, i.e. long term acceptance and ownership of development changes by the citizens, their organisations and associations (civil society), and financial and economic sustainability. 4. Territorial development This dimension of development refers to a territorial system, intended as a set of interrelationships between rural and urban areas, in a space characterised by the existence of poles of attraction for human activities (production and consumption of goods and services, but also culture and social life), and connected by information systems and transport infrastructures. When referring to production activities, poles of attraction can be characterised as "Clusters" where, for various reasons, homogeneous or closely interlinked activities are implemented. Territorial systems are open to influences from the national and supra-national contexts and from the interrelationships between territories. Territorial development implies focusing on the assets of the territory, its potential and constraints (FAO, 2005). Polices to exploit and enhance this potential play an important role in the development process. Development was very rarely considered to be a "god-given" condition of socioeconomic systems, implying that policy makers at national and international level have always thought that some activities (or even refraining from carrying out any activity) were required to promote positive changes. However, countries as well as the international development community in different periods, have privileged specific ways of achieving development, adhering to a specific "Development paradigm" i.e. to a defined modality or path to follow

20 NSOU ? GE-GR-11 to achieve development, based on a codified setof activities and/or based on a vision regarding the functioning and evolution of a socioeconomic system. Nevertheless, it is particularly important, in the light of emerging global development issues to assess past processes and design-redesign ongoing/future ones to find new perspectives for development processes and related policies. The issues include: the overuse of exhaustible energy sources; carbon emissions and climate change; recurrent food crises; the general social and political instability of entire regions; widespread inequalities, persistent poverty and food insecurity, In this light, and particularly in view of the unsustainable levels of development of the so called “developed” countries, it is imperative to fully revisit the way development has been conceived so far and completely reassess the usefulness of the dichotomy “developed” versus “developing” countries. The identification of prevailing development paradigms is a first step in this reassessment process. 2.2 ????? The Lewis Model of Economic Development The dual-sector model is a well-known model in developmental economics. It is commonly known as the Lewis model after its inventor W. Arthur Lewis. It explains the growth of a developing economy in terms of a labour transition between two sectors, the capitalist sector and the subsistence sector. Initially the dual-sector model as given by W. Arthur Lewis was enumerated in his article entitled “Economic Development with Unlimited Supplies of Labor” written in 1954, the model itself was named in Lewis’s honor. First published in The Manchester School in May 1954, the article and the subsequent model were instrumental in laying the foundation for the field of developmental economics. The article itself has been characterized by some as the most influential contribution to the establishment of the discipline.Before the model was framed some assumptions were made by Lewis; 1. The model assumes that a developing economy has a surplus of unproductive labor in the agricultural sector. 2. These workers are attracted to the growing manufacturing sector where higher wages are offered. 3. It also assumes that the wages in the manufacturing sector are more or less fixed. 4. Entrepreneurs in the manufacturing sector make profit because they charge a price above the fixed wage rate.
NSOU ? GE-GR-11 21 5. The model assumes that these profits would be reinvested in the business in the form of fixed capital. 6. An advanced manufacturing sector means an economy has moved from a traditional to an industrialized one. W. A. Lewis divided the economy of an underdeveloped country into 2 sectors: The capitalist sector- Lewis defined this sector as “that part of the economy which uses reproducible capital and pays capitalists thereof”. The use of capital is controlled by the capitalists, who hire the services of labour. It includes manufacturing, plantations, mines etc. The capitalist sector may be private or public. The subsistence sector- This sector was defined by him as “that part of the economy which is not using reproducible capital”. It can also be adjusted as the indigenous traditional sector or the “self-employed sector”. The “Dual Sector Model” is a theory of development in which surplus labor from traditional agricultural sector is transferred to the modern industrial sector whose growth over time absorbs the surplus labour, promotes industrialization and stimulates sustained development. In the model, the subsistence agricultural sector is typically characterized by low wages, an abundance of labour, and low productivity through a labour-intensive production process. In contrast, the capitalist manufacturing sector is defined by higher wage rates as compared to the subsistence sector, higher marginal productivity, and a demand for more workers. Also, the capitalist sector is assumed to use a production process that is capital intensive, so investment and capital formation in the manufacturing sector are possible over time as capitalists’ profits are reinvested in the capital stock. Improvement in the marginal productivity of labour in the agricultural sector is assumed to be a low priority as the hypothetical developing nation’s investment is going towards the accumulation of physical capital stock in the manufacturing sector. Relationship between the two sectors The primary relationship between the two sectors is that when the capitalist sector expands, it extracts or draws labour from the subsistence sector. This causes the output per head of labourers who move from the subsistence sector to the capitalist sector to increase. Since Lewis in his model considers overpopulated labour surplus economies, he assumes that the supply of unskilled labour to the capitalist sector is unlimited. This gives rise to the possibility of creating new industries and expanding existing ones at the existing

22 NSOU ? GE-GR-11 wage rate. A large portion of the unlimited supply of labor consists of those who are in disguised unemployment in agriculture and in other over-manned occupations such as domestic services casual jobs, petty retail trading. Lewis also accounts for two other factors that cause an increase in the supply of unskilled labour; they are women in the household and population growth. The agricultural sector has a limited amount of land to cultivate, the marginal product of an additional farmer is assumed to be zero as the law of diminishing marginal returns has run its course due to the fixed input, land. As a result, the agricultural sector has a quantity of farm workers that are not contributing to agricultural output since their marginal productivities are zero. This group of farmers that is not producing any output is termed surplus labour since this cohort could be moved to another sector with no effect on agricultural output. Therefore, due to the wage differential between the capitalist and subsistence sector, workers would tend to transit from the agricultural to the manufacturing sector over time to reap the reward of higher wages. If a quantity of workers moves from the subsistence to the capitalist sector, regardless of who actually transfers, general welfare and productivity would improve. Infact,total agricultural product would remain unchanged while total industrial product increases due to the addition of labour, but the additional labour also drives down marginal productivity and wages in the manufacturing sector. Over time as this transition continues to take place and investment results in increases in the capital stock, the marginal productivity of workers in the manufacturing will be driven up by capital formation and driven down by additional workers entering the manufacturing sector. Eventually, the wage rates of the agricultural and manufacturing sectors will equalize as workers leave the agriculture sector for the manufacturing sector, increasing marginal productivity and wages in agricultural sector whilst driving down productivity and wages in the sectors of manufacturing. Consequently, this transition process leads to the fact that the agricultural wage equals the manufacturing wage, and the agricultural marginal product of labour equals the manufacturing marginal product of labour. Moreover, no further manufacturing sector enlargement takes place as workers no longer have a monetary incentive to transition. Criticism The Lewis model has attracted attention of underdeveloped countries because it brings out some basic relationships in dualistic development. However, it has been criticized on the following grounds: 1. Economic development takes place via the absorption of labor from the
NSOU ? GE-GR-11 23 subsistence sector where opportunity costs of labor are very low. However, in situations like loss of crops during peak harvesting season, such labour transfer would reduce agricultural output. 2. Absorption of surplus labor itself may end prematurely because competitors may raise wage rates and lower the share of profit. It has been shown that rural- urban migration in the Egyptian economy was accompanied by an increase in wage rates of 15 percent and a fall in profits of 12 per cent. In fact, given the urban-rural wage differential in most poor countries, large scale unemployment is now seen in both the urban and rural sectors. 3. The Lewis model underestimates the full impact on the poor economy of a rapidly growing population, i.e. its effects on agriculture surplus, the capitalist profit share, wage rates and overall employment opportunities. Similarly, Lewis assumed that the rate of growth in manufacturing would be identical to that in agriculture, but if industrial development involves more intensive use of capital than labor, then the flow of labor from agriculture to industry would simply create more unemployment. 4. The transfer of unskilled workers from agriculture to industry is regarded as almost smooth and costless, but this does not occur in practice because industry requires different types of labor. The problem can be solved by investment in education and skill formation, but the process is neither smooth nor inexpensive. The model assumes rationality, perfect information and unlimited capital formation in industry. These do not exist in practical situations and so the full extent of the model is rarely realized. However, the model does provide a good general theory on labour transitioning in developing economies. 2.3 ????? Big Push Theory The idea of a big push is one of the earliest theories in development economics and the original justification for foreign aid. The past years have witnessed the publication of numerous studies on aid effectiveness with varying results. Introduction : How developing countries can escape poverty has for centuries been a controversial subject. A majority of economists agree that economic growth is important for achieving poverty reduction since it mainly determines the material well-being of people (Aghion and Howitt, 2009:2). Various theories explain how a country can achieve sustainable

24 NSOU ? GE-GR-11 economic growth. Originally developed by Rosenstein-Rodan in 1943, the big push theory has been influential in development economics, but became less popular during the market —oriented 80s and 90s (Easterly, 2006). However, the big push theory made a comeback in the new millennium and this thesis aims to contribute to this discussion. Poor countries are generally short on capital and are therefore constrained by low levels of savings and investments resulting in low economic activity. Foreign aid has been one of the main instruments for countries to break these constraints and one core objective is poverty reduction. There are cases of undeveloped countries caught in poverty traps, out of which they need a big push. This push, involving increased aid aimed to increase rates of savings and investments, should lead to a take-off in per capita income, all necessary for a permanent reduction in poverty (see e.g. UNCTAD, 2006:3 and Kraay and McKenzie, 2014). Even if economic growth is essential for reducing income poverty, the link is far from automatic. Various countries have experienced a decrease in income poverty due to economic growth, while other countries have experienced the opposite, increased income poverty despite economic growth. The big push model is a concept in development economics or welfare economics that emphasizes that a firm's decision whether to industrialize or not depends on its expectation of what other firms will do. It assumes economies of scale and oligopolistic market structure and explains when industrialization would happen. The originator of this theory was Paul Rosenstein-Rodan in 1943. Further contributions were made later on by Murphy, Shleifer and Robert W. Vishny in 1989. Analysis of this economic model ordinarily involves using game theory.The theory of the model emphasizes that underdeveloped countries require large amounts of investments to embark on the path of economic development from their present state of backwardness. This theory proposes that a 'bit by bit' investment programme will not impact the process of growth as much as is required for developing countries. In fact, injections of small quantities of investments will merely lead to a wastage of resources. Paul Rosenstein-Rodan approvingly quotes a Massachusetts Institute of Technology study in this regard, "There is a minimum level of resources that must be devoted to... a development programme if it is to have any chance of success. Launching a country into self-sustaining growth is a little like getting an airplane off the ground. There is a critical ground speed which must be passed before the craft can become airborne...." ? Rosenstein-Rodan argued that the entire industry which is intended to be created should be treated and planned as a massive entity (a firm or trust). He supports

NSOU ? GE-GR-11 25 this argument by stating that the social marginal product of an investment is always different from its private marginal product, so when a group of industries are planned together according to their social marginal products, the rate of growth of the economy is greater than it would have otherwise been. THE THREE INDIVISIBILITIES According to Rosenstein-Rodan, there exist three indivisibilities in underdeveloped countries. These indivisibilities are responsible for external economies and thus justify the need for a big push. The indivisibilities are as follows- 1. Indivisibility in production function 2. Indivisibility of demand 3. Indivisibility in the supply of savings 1. Indivisibility in production function Indivisibilities in the production function may be with respect to any of the following: ? Inputs ? Processes ? Outputs These lead to increasing returns (i.e., economies of scale), and may require a high optimum size of a firm. This can be achieved even in developing countries since at least one optimum scale firm can be established in many industries. But investment in social overhead capital comprises investment in all basic industries (like power, transport or communications) which must necessarily come before directly productive investment activities. Investment in social overhead capital is 'lumpy' in nature. Such capital requirements cannot be imported from other nations. Therefore, heavy initial investment necessarily needs to be made in social overhead capital (this is approximated to be about 30 to 40 percent of the total investment undertaken by underdeveloped countries). Social overhead capital is further characterized by four indivisibilities: 1. Irreversibility in time: It must precede other productive investments 2. Minimum durability of equipment: Any lesser level of durability is either impossible due to technical reasons or much less efficient

26 NSOU ? GE-GR-11 3. Long gestation periods: The investment in social overhead capital takes time to generate returns and its impact in the economy is not immediately or directly visible 4. Irreducible minimum social overhead capital–industry mix: Investment needs to be of a certain minimum magnitude and spread across a mix of industries, without which it will not significantly impact the process of growth. 2. Indivisibility (or complementarity) of demand Developing countries are characterized by low per-capita income and low purchasing power as well. Markets in these countries are therefore small. In a closed economy, modernization and increased efficiency in a single industry has no impact on the economy as a whole since the output of that industry will fail to find a market. A large number of industries need to be set up simultaneously so that people employed in one industry consume the output of other industries and thus create complementary demand. To illustrate this, Rosenstein Rodan gives the example of a shoe industry. If a country makes large investments in the shoe industry, all the disguisedly employed labour from the other industries find work and a source of income, leading to a rise in production of shoes and their own incomes. This increased income will not be expended only on buying shoes. It is conceivable that the increased incomes will lead to increased spending on other products too. However, there is no corresponding supply of these products to satisfy this increased demand for the other goods. Following the basic market forces of demand and supply, the prices of these commodities will rise. To avoid such a situation, investment must be spread out amongst different industries. The situation may be different in an open economy as the output of the new industry may replace former imports or possibly find its market by way of exports. But even if the world market acts as a substitute for domestic demand, a big push is still needed (though its required size may now be reduced due to the presence of international trade). 3. Indivisibility in the supply of savings High levels of investment require a corresponding high level of savings. We cannot always rely on foreign aid as the huge levels of investments in the different sectors need to be made not only once, but multiple times. Hence domestic savings are a must. But in an underdeveloped economy, this is a challenge due to the low-income levels. The marginal rate of savings needs to be increased following the rise in incomes due to higher investment.

NSOU ? GE-GR-11 27 Consider a country whose economy is characterized by a large number sectors which are so small that any increase in the productivity of one sector has no impact on the economy as a whole. Each sector can either rely on traditional methods or switch to modern methods of production which would increase its efficiency. The theory has been criticized by HlaMyint and Celso Furtado, among others, primarily on the grounds of the massive effort required to be taken by underdeveloped countries to move along the path of industrialization. Some of the major criticisms are as follows. ? Difficulties in execution and implementation: The execution of related projects during the course of industrialization may involve unexpected or unavoidable changes due to revisions of plans, delays and deviations from the planned process. HlaMyint notes that the various departments and agencies involved in the process of development need to coordinate closely and evaluate and revise plans continuously. This is a challenging task for the governments of developing countries. ? Lack of absorptive capacity: The implementation of industrialization programmes may be constrained by ineffective disbursement, short-term bottlenecks, macroeconomic problems and volatility, loss of competitiveness and weakening of institutions. Credit is often utilized at low rates or after long time lags. There is often a loss of competitiveness due to the Dutch disease effect. ? Historical inaccuracy: When viewed in light of historical experience of countries over the last two centuries, no country displayed any evidence of development due to massive industrialization programmes. Stationary economies do not develop simply by making large-scale investment in social overhead capital. ? Problems in mixed economies: In a mixed economy, where the private and public sectors co-exist, the environment for growth may not be a conducive one. Unless there is a complementarity between the sectors, there is bound to arise competition between them, with the government departments keeping their plans confidential out of fear of speculative activities by the private sector. The private sector’s activities are simultaneously inhibited due to lack of information of government policies and the general economic situation ? Neglect of methods of production: Rather than capital formation, it is productive techniques which determine the success of a country in economic development.

28 NSOU ? GE-GR-11 The big push model ignores productive techniques in its support for capital formation and industrialisation. ? Shortage of resources in underdeveloped countries : Eugenio Gudin criticizes the theory of the big push on the grounds that underdeveloped countries lack the capital required to provide the big push required for rapid development. If an underdeveloped nation had ample capital supply and scarce factors, it would not be classified as underdeveloped at all. Limited resource availability is the first impediment to such countries. Though this problem may be overcome by foreign aids, industrialization may not take off as expected if the aid flows are volatile. ? Ignores the agricultural sector : With its heavy emphasis on industry, the model finds no place for agriculture. This is a gaping flaw in the theory, as in most underdeveloped countries it is this sector which is large and has labor surplus. Investments in agriculture need to go hand-in-hand with those in industry so as to stimulate the industrial sector by providing a market for industrial goods. If neglected, it would be difficult to meet the food requirements of the nation in the short run and to significantly expand the size of the market in the long run. ? Dependence on indivisibilities : The emphasis of this theory on indivisibility of processes is too much, as investments need not necessarily be on such a large scale to be economic. Social reforms are ignored, which are vital if a country is to grow on the basis of its own resources and initiatives. Development is bound to intensify if social reform is a part of the industrialization process. 2.4 ????? Gunnar Myrdal's Theory of Spread and Backwash Effects Economic growth provides benefits and costs in the region in which it occurs. It has a positive impact on nearby localities if jobs, population, and wealth spill over into these communities. Alternatively, it has adverse effects on the nearby localities if growth in the core region attracts people and economic activity away from these peripheral areas. Circular cumulative causation is a theory developed by Swedish economist Gunnar Myrdal in the year 1956. It is a multi-causal approach where the core variables and their linkages are delineated. The idea behind it is that a change in one form of an institution will lead to

NSOU ? GE-GR-11 29 successive changes in other institutions. These changes are circular in that they continue in a cycle, many times in a negative way, in which there is no end, and cumulative in that they persist in each round. The change does not occur all at once as that would lead to chaos, rather the changes occur gradually. Dynamics of the Thoery In the characteristics that are relevant to the development process of an economy Myrdal mentioned the availability of natural resources, the historical traditions of production activity, national cohesion, religions and ideologies, economic, social and political leadership. Myrdal stated that the immediate effect of closing down certain lines of production in a community is the reduction of employment, income and demand. Through the analysis of the multiplier he pointed out that other sectors of the economy are also affected. Then he argued that the contraction of the markets in that area tends to have a depressing effect on new investments, which in turn causes a further reduction of income and demand and, if nothing happens to modify the trend, there is a net movement of enterprises and workers towards other areas. Among the further results of these events, fewer local taxes are collected in a time when more social services is required and a vicious downward cumulative cycle is started and a trend towards a lower level of development will be further reinforced. Gunnar Myrdal developed the concept from Knut Wicksell and developed it with Nicholas Kaldor when they worked together at the United Nations Economic Commission for Europe. Myrdal concentrated on the social provisioning aspect of development, while Kaldor concentrated on demand-supply relationships to the manufacturing sector. Spread refers to the situation where the positive impacts on nearby localities and labor markets exceed the adverse impacts. Backwash occurs if the adverse effects dominate and the level of economic activity in the peripheral communities declines. The idea of backwash originated in international-trade theory in a book by Gunner Myrdal (1957). Myrdal noted that an increase in exports from a region may stimulate capital and labour flows into the region to the detriment of the localities from which the resources came. Thomas Vietorisz and Bennett Harrison (1973) later proposed that spread and backwash feedbacks between labour markets contributed to a divergence of technology levels, labour productivity, and wages in these markets. Gary Gaile (1980) used backwash concepts to describe the potential negative effects of urban growth on peripheral areas.

30 NSOU ? GE-GR-11 This growth in urban (core) areas may lead to a decline in rural (peripheral) population and employment (a backwash effect) if rural-to-urban flows weaken rural economies. Five types of flows contribute to backwash: ? Rural funds are invested in urban areas to take advantage of entrepreneurial activities and relatively rapidly growing markets for goods and services. ? Spending in rural trade and service markets declines owing to increased competition from urban businesses. ? Rural residents move to the expanding urban areas for improved access to jobs and urban amenities. ? Rural firms in the innovative stage of their life cycle move to urban areas to benefit from proximity to specialized services, skilled labor, and expanding markets. ? And finally, political influence and government spending may shift to the more rapidly growing core areas. The adverse rural-to-urban flows occur in conjunction with the spillover of people, jobs, and funds from the growing core to peripheral areas (spread effects). The size and geographical extent of the beneficial and adverse forces on rural areas depend on the characteristics of the rural and urban areas and the nature of rural-urban linkages. In general, the beneficial forces are stronger for rural areas near urban cores, while the adverse flows dominate in regions more peripheral to the growing urban areas. Thus, backwash is more likely in rural areas outside of the rural-to-urban commuting zones. The policy implications of backwash are that localities distant from urban growth centres will likely be adversely affected by regional economic-development policies that focus on innovation and entrepreneurial development in urban areas. These remote regions would need to devise economic-development programs that emphasize competitive advantages specific to their economies. It is generally recognized that Myrdal's work on development and underdevelopment made three important contributions. 1. He proposed a cumulative causation approach in opposition to the dominant one, which he called the stable equilibrium approach. 2. He pointed out that analyses of development processes, which only focus on economic factors, are irrelevant and misleading because historical, institutional, social and cultural factors also matter.

NSOU ? GE-GR-11 31 3. He disputed the existence of a body of economic thought that is 'objective' in the sense that it is contributing towards development concepts. This theory confirms the views expressed by the literature, clarifying some aspects of Myrdal's position that have not been sufficiently explored. Moreover, it points out the existence of a contribution to another point, which the literature has broadly overlooked, namely the fact that he criticized the logical consistency of the dominant theories, stating that they were based on unsatisfactory assumptions regarding the characterization of individual preferences. These assumptions were the heritage of utilitarian moral philosophy and rationalist psychology, which at the beginning of the 20th century the other social sciences had abandoned. Myrdal himself stated that in "The Political Element in the Development of Economic Theory" (1930) he had focused on the subjective element of the neoclassical theory to criticize its logical consistency, that is 'to demonstrate that certain practices of reasoning common in economics were logically defective' (Myrdal, 1958, p. 237). A term used by G. Myrdal; "spread effects" describe the prosperity flowing from a central thriving area to peripheral less well-off areas. This could be related to the technological advances spreading out or it could be due to the fact that a growing area will need raw materials to fuel its continued growth. Backwash Effect and Spread Effect It is an economic development effect suggested by Swedish economist Gunnar Myrdal.It basically means that if one particular area in a country starts growing or developing, it causes people, human capital as well as physical capital (infrastructure, finance, machines etc.) from other parts of the country to gravitate towards this growing centre.This essentially leaves the other areas worse off than before because their best brains and capital leave them to go to the growing centre. It means that growth in one area adversely affects the growth in the other. For instance, in India, let's say, ? Delhi is the developing centre with all the companies being set up there.

32 NSOU ? GE-GR-11 ? Then people from all over Haryana, Punjab, UP, Bihar etc. have a tendency to move to Delhi because all companies are located there and better employment opportunities exist. ? So, Delhi will grow but the remaining areas will be worse off. This is Backwash effect. Counter to the Backwash Effect is the Spread Effect ? It is an economic development effect suggested by Swedish economist Gunnar Myrdal ? development in one place, spreads to its suburbs and all the adjoining areas. ? Again, taking the example of Delhi, we could argue that suburbs like Faridabad, Gurgaon, Ghaziabad etc. have benefited from Delhi's growth due to the Spread Effect caused by Delhi's growth 2.5 ????? Questions 1. Highlight the main components of Lewis Model of Economic Development. 2. What is Big Push? How does it influence economy? 3. What are Spread and Backwash Effects? Highlight the concept in relation to Myrdal's Theory. 2.6 ????? Suggested Readings ? Easterly, William. 2006. "Reliving the 1950s: The Big Push, Poverty Traps, and Takeoffs in Economic Development." Forthcoming, Journal of Economic Growth. ? Evans, Peter. 1995. Embedded Autonomy: States and Industrial Transformation. Princeton University Press. ? Hausmann, Ricardo, Dani Rodrik, and Andres Velasco. 2005. "Growth Diagnostics." Harvard University. Cambridge, Mass.: Processed. ? Sen, A. K. (1966). "Peasants and Dualism With or Without Surplus Labor." Journal of Political Economy 74(5): 425-450. Stiglitz, J. (1976). "The Efficiency Wage Hypothesis, Surplus Labour, and the Distribution of Income in LDCs." Oxford Economic Papers 28: 185-207.

NSOU ? GE-GR-11 33 Unit 3 ????? Need for Rural Development Structure 3.1 Defining Rural 3.2 Need and Importance of Rural Development 3.3 The New Approach to Rural Planning 3.4 The Gandhian Approach to Rural Development 3.5 Questions 3.6 Suggested Readings 3.1 ????? Defining Rural There are many ways to define areas that are "rural." Although the general idea of specifically conceptualizing "rural" areas came into use in the 1920s with its basis in sociology, many, if not most, of the current explanatory frameworks evolved to provide guidance for the distribution of government monies or to perform a census of places and people. As a corollary to these classification systems, there persists the traditional assumptions that tend to go along with the word "rural," assumptions that are often ungrounded and at best belie the diversity inherent in areas typically grouped together as "rural" or "nonmetropolitan." For instance, it is a commonly held belief that farming is a mainstay of most rural economies. In fact, fewer than one-fifth of rural counties in North America now have a significant economic dependence on farming, and the 20% of nonmetro counties that have farming as their principal economic base contain less than 10% of the nonmetro population (Deavers, 1992). Moreover, the geopolitical boundaries that usually serve as the basis for these classifications often are not optimal. 3.2 ????? Need and Importance of Rural Development India lives in its villages, and while the cities have grown immensely over the last fifty years, rural areas have not seen that kind of development. For India's economy to be strong, the rural economy needs to grow. Rural areas are still plagued by problems of malnourishment, illiteracy, unemployment and lack of basic infrastructure like schools, colleges, hospitals, sanitation, etc. This has led to youth moving out of villages to work in cities. "All

34 NSOU ? GE-GR-11 of us know," for example, that people prefer to live in cities because there are more opportunities, services, and great personal fulfillment. "Everyone knows" that successful business and economic development must stay focused on metropolitan locations to maximize transportation and labor costs. "Everyone knows" that many of our small towns and villages are in distress and that even though the unsettling of the countryside may be a national tragedy, it amounts to no more than a natural process that will continue to occur over the next century. Basically, what we need is to empower the rural people by providing them education and proper health care. They need to have infrastructure like electricity and water so that they are free from the cycle of droughts and floods. We need to give them self-employment so that they want to stay in villages instead of migrating in cities. There is a need to empower the villagers, and not just supporting them by food subsidies, loan waivers which end up crippling them. India will grow only when rural India marches hand in hand with cities in the twenty first century.

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Rural development is a national necessity and has considerable importance in India because of the following reasons: 1. To develop rural area as whole in terms of culture, society, economy, technology and health. 2. To develop living standered of rural mass. 3. To develop rural youths, children and women. 4. To develop and empower human resource of rural area in terms of their psychology, skill, knowledge, attitude and other abilities. 5. To develop infrastructure facility of rural area. 6. To provide minimum facility to rural mass in terms of drinking water, education, transport, electricity and communication. 7. To develop rural institutions like panchayat, cooperatives, post, banking and credit. 8. To provide financial assistances to develop the artisans in the rural areas, farmers and agrarian unskilled labour, small and big rural entrepreneurs to improve their economy. 9. To develop rural industries through the development of handicrafts, small scaled industries, village industries, rural crafts, cottage industries and other related economic operations in the rural sector.

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To develop agriculture, animal husbandry and other agricultural related areas. 11. To restore uncultivated land, provide irrigation facilities and motivate farmers to adopt improved seed, fertilizers, package of practices of crop cultivation and soil conservation methods. 12. To develop entertainment and recreational facility for rural mass. 13. To develop leadership quality of rural area. 14. To improve rural marketing facility 15. To minimise gap between the urban and rural

The Urban - Rural Imbalance Since 1950 it should be clear that metropolitan settlement structure leading to urban conglomerations is the dominant growth form of the world. Metropolitan areas will account for 70 percent of the net growth in world population during the 1990s - an additional 67 million people every year. Other than natural increase, the prime engine of metropolitan growth is rural-to-urban migration. It is, however, important to note that rural - to - metropolitan trends have changed directions several times in the latter part of the 20 th Century. It would appear that change, rather than stability, is the typical demographic and economic situation for most of the world's rural and nonmetropolitan areas at the end of the 20 th Century.The United Nations reports that 43 percent of the world's population lived in urban areas in 1990; a 34 percent increase since 1960. In the next several years (2005), the world will pass a historic milestone: more than half of its population — or more than three billion people — will live in cities. At the turn of the century, only 14 percent of the Earth's population called cities home — and just 11 centres on the planet had more than one million inhabitants. Now there are 400 cities with populations of at least one million, and 20 megacities with populations exceeding 10 million, with a half dozen of them approaching or exceeding the 20 million level. While the developing world still flocks to core cities, much of Europe, North America, the Russian Federation, and Australia are reversing the process: emptiness at the centre and growth on the edges - or the new "Edge City" metropolitan areas. At the halfway mark of the 21 st Century, more than 70 percent of the world's population will live within the metropolitan framework (an area now loosely defined up to 40 - 100 kilometers from the older urban cores). In most more developed nations, especially in North America and Europe, the urban-rural distribution now stands at 75 - 80 percent metropolitan to 20 - 25 percent rural.

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36 NSOU ? GE-GR-11 The most common factor contributing to rural-to-urban migration is rural unemployment resulting in part from rural areas having higher fertility levels than urban areas, according to Lori S. Ashford, a senior policy analyst with the Population Reference Bureau (PRB). A shortage of basic technology in rural areas also promotes out-migration and environmental degradation; it has led to a serious shortage of arable land in many communities throughout the developing world. While the growth of cities can contribute to economic progress, the study notes that problems arise when urbanization "occurs so rapidly that it strains the ability of urban governments to provide housing, sanitation, public safety, and other necessary services — and when there are not enough jobs." The New Paradigm The relationship between government and economic development began to change marked during the late 1970's and early 1980's. The beginning of the 1980's saw many less developed countries heavily borrowed and unable to service their debt. The physical plant and infrastructure fashioned in the 1950s and 1960s - often of exceptionally poor quality - created high levels of service costs that even the most developed nations could not bear. Hardest hit were the rural economies and regional settlement patterns resulting in a virtually unabated flow of resources to the metropolitan areas. The final result was the beginning of the demise of the centrally-planned economy and the ushering of the "Age of Austerity." The concept of integrated population and development planning had to be adjusted in light of the changes brought about by this austerity. Many planners and development analysts regarded the goals of development under austerity as self-evident and non-problematic, seeing the only problems as concerning how to attain them. [Nussbaum and Sen, 1989]. The new paradigm recognized that both the environment and human settlement where open systems and regulated by things happening beyond local and national boundaries - the Global Economy - and greatly affected by natural and human imbalances. In short, the urbancentricview of the world was called into question, especially the prevalent notion that the purpose of rural areas was to provide food, fuel, and cheap workers. The new paradigm not only recognizes the connectivity of the urban - rural spheres, but also addresses the issue of rural vitality. For, unless rural areas are revitalized, the metropolitan centers must ultimately provide the rescue funds and resources to support the countryside. The solution is what we typically call economic development. In principle, the new paradigm called for self-sustaining economic growth and social policy designed to provide the requisites of existence and citizenship. While the former can help provide the fuel for the latter, we must be under no illusion that growth itself will fulfill basic needs. NSOU ? GE-GR-11 37 3.3 ????? The New Approach to Rural Planning The most important question to be asked is "are rural areas and country towns sustainable as working and living communities?" Many rural areas have proven to be persistent - they have sustained while both inner city and suburban area have declined in the face of metropolitan spread. The only reasonable conclusion that can be reached concerning this persistence is their diversity. Less than a century ago the rural economy depended almost entirely on resource extraction, agriculture (and support service to agriculture), and fishing. Economic Diversity The rural areas that show the most favorable growth and economic strength have their economies based on recreation and tourism. Throughout most of North and South America, Western Europe, Australia, and New Zealand the lure of the natural environment and tourism (place and historicity) are significant parts of their economies. Firms and industries built around the exploitation of amenities show exceptionally strong growth and are a world leader in providing new jobs. Are rural economies built around tourism and amenities sustainable? Thought on this question is decidedly mixed and generally negative. Tourism, in one form or another is the world's second largest industry. As a whole, this activity mines and extracts wealth in the form of money and exports the final resources to metropolitan areas where the corporations and trusts reside. Tourism is dependent on wealth and increasing affluence - it is not an activity within reach of the world's poor. Thus, there is a closed cycle of events whereby tourism and amenity based economies demand ever increasing affluence and affluence itself is associated with migration to metropolitan areas. Tourism and amenity jobs are among the lowest paying service industries in the world - or what is termed minimum or subsistence wage in most countries. The firms that service the local industries are labor intensive and built around employment in food service, lodging and accommodation, information assistance, maintenance, and service sales to the traveling public. Since most tourism is seasonal, the industry depends on high migration rates based on boom and bust seasons that in turn demand the cheapest labor available. Factors such as poor seasonal weather, higher transportation costs due to both profit taking and increasing costs for fuels can send a local economy into shambles within a short period of time - causing some of the highest unemployment rates in any industry.

38 NSOU ? GE-GR-11 Finally, there is the long term (and often conflicting) goal of greater economic sustainability in local areas based on tourism and amenities. The goal is to extend visiting seasons by creating greater opportunity to capture market share of tourism monies. Since 1980 the most popular methods in the western world are gaming or gambling, conventions/meetings, and multiple use recreation (golfing, theme parks, and similar facilities). The controversy over gaming/gambling as a supplement to economic diversity continues in a worldwide debate. Regardless, it has achieved phenomenal rates of return and now appears to be reaching saturation as larger scale enterprises are developed. Wage and salary incomes paid to industry employees are among the highest in rural areas. Remoteness Remoteness is the one characteristic that all true rural areas share in common. It is viewed as both an asset and a major liability. Many development specialists and rural sociologists take the stance that remoteness and isolation is an asset. They argue that small structure, vertical leadership, and cooperation are important strengths that contribute to ethic and social identity. Although they acknowledge that interlocal cooperation with regional towns is important, they also counter that individual community ties are the most important process in local development. They imply that to dismiss the importance of local pride, concern, and problem solving capabilities would ignore much of the community's true resource base [Allen, pg. 219]. On the other hand, current economic development practice now strongly is encouraged in rural areas that promotes inter-community cooperation, assimilation with other communities, and common work towards development. This is based on the theory that small size and remoteness is the major inhibitor of development efforts. Thus, the other side of the problem is how to overcome distance factors in rural areas. In general, remoteness factors are related to four major policy choices in central planning: transportation, critical service deliver, communications, and jobs skills/training. Communications, more specifically telecommunications amounting to both advanced systems of current technologies, and emerging forms of real time delivery, are predicted by many to be the total planning solution for rural areas. Unlike transportation outcomes, which must overcome place to place remoteness, telecommunications offer the hope of in-place service and need delivery. It is attractive, if for no other reason, because it offers quick and incremental upgrade paths - often at a decreasing marginal cost - rather than enormous sunk costs experienced in transportation and regional development.

NSOU ? GE-GR-11 39 The final factor is training and skill development. No society or societal sector in the world can afford to concentrate its educational and development resources solely in metropolitan areas. Yet, decentralization of educational resources and development is not too high in rural areas. Lack of Resources A lack of basic resources to meet rural residences' needs is repeatedly shown as a major factor in a community's inability to sustain and maintain community identity and commitment. Resources are understood to mean both fiscal (material) and human and therefore most planning solutions employ a two-pronged set of policies designed to increase resource capacity. Efforts to redirect material resources to rural areas have been ongoing throughout the 20 th Century and far outnumber programs targeted towards urban areas. Worldwide, major efforts include wide-ranging programmes such as education (extension), farm and price supports, direct grants-in-aid, revenue sharing, new towns, and health care etc. No comprehensive assessment of the effectiveness of these programmes exists, but few will venture to say that trillions of dollars poured into rural development has not made a difference in the shape of the nonmetropolitan sectors of our countries. The argument against sustainability and a total planning solution is that a heavy presence of the second type of RIs denotes increasing poverty in the region. Some researchers note, therefore, that the presence of the second type of RIs can only be justified on the basis of their labour intensity and not productivity or income gains. Building Local Capacity as A Route to Sustainability Throughout North America, much of Western Europe, Australia, and New Zealand, community generated rural revitalization (generally termed Local Economic Development - or LED) is currently a matter of considerable profile. A prominent feature of this activity is what is termed the process related dimensions of rural LED -meaning that the capacity of individual communities to bring about a better future for themselves depends in no small measure on how well they are equipped in terms of leadership and team related skills. The root challenge of all rural communities must be the shaping of new strategies responsive to the enduring realities of rural economies and cultural life - high unemployment; persistent poverty; deteriorated social well-being; lower earnings; and diminished health care - as well as changing national and global circumstances. Revitalizing "rural" must include the participation of small communities in search of positive change, whereby local

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40 NSOU ? GE-GR-11 people are encouraged to think more about their futures and to put into practice their ideas for securing those futures. Capacity building, therefore, deals mostly with the ability of local people to solve problems. These process dimension programmes seek to bring about change by forging new skills within rural communities related to leadership, mediation and conflict resolution, group processes, understanding the business of government, and the articulation of a shared vision. In the simplest terms, capacity building can be defined as increasing the ability of people and institutions to do what is required of them [Newlands, 1981]. The Impact of Telecommunications "While we weren't looking, the future arrived" [Cong. Office, 1997]k Since the middle 1980s, futurists such as Alvin Toffler [Toffler, 1985] have said that "it is certainly no secret that our society is moving away from a manufacturing focus and becoming an information driven machine . . . The nascent markets of the next century are based on value-added service which are typically the result of adept information management." [page 43]. The heart of this new information Third Wave technology is the digital network and digital communications via the computer modem, faxes, and wireless telephones. The true, large scale impact of telecommunications on rural areas lies some distance in the future; some would say between the year 2030 and 2050 before global wireless is a truly dependable and integrated source of doing business. Even now in 1997, digital communications through the Internet are reforming some selected market relationships between rural and metro locations. Without a doubt, telecommunications will have a marked impact on the two overriding factors that affect non-metropolitan performance: remoteness and labor pools. Reliable, real time telecommunications cannot solve, but will certainly diminish the impact of distance between more remote rural locations and their major markets and suppliers in metro areas. The bourgeoning service sector worldwide that is essentially responsible for the assimilation, interpretation, and management of information will no longer be place bound - location will be irrelevant assuming that global communications will be the same everywhere. Telecommunications will be a major factor in transforming, rather than reforming, the way rural communities do business and live their lives. No amount of digital information can reform the basic distinction between the urbanized and the small place given the massive imbalance of resources. It cannot be a total planning solution, but it can help to create a greater competitiveness in the way rural people receive their
NSOU ? GE-GR-11 41 education, medical and social care, market their goods, acquire their supplies, and conduct their affairs. It is assumed that rural areas already showing signs of great vitality will be best positioned to benefit from the new technologies and more remote centers already in decline the least. There is, however, a counter hypothesis to this argument. Telecommuting may contribute to further suburbanization and urban sprawl by releasing households from location constraints related to maximum acceptable commute time and distance (Mokhtarian, 1991b). Because the practical use of modern digital telecommunications is such a relatively new activity, no studies have been able to confirm or deny this hypothesis (Handy, 1994). If this indeed occurs, the environmental costs of further sprawl could far outweigh benefits received by reduced automobile and office use. It is difficult to estimate the likelihood of this scenario because there are so many factors contributing to housing location decisions. The second overriding factor related to rural - metro imbalance likely to be impacted by telecommunications is the labor pool itself. Remote, rural areas may (at least according to some studies and many common perceptions in local economic development) be good places to start both services and new start-up firms, but they cannot sustain the need for increased capital and labor due to lack of available resources and worker pools. The concept of telecommuting - large groups of workers who are place bound throughout a nation, but who work for a remote and centralized firm via digital communications - will diminish the need for regional labor. The argument that telecommunications can never supplant the need for specific site, skilled labor in manufacturing and fabrication will always remain valid, however it is necessary to realize that most now agree that the distinction between value-added activities and services is becoming less important. 3.4 ????? The Gandhian Approach to Rural Development In the Indian context rural development may be defined as maximising production in agriculture and allied activities in the rural areas including development

100%	MATCHING BLOCK 26/223	W
of rural industries with emphasis on village and cottage industries.		

It attaches importance to the generation of

80%	MATCHING BLOCK 28/223	W
maximum possible employment opportunities in rural areas, especially for the weaker sections of		

the community

100%	MATCHING BLOCK 27/223	W
so as to enable them to improve their standard of living.		

Theoretically, Gandhian approach to rural development may be labelled as 'idealist'. It attaches supreme importance to moral values and gives primacy to moral values over material conditions. The Gandhians believe that the source of moral values in general lies
42 NSOU ? GE-GR-11 in religion and Hindu scriptures like the Upanishads and the Gita, in particular.The concept of 'Rama Rajya' is the basis of Gandhiji's idea of an ideal social order. Gandhi defined Rama Rajya as "sovereignty of the people based on moral authority". He did not view Rama as a king, and people as his subjects. In the Gandhian scheme, 'Rama' stood for God or one's own 'inner voice' Gandhi believed in a democratic social order in which people are supreme. Their supremacy is, however, not absolute. It is subject to moral values. M.K.Gandhi (1941) very clearly mentions socio-economic and political problems which are deep rooted in Indian villages. He dreamt that Indian village people should be free from malnutrition, poverty and unemployment in near future. The principle of non-violence could be upheld in the present society through the village economy as well as the sufficient marketing methods. He emphasizes the need for rebuilding Indian villages and its developmental features in all dimensions. Shriman Narayan (1960) very clearly and analytically explains the Gandhian planning to the society and its implementation. He presents some arguments for proving the authenticity of Gandhi's view on rural development approach. Ideal Village: The village is the basic unit of the Gandhian ideal social order. Gandhi succinctly pointed out, "If the village perishes India will perish too.... We have to make a choice between India of the villages that is as ancient as herself and India of the cities which are a creation of foreign domination". Gandhi's ideal village belongs to the Pre-British period, when Indian villages were supposed to constitute the federation of self-governing autonomous republics. Mahatma Gandhi, was probably the first among our leaders to promote rural development in India. On March 30, 1946 at the Prayer meeting at Urulikanchan before leaving for Delhi for final negotiation with the British, Gandhiji reiterated that we cannot retain power in Delhi without developing rural India. His concept of rural development meant self-reliance with least dependence on outsiders. The Swadeshi Movement was launched through spinning and weaving to promote Khadi. This also provided livelihood to the rural people. The other emphasis was curb on consumption as excessive consumption causes pressure on resources and adds to wastage and pollution. His thought-provoking statement, 'there is enough on this earth to meet the need, but not the greed' has now become a universal slogan for ensuring environmental protection and sustainable development. The Gandhian model of development can provide solutions to our rural problems which are linked to the basic needs of the people, such as 'Anna' (livelihood), 'Akshar' (literacy),

NSOU ? GE-GR-11 43 'Arogya' (health) and 'Acharan' (moral values). While the development programmes should aim at meeting these needs, it is essential to blend these activities with 'Dharam' not any particular religion but the essence of all religions along with a focus on moral values 'Acharan'. In the absence of moral values, particularly non violence, non addiction to gambling, drugs and alcohol and marital discord, the development may shape our future generations as demons, instead of citizens of a civilised society. If one can insist on adopting moral values, it will be easy to curb one's greed and with sincere efforts, there will be no difficulty in meeting one's needs. Our natural resources although degraded and abused beyond sustainability, still have the potential to support its people. However, we need to discipline ourselves for managing our resources and environment carefully. This calls for a radical change in our planning strategy. Earlier, our rural development programmes were planned by the Planning Commission and thereafter at the state headquarters. Later on, we accepted the need for planning at the district level. Considering the variation in the quality of our natural resources and opportunities at the village level, it is strongly recommended to develop block level or taluka level planning. Such decentralised, 'micro level planning' should primarily focus on conservation and optimum utilisation of water resources. As water is the basic need, supply of safe drinking water for our rural people should be the priority. We transport water hundreds of kilometres to set up our industries and to meet the demand in urban areas. Then why not for the rural people? If we can ensure safe potable water for them, we can solve the major problem of health, because a majority of the health disorders in rural areas is linked with contaminated water. This can also reduce the drudgery of rural women who often have to walk barefoot a long-distance carrying headloads of water throughout the year. Subsequently, our farmers need water to maintain their livestock and the surplus can be used for growing trees and crops. Indian planning should also explore the possibility of making optimum use of the degraded land and unproductive livestock which are posing a threat to our environment. Wastelands spread almost over one half of the total land area in the country cannot absorb rainwater. The water and top fertile soil flow through agricultural fields into the river resulting in floods and droughts. In this situation, the efforts and resources of our development agencies are diverted towards relief measures. Livestock, when left free for grazing, denude our pastures and forests. This further accelerates the process of soil erosion, floods and global warming. Hence our planning should give priority to convert our wastelands 44 NSOU ? GE-GR-11 and non descript livestock into productive assets for ensuring employment and livelihood in rural areas, while enriching our environment. It is difficult to motivate villagers to adopt family planning without assuring good health. Child care through nutritional awareness camps and Anganwadis should become an important component of our health care programme. Literacy too cannot be ignored, because in the absence of functional literacy, rural people cannot adopt appropriate technology. Even if they earn surplus money, they may not utilise it in the proper direction. This can be harmful for the community. As livelihood, education and health are inter related, we need to tackle them simultaneously. This integrated approach can provide an excellent opportunity for the development agencies and field workers to interact with the rural people, who in turn can be motivated to participate in development programmes. The focus of a programme should be on the rural family rather than on a village. This is because the village has a heterogeneous character with respect to socio economic status. If this important fact is overlooked, the benefits of development are invariably snatched by a few well to do families. As a result, the development agency becomes instrumental in widening the gap between the rich and poor. It is necessary to realise that the programme should be competent to attract the rural poor. Efforts should also be made to involve rural women who contribute to about 75% of the family responsibility through child care and development. The government entered the areas of dairy cattle production, run off water harvest, horticulture, forestry, sericulture, bio energy, skill oriented training and community health programmes for development of women and children. Such activities enable the families to settle down within 5 7 years and develop their own infrastructure to continue the activities without external support. An integrated programme to rehabilitate the weaker sections of the society on a hectare of degraded land through tree based farming systems has been a major breakthrough for ensuring livelihood along with a clean environment. Rural Development has never been a new concept for India it is rather interwoven in the heritage of Indian culture, mention of it has been made along with the history of mankind. Even in the famous epics like Ramayana and Mahabharata the instances of rural governance in terms of welfare of the people, justice to the people has been made. During the British rule, no sincere efforts were made for rural development. Famines were a common phenomenon, and rural agrarian economy suffered a lot under the feudal system. The tillers of the soil were isolated from their land. According to Ministry of Rural Development (2013-2014) India has the largest rural population in the world. Sixty-nine per cent of Indian population, that is 833 million people, lives in rural areas. The population

NSOU ? GE-GR-11 45 of rural India is about 12% of the world population, which makes it bigger than the size of Europe. Most of the rural people remain engaged in farm related activities. It is difficult to make out a living from the small and marginal farms upon which over 80 per cent of rural households depend. The unemployment rate in rural India has increased by 2% in rural areas. As on January 1, 2010 the number of unemployed was 9.8 million. By January 1, 2012 it has increased to 10.8 million. In rural areas poverty ratio remained above 50% with a marginal decline until mid-1990s and declined faster thereafter. Promoting development in rural areas is a slow and complex process faced with many challenges. The enhancement of productivity and income of rural communities is at the core of rural development. Due to lack of adequate options, majority of rural population rely on agriculture and farm related works for their livelihood. Moreover, social and economic inequality adversely affects people's quality of life; leading to a higher incidence of poverty. Gandhi visualized an ideal social order wherein man and machine together would promote the basic human values. The approach of Gandhi based on decentralization with its corollary people's empowerment opens up a new chapter in the socio-economic and political order. Gandhi sought to revive villages for it is impossible to have non-violence on a factory civilization which is essentially materialistic. Thus, Gandhi advocated Swadeshi, which symbolizes economic self-reliance and economic independence. He envisaged an ideal socio-economic and political order with the individual at its center.ForGandhi,true economics, stands for social justice; it promotes the good of all by equally including the weakest, and is indispensable for decent life." The Gandhian approach to economic problems is an essentially practical and Gandhian approach to rural development accepts the method of planning and development but of different nature. He did not want it along industrial lines. He wanted to prevent our villages from catching the infection of industrialization. Gandhian plan is man centered one. As the plan has integrated approach to rural life it covers all the aspects of rural life. Gandhi is a champion of swadesi or home economy. According to him mass production forces the people to leave their villages, their land, their craft and their homesteads. Gandhi was always laying stress on the twin principles of maximum production and fuller employment. 3.5 ????? Questions 1. Highlight the needs and importance of rural development. 2. Highlight the Gandhian Approach of Rural Development

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48 NSOU ? GE-GR-11 Unit 4 ????? Rural Economic Base Structure 4.1 Rural Co-operatives 4.1.1 Introduction 4.1.2 Historical Background of the Co-operative 4.1.3 Cooperative Movement in India 4.1.4 Types of Co-operative Societies 4.1.5 Role of Agricultural Co-operatives 4.2 Agricultural Marketing 4.2.1 Introduction 4.2.2 Birth of Market Regulation 4.3 Regulated Marketing System in India and Reforms 4.4 Questions 4.5 Suggested Readings 4.1 ????? Rural Co-operatives 4.1.1 Introduction Rural development is a major concern before our planners. Most of the planning objectives cannot be achieved without making sufficient and necessary efforts towards rural development. How the issue of rural development is addressed by country decides its approach towards comprehensive economic development. From this point of view the process of development in every developing country should be rural development. Most of the developing countries have a large population in rural areas. There is continuous and growing divide between urban and rural regions. This growing division leads to neglect of rural areas, disproportionate distribution of resources and absence of logical approach towards development.

NSOU ? GE-GR-11 49 Want of resources, lack of infrastructure, low income and lack of progressive approach of people are some of the reasons of absence of low development in rural areas. When a large population stays in rural area, a country cannotafford to neglect the growth process and aspiration of people in rural area. Without economic transformation the social change and development is not possible. In county like India rural regions often are extremely neglected and not properly attended. When it comes to developmental process, inadequateresources, lack of development processes, inappropriate system of implementation are some of the reasons of the poor rural development in India as well. Rural cooperatives : Cooperative must have a great and long history of its implementation both in the developed and developing nations. First cooperative movement started in England, today its beneficiaries are spread all over the world. Various financial institutions and Banks are result of principles of cooperatives. Cooperative institutions have brought changes in many societies and nations. When it comes to conflict of ideologies like capitalism and socialism often cooperative is considered as middle path. Cooperative ideology and institutions work as golden means that balance the priorities, preferences and requirements of different stakeholders in effective manner. In India cooperative has been expected as mantra of development in early 20th century. Since then a large number of cooperative institutions have emerged and have changed socioeconomic dimensions of developmental process. The weaker section of the society, backwardcommunities, unorganized economic players are rightly benefited through cooperative organizations. In a heterogeneous country like India the purpose of development cannot be achieved by using a single mechanism and unique ideology. It requires multifold solution. A mix of various institutions, agencies and techniques only can help to achieve the goal of economic development. That is why Indian planners have adopted mixed economic system, giving scope and opportunity to capitalist and socialist ideas and simultaneously have given cooperatives and cooperative institutions due weightage and importance. In rural India the only solution for rapid economic development can come in the form of rural cooperatives. Rural India requires economic institutions that can utilize and scatter small resources effectively. It requires institutions that are helpful in creating confidence, organizing people and utilizing their resources effectively. From this point of view rural cooperatives have a vital role to play. These institutions can bring in desired social change and help in economic development. Rural cooperatives can generate desired confidence which can help in creating appropriate infrastructure and improve the network of various

50 NSOU ? GE-GR-11 agencies and institutions in rural area. Rural cooperatives can play the role of catalyst in organizing resources, implementing plan and developing the target of economic development. Rural cooperatives have a great role to play in organizing small but profitable purposive economic activities. They can take initiative tocreate a right system with people's participation as the basic plank of socio-economic transformation. 4.1.2 Historical Background of the Co-operative Ancient records and archaeological discoveries in fact provide evidence that co-operative activity was common in early civilization. For example, many years before the birth of Christ, the Chinese developed sophisticated savings and loan association not too different from those we have today. In addition, Babylonians developed a way for farmers to cooperate and farm together, and craft and burial societies were common among ancient Egyptians, Greeks, and Romans. In 1752, Benjamin Franklin, one of the signers of the Declaration of Independence, helped start is considered the first formal co-operative business in the United States (Cobia 1989). It is not clear who first thought of identifying and proposing the concept and content of cooperative principles. However, it is generally agreed that current-day principles evolved from "rules of conduct and points of organization" put forth by the Rockdale Society, probably for the first time. The Rochdale Society continued to evolve from its founding in 1844 during the 16 years up to its 1860 publication and thereafter. The Rockdale principles are a set of guidelines that grew out of the experience of the Rockdale Society. This co-operative operated for the first eight years under the Friendly Societies Act of British law. In 1852 they incorporated. The 28 founders of the Rochdale Society, often called the Rochdale pioneers, were from a variety of profession such as cloth manufacturer, wool sorters, shoemakers, traders etc (Cobia 1989). Robert Owen assumed as father of co-operative movement. Co-operative movement in the Globe has already stepped into the hundred and sixtieth year of its existence. In India, it has a history of a century now since the enactment of "the Co-operative Credit Societies Act, 1904 (Act 10 of 1904)" under the British hegemony on Raiffeisen model borrowed from Germany (Bandyopadhyay 2004) The term co-operation is derived from the Latin word co-operari, where the word co means 'with' and operari means 'to work'. Thus, co- operation means working together. So those who want to work together with some common economic objective can form a society which is termed as "co-operative society". It is a voluntary association of persons who work together to promote their economic interest. It works on the principle of self-help as well as mutual help.

NSOU ? GE-GR-11 51 4.1.3 Cooperative Movement in India From the days of Hazare Committee (1971) to VaidhyanathanCommittee (2004) and High-Powered Committee on Cooperatives (2009) Government has shown its intent on institutional and legal reforms to make the cooperatives as vibrant economic entities. The development of Cooperative movement is so spectacular that it has emerged as a very big sector in Indian economy contributing to the economic development of this country. Maharashtra has been in the forefront in the cooperative movement. With its success on one hand, the Cooperative movement has been facing severe criticism on other, only because of few instances of mis-management, malpractices and failures in this movement. To enable the state to maintain its premier position in the country in this respect, the government had decided to give due emphasis to capacity building of all the stakeholders in the cooperative sector. With a view to ensure this and having regard to the fact that a large number of training programmes have been organized for the capacity building of officials and non-officials of Co-operative Banks / Co-operative Credit Societies / DCC Banks/ APMCs, it was felt necessary to establish a Centre for Co-operative Training and Research. The Centre for Co-operative Training and Research was established on 7th April 2004. The history of co-operative movement in India was initiated with the passing of the first cooperative societies act in 1904 by the government of India. The primary objective of this act was to extend credit facilities in adequate measure at a cheap rate of interest. However, in the Act of 1904, nothing was said about the establishment of central bank necessary for financing of the primary credit societies. The Act of 1912 recognized along with co-operative credit societies, cooperatives for marketing, farming, housing etc. The consequent acts in the years 1919 and 1925 minimized the limitations of the previous laws. Co-operative movement has also been highlighted by the rural Survey committee (1954), by Vaikuntilal Mehta Committee (1960) and also by the five yearly plans. In 1901 the famine commission expressed the view that 'in the establishment of mutual credit associations lies a large hope for the future of agriculture in India and the probability of lasting success which will be greatly strengthened if mutual credit associations take root and flourish in the country.' The attainment of independence by India gave impetus to the development of the cooperative movement as the rural development received priority in the development of the nation building agenda of the Government of India. There was a marked shift from the laissez faire state to a welfare state, with emphasis of planning. The encouragement and the financial support extended by the government of India and state government resulted in not

52 NSOU ? GE-GR-11 only in the expansion of the credit co-operative institutions but also led to the proliferation in several other fields. 4.1.4 Types of Co-operative Societies 1. Consumers' Co-operative Society: These societies are formed to protect the interest of general consumers by making consumer goods available at a reasonable price. They buy goods directly from the producers or manufacturers and thereby eliminate the middlemen in the process of distribution. KendriyaBhandar, Apna Bazar and SahkariBhandar are examples of consumers' co-operative society 2. Producers' Co-operative Society: These societies are formed to protect the interest of small producers by making available items of their need for production like raw materials, tools and equipments, machinery, etc. Handloom societies like APPCO, Bayanika, Haryana Handloom, etc., are examples of producers' co-operative society 3. Co-operative Marketing Society: These societies are formed by small producers and manufacturers who find it difficult to sell their products individually. The society collects the products from the individual members and takes the responsibility of selling those products in the market. Gujarat Co- operative Milk Marketing Federation that sells AMUL milk products is an example of marketing co-operative society. 4. Co-operative Credit Society: These societies are formed to provide financial support to the members. The society accepts deposits from members and grants them loans at reasonable rates of interest in times of need. Village Service Co-operative Society and Urban Cooperative Banks are examples of cooperative credit society. 5. Co-operative Farming Society: These societies are formed by small farmers to work jointly and thereby enjoy the benefits of large-scale farming. Lift-irrigation cooperative societies and Pani-panchayats are some of the examples of co-operative farming society.

NSOU ? GE-GR-11 53 4.1.5 Role of Agricultural Co-operatives 1) Providing credit to agricultural field- Farmers, laborers, artisans get such assistance to protect farmers from the hands of landlord's credit co-op. provides protection. 2) Assistance to small-scale industry- There are artisans, small entrepreneurs at rural level. These small entrepreneurs can be financially supported by co-operatives. It helps to create employment opportunities and, then improve the standard of living of rural people. 3) Development of processing industry- Factories based on agricultural product can my be started such as Sugar factory, Paper mill, Rice mill, Dairy business, etc. Business could be started because the required raw material is easily available. 4) Employment opportunities- In India we are facing big problem of unemployment. Co-operatives formed in different regions help to eradicate unemployment by creating employment opportunities. 5) Saving habits- Weaker section of the society having less finance tends to spend fully without the provision of future. It is co-operative credit society, which inculcates the saving habits among the masses. 6) More participation in export- The economy of any country becomes healthy when it has more export and less import. Co-operative sector has definitely helped to produce more and export it to foreign countries especially in the field of agriculture, Dairy, etc. 7) Source of rural development- Majority of people in India resides in rural areas. After 62 years of independence majority of Indian in rural areas are still backward. Rural development is the need of the hour.

54 NSOU ? GE-GR-11 4.2 ????? Agricultural Marketing Agriculture in India has directly or indirectly continued to be the source of livelihood to majority of the population. Indian agriculture has seen a lot of changes in its structure. India, predominantly with an agricultural economy, has healthy signs of transformation in agriculture and allied activities. India has seen agriculture as a precious tool of economic development as other sectors of production depend on it. Efficient backward and forward integration with agriculture has led to globally competitive production system in terms of cost and quality. Cooperatives seem to be well positioned to coordinate product differentiation at the farm level and to integrate forward into value added processing activities.. Indian agriculture can be balanced and made efficient through proper and better management practices. The present study brings out past and present scenario of agricultural marketing prevailing in India, its challenges and future recommendations. Moreover the opportunities provided by agricultural marketing should be tapped effectively by the marketers. 4.2.1 Introduction Market-led Extension focuses on enhancement of knowledge, awareness and skills of different stakeholders of the sector on different aspects of marketing aspects of agricultural produce besides those relating to their production. The farmer, after all, has to know what to produce as per the demand, where to sell, when to sell, whom to sell his produce etc. Hence, it is incumbent on the extension functionaries to go beyond seed, soil and fertilizer and also disseminate knowledge on marketing aspects such as grading, standardization, packaging, labelling, storage, transportation, market intelligence, wholesaling, retailing and modern tools of marketing such as contract farming, terminal markets, future markets etc. The farmer has to be empowered to avail himself of the different modes of price discovery mechanism to his advantage. The agricultural extension system in India is production- focused, relegating the marketing issues to the backburner. As market-driven production is the need of the hour, the extension system has got to be made market-led. In order to make the extension system fully market-led, at the outset, focus has to be laid on agricultural marketing extension system and its contents. A typical production-based extension system promotes good agricultural practices by enhancing knowledge, awareness, and skill level of the stakeholders on production aspects such as soil, water, fertilizer, seeds, planting material, agronomical practices etc. On the other hand, agricultural marketing extension has to focus on disseminating knowledge, awareness and skill level of the stakeholders on different marketing aspects such as grading,, standardization, packaging, storage,

NSOU ? GE-GR-11 55 transportation, agricultural marketing finance, regulated marketing system, wholesaling, retailing, alternative marketing system etc. In order to strengthen and develop agricultural marketing system in the country, efforts in the area of training and extension have to be made at three levels. At policy level, it is necessary to formulate an effective policy on agricultural marketing under which various components of marketing programmes and activities can be integrated and coordinated. At managerial level, the managerial and technical capabilities of those technical institutions involved in the implementation of the marketing policy need to be improved to enable them to deliver more efficiently and economically. At farm level, marketing extension should assist farmers in improving marketing skills, thereby helping them get remunerative prices for their produce. As the days of the mass production and mass marketing are now being replaced by customer-based or market- driven strategies, an effective marketing extension service is the need of the hour. This has added significance in the light of post-WTO scenario. If the Indian farmers have to withstand the possible onslaught of international competitors, both in domestic as well as overseas markets, marketing extension would be an effective instrument to safeguard farmers' interest through proper education and guidance on regular basis. The marketing extension service to assist small and marginal farmers in solving the problems faced in marketing their produce is, therefore, a sine-qua-non in the free trade environment. 4.2.2 Birth of Market Regulation The need for regulation of markets arose from the anxiety of the British rulers to make available supplies of pure cotton at reasonable prices to the textile mills in Manchester. The first regulated Karanjia Cotton Market was established as early as in 1886 under Hyderabad Residency Order. The first legislation was the Berar Cotton and Grain Market Act of 1897. The 1897 Act became Model Act for legislation in other parts of the country. The then Bombay Government was first to enact Cotton Market Act in 1927. This was the first law in the country that attempted to regulate markets with a view to evolving fair market practices. In order to overcome the problems of agricultural marketing in India, the Royal Commission on Agriculture in 1928 and Central Banking Enquiry Committee in 1931 recommended establishment of Directorate of Marketing and Inspection under the Ministry of Food and Agriculture. The main Act for market regulation, "Agricultural Produce Market Regulation Act" is implemented by the State Governments. A network of more than 7100 regulated markets and about 28000 Rural Primary Markets services the marketing system of the country; and about 15% of which are also regulated. The objectives of market regulation initially were to ensure correct weighment, prompt payment to the farmers for

56 NSOU ? GE-GR-11 their produce and to avoid their exploitation at the hands of middlemen. However, the markets originally meant for protecting the farmers from the clutches of the exploitation by middlemen ended up inhibiting the free play of market forces, pushing the interests of the farmers to the backburner. The increasing focus on liberalization, privatisation and globalisation is both a challenge and an opportunity for our farmers. However, in order to enable our farmers to reap the external opportunities, effective internal reforms in the agricultural marketing system of the country are inescapable. 4.3. ????? Regulated Marketing System in India and Reforms It goes without saying that marketing and production of agricultural produce are inextricably intertwined with each other. In the post-WTO regime, an effective agricultural marketing system is the key driver of the agricultural economy of a country. An effective marketing system aims at ensuring remunerative prices to the producers at cost effective marketing costs and smooth supply of commodities to consumers at reasonable prices. In order to protect the interests of the various stakeholders of the agricultural marketing system of the country, a number of governmental interventions have been taken from time to time. However, the present agricultural marketing system of the country leaves much to be desired. There are many imperfections in the marketing system for agricultural commodities. Some reform measures by the government have already been initiated to address these issues and some are in the pipeline. This chapter includes a description of the traditional marketing system for agricultural commodities and the steps taken by the government from time to time to overcome the defects and to improve the marketing system. Characteristics of Traditional Agricultural Marketing System The problems of agricultural marketing have received the attention of the government for a long time. As early as in 1928, the Royal Commission on Agriculture had pointed out that the then existing system did not meet the requirements of an ideal marketing mechanism. Some of the important characteristics of the traditional marketing system for agricultural commodities have been discussed below: Many of these still exist, though efforts are under way to improve them. (i) Heavy Village Sales of Agricultural Commodities A majority of farmers in India sell a large part of their produce in villages resulting in low returns for their produce. There is a difference in the price prevailing at different levels of marketing, i.e., the village, the primary wholesale market, the secondary wholesale, and
NSOU ? GE-GR-11 57 retail levels. The extent of village sales varies from area to area, commodity to commodity, and also with the status of the farmer. The village sale is 20 to 60 percent in food-grains, 35 to 80 percent in cash crops and 80 to 90 percent in perishable commodities. This practice is very common even now. The factors responsible for village sales are – a) Farmers are indebted to village moneylenders, traders or landlords. They are often forced either to enter into advanced sale contracts or sell the produce to them at low prices. b) Many villages are still not connected by roads. Adequate transport means are not available even in villages connected by roads. It is difficult to carry the produce in bullock or camel carts to markets, which are often situated at long distances. c) There is only a small quantity of marketable surplus with a majority of the farmers because of the small size of holdings. d) Farmers are hard-pressed for money to meet their social and other: obligations, and are often forced to sell their produce right in the villages. e) Most of the perishable products need to be marketed in the villages because of their low "keeping" quality and the non-availability of quick transport means. f) Many farmers disliked city markets mainly because of their lack of knowledge about prevailing market practices, the possibility of theft or robbery in transit and problems faced by them for selling their produce in city markets. g) The information on the prices prevailing in the nearby primary and secondary wholesale markets is not readily available to the farmers. (ii) Post-Harvest Immediate Sales by Farmers A majority of the cultivators tend to sell their produce immediately after the harvest at low prices prevailing at that time. Because of substantial supplies, Indian markets are glutted in the post-harvest season. Traders often take advantage of this situation. About 60 to 80 percent of the food grains are still marketed in the first quarter of the harvest season. (iii) Inadequacy of Institutional Marketing Infrastructure and Lack of Producers' Organizations (iv) Multiplicity of Market Charges

58 NSOU ? GE-GR-11 (v) Existence of Malpractices and lack of reliable and up-to-date Market Information (vii) Low Marketable surplus of a Large Variety of Products (viii) Absence of grading and Standardization of Produce (ix) Absence of Quick Transport Means (x) Strong Associations of Traders and Market Functionaries State Marketing Departments were set up in the States as counterparts of the Central Marketing Department. The structure of the State Departments varies from State to State, and their status ranges from that of a full-fledged department to a cell under the Agriculture Department. However, all the States now have a marketing department/cell to look after the marketing problems of farmers. With increasing role of agricultural marketing in the economic development of the state and the increasing activity of market regulation, State Agricultural Marketing Boards were set up in States and Union Territories. These State Agricultural Marketing Boards look after the regulation of markets and bring about an effective level of coordination in the functioning of the regulated markets at the State level. The market regulation scheme received momentum after the establishment of State Agricultural Marketing Boards in the State. In some states Agricultural Marketing Departments were merged with boards. However, National Commission on Agriculture in 1976 again recommended establishment of separate Directorate of Agricultural Marketing in every state. Regulation of Agricultural Marketing The features like high marketing cost, unauthorized deductions and prevalence of various malpractices prompted regulation of agricultural marketing in different states of the country. Establishment of regulated markets has been able to overcome the problems of traditional marketing system to a great extent. However, these problems still persist in the case of village sales where regulation of markets become necessary. Definition of Regulated Market A regulated market aims at ensuring correct weighment of produce, prompt payment to the farmers and avoidance of exploitation of farmers by middlemen. Regulated market is one that aims at the elimination of the unhealthy and unscrupulous practices, reducing marketing costs, and providing facilities to the producer-seller in the market. A legislative

NSOU ? GE-GR-11 59 measure designed to regulate marketing of agriculture produce basically focuses on establishment of regulated markets. Objectives of Regulated Marketing: a) To prevent exploitation of farmers by helping them overcome the handicaps in the marketing of their produce. b) To make the marketing system effective and efficient so that farmers may get remunerative prices for their produce and the goods are made available to consumers at reasonable cost. c) To provide incentive prices to farmers for inducing them to increase the production both in terms of quantity and quality. d) To promote an orderly marketing of agricultural produce by improving the infrastructure facilities. Current agricultural marketing system in India is the outcome of several years of efforts of government policy. The system has undergone several changes during the last 60 years, regarding the increased marketed surplus; growing urbanization and income levels and consequent changes in the pattern of demand for marketing services; increase in linkages with distant and overseas markets; and changes in the policies of government. There are three important aspects of an agricultural marketing system. These are market structure, conduct and performance. In agricultural marketing, government intervention is necessary. The intervention of the government always influences it. An important characteristic of agricultural produce markets in India has been that private trade has continued to dominate the market. Millions of wholesalers and retailers handle the trade in food grains. Apart from traders, processors also play an important role as they also enter in the market as bulk buyers and sellers.Agricultural development continues to remain the most important objective of Indian planning and policy. The experience of agricultural development in India has shown that the existing systems of delivery and marketing of agricultural output have not been efficient in reaching the benefits of technology to all the sections of farmers. The timely, quality and cost-effective delivery of adequate inputs are still a dream, even though there are a few marketing attempts of the corporate sector and the developmental programmes of the state. Also, the farmers are not able to sell their surplus produce properly. There are plenty of distress sales among farmers both in agriculturally developed as well as backward regions. There are temporal variations and fluctuations in the markets

60 NSOU ? GE-GR-11 and the producers' share in consumers' money has not been satisfactory, with the exception of a few commodities. 4.4 ????? Questions 1. Discuss the major role played by the rural co-operatives in the rural economy of India. 2. What is Agricultural Marketing? What are the reasons behind to regulate rural marketing? 4.5 ????? Suggested Readings Ramkishen Y. Rural & Agricultural marketing, JaicoPubllishing House, Mumbai, 2004. S Neelamegham, Marketing in India, Vikas public house ltd., Delhi, 2004 Risley, George, Modern Industrial Marketing, Mc Grew Hill, New York, 1970 James A. Anderson and James A. Narus and (2004), Business Market Management, Pearson Education Asia Pte Ltd, Singapore, 2004.

NSOU ? GE-GR-11 61 Unit 5 ????? Rural Co-operatives and Agricultural Marketing Structure 5.1 Meaning and Concept 5.2 Agriculture and Allied Sector 5.3 Major Products and Yields 5.4 Non-Farm Economy and

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Rural Development 5.5 Questions 5.6 Suggested Readings 5.1 ????? Meaning and Concept Although policy makers and the development community have widely used the phrase "rural development", what constitutes rural development seems to have changed significantlyovertimes. The concept of rural development has changed significantly during the last three decades. Until the 1970s, rural development was synonymous with agricultural development and hence focused on increasing agricultural production. This focus seems to have been driven primarily by the interest of industrialization to extract surpluses from the agriculture sector to reinforce industrialization. The establishment of the Millennium Development Goals has significantly reinforced the concerns about non-income poverty. With the parading shifts in economic development from "growth" to broadly defined "development", the concept of rural development has begun to be used in a broader sense. In more recent years increased concerns on the environmental' aspects of economic growth have also influenced the changes. Today's concept of rural development is fundamentally different from that used about three or four decades ago. The concept

of rural economic base

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now encompasses "concerns that go well beyond improvements in growth, income and output. The concern includes an assessment of changes in the quality of life, broadly defined to include improvement in health and nutrition, education, environmentally safe living conditions and reduction in gender and Income inequalities. Today, there seems to be a universal consensus that the ultimate objective of rural development is to improve the quality of life of rural people. This makes it essential to go beyond the income-related 62 NSOU ? GE-GR-11 factors such as prices, production, and productivity to a range of non- income factors that influence quality of life and hence inclusiveness of rural development." Inclusive rural development is more specific concept than the concept of rural development. In broader terms, inclusive rural development is about improving the quality of life of all members of rural society. More specifically, inclusive rural development covers three different but interrelated dimensions. 1. Economic dimension 2. Social dimension 3. Political dimension Economic dimension encompasses providing both capacity and opportunities for the poor and low-income households in particular who may benefit from the economic growth. Socialdimension supports social development of poor and low- Income households, promotes gender equality and women's empowerment and provides social safety nets for vulnerable groups. Political dimension improves the opportunities for the poor and low-Income people in rural areas to effectively and equally participate within the political processes at the village level. ECONOMIC INCLUSIVE RURAL DEVELOPMENT

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The notion of rural development has been conceived in diverse ways by researchers, ranging from thinking of it as a set of goals and programmes to a well-knit strategy,

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approach or even an ideology. There is a widely shared view that its essence should be poverty alleviation and distributive Justice oriented economic transformation. 5.2 ?????

Agriculture and Allied Sector The history of Agriculture in India dates back to Indus Valley Civilization and even before that in some places of Southern India.India ranks second worldwide in farm outputs. As per 2018, agriculture employed 50% of the Indian work force and contributed 17-18% to country's GDP. In 2016, agriculture and allied sectors like animal husbandry, forestry and fisheries accounted for 15.4% of the GDP (gross domestic product) with about 31% of the workforce in 2014.India ranks first globally with highest net cropped area followed by US and China. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. India exported $38 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide and the sixth largest net exporter.Most of its agriculture exports serve developing and least developed nations.Indian agricultural/horticultural and processed foods are exported to more than 120 countries, primarily to the Middle East, Southeast Asia, SAARC countries, the European Union and the United States. As per the 2014 FAO world agriculture statistics India is the world's largest producer of many fresh fruits like banana, mango, guava, papaya, lemon and vegetables like chickpea, okra and milk, major spices like chili pepper, ginger, fibrous crops such as jute, staples such as millets and castor oil seed. India is the second largest producer of wheat and rice, the world's major food staples. India is currently the world's second largest producer of several dry fruits, agriculture- based textile rawmaterials, roots and tuber crops, pulses,farmed fish, eggs, coconut, sugarcane and numerous vegetables. India is ranked under the world's five largest producers of over 80% of agricultural produce items, including many cash crops such as coffeeand cotton, in 2010. India is one of the world's five largest producers of livestock and poultry meat, with one of the fastest growth rates, as of 2011.One report from 2008 claimed that India's population is growing faster than its ability to produce rice and wheat.While other recent studies claim that India can easily feed its growing population, and produce wheat and rice for global exports, if it can reduce food staple spoilage or wastage, improve its infrastructure 64 NSOU ? GE-GR-11 and raise its farm productivity like those achieved by other developing countries such as Brazil and China.In fiscal year ending June 2011, with a normal monsoon season, Indian agriculture accomplished an all-time record production of 85.9 million tonnes of wheat, a 6.4% increase from a year earlier. Rice output in India hit a new record at 95.3 million tonnes, a 7% increase from the year earlier.Lentils and many other food staples production also increased year over year. Indian farmers, thus produced about 71 kilograms of wheat and 80 kilograms of rice for every member of Indian population in 2011. The per capita supply of rice every year in India is now higher than the per capita consumption of rice every year in Japan.India exported $39 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide, and the sixth largest net exporter.This represents explosive growth, as in 2004 net exports were about $5 billion, India is the fastest growing exporter of agricultural products in the last decade, its $39 billion of net export is more than double the combined exports of the European Union (EU-28). It has become one of the world's largest supplier of rice, cotton, sugar and wheat. India exported around 2 million metric tonnes of wheat and 2.1 million metric tonnes of rice in 2011 to Africa, Nepal, Bangladesh and other regions around the world. Aquaculture and catch fishery are amongst the fastest growing industries in India. Between 1990 and 2010, the Indian fish capture harvest doubled, while aquaculture harvest tripled. In 2008, India was the world's sixth largest producer of marine and freshwater capture fisheries and the second largest aquaculture farmed fish producer. India exported 600,000 metric tonnes of fish products to nearly half of the world's countries.Though the available nutritional standard is 100% of the requirement, India lags far behind in terms of quality protein intake at 20 which is to be tackled by making available protein rich food products such as eggs, meat, fish, chicken etc. at affordable prices . India has shown a steady average nationwide annual increase in the kilograms produced per hectare for some agricultural items, over the last 60 years. These gains have come mainly from India's green revolution, improving road and power generation infrastructure, knowledge of gains and reforms. Despite these recent accomplishments, agriculture has the potential for major productivity and total output gains, because crop yields in India are still just 30% to 60% of the best sustainable crop yields achievable in the farms of developed and other developing countries. Additionally, post-harvest losses due to poor infrastructure and unorganized retail, caused India to experience some of the highest food losses in the world.

NSOU ? GE-GR-11 65 In the years since its independence, India has made immense progress towards food security. Indian population has tripled, and food-grain production more than quadrupled. There has been a substantial increase in available food-grain per capita.Before the mid- 1960s India relied on imports and food aid to meet domestic requirements. However, two years of severe drought in 1965 and 1966 convinced India to reform its agricultural policy and that they could not rely on foreign aid and imports for food security. India adopted significant policy reforms focused on the goal of food grain self-sufficiency. This ushered in India's Green Revolution. It began with the decision to adopt superior yielding, disease resistant wheat varieties in combination with better farming knowledge to improve productivity. The state of Punjab led India's green revolution and earned the distinction of being the country's bread basket. The initial increase in production was centred on the irrigated areas of the states of Punjab, Haryana and western Uttar Pradesh. With the farmers and the government officials focusing on farm productivity and knowledge transfer, India's total food grain production soared. A hectare of Indian wheat farm that produced an average of 0.8 tonnes in 1948, produced 4.7 tonnes of wheat in 1975 from the same land. Such rapid growth in farm productivity enabled India to become self-sufficient by the 1970s. It also empowered the smallholder farmers to seek further means to increase food staples produced per hectare. By 2000, Indian farms were adopting wheat varieties capable of yielding 6 tonnes of wheat per hectare. With agricultural policy success in wheat, India's Green Revolution technology spread to rice. However, since irrigation infrastructure was very poor, Indian farmers innovated with tube-wells, to harvest ground water. When gains from the new technology reached their limits in the states of initial adoption, the technology spread in the 1970s and 1980s to the states of eastern India — Bihar, Odisha and West Bengal. The lasting benefits of the improved seeds and new technology extended principally to the irrigated areas which account for about one-third of the harvested crop area. In the 1980s, Indian agriculture policy shifted to "evolution of a production pattern in line with the demand pattern" leading to a shift in emphasis to other agricultural commodities like oil seed, fruit and vegetables. Farmers began adopting improved methods and technologies in dairying, fisheries and livestock, and meeting the diversified food needs of a growing population. As with rice, the lasting benefits of improved seeds and improved farming technologies now largely depends on whether India develops infrastructure such as irrigation network, flood control systems, reliable electricity production capacity, all-season rural and urban highways, cold storage to prevent spoilage, modern retail, and competitive buyers of

66 NSOU ? GE-GR-11 produce from Indian farmers. This is increasingly the focus of Indian agriculture policy. India ranks 74 out of 113 major countries in terms of food security index.India's agricultural economy is undergoing structural changes. Between 1970 and 2011, the GDP share of agriculture has fallen from 43% to 16%. This isn't because of reduced importance of agriculture or a consequence of agricultural policy. This is largely because of the rapid economic growth in services, industrial output, and non-agricultural sectors in India between 2000 and 2010. As of 2011, India had a large and diverse agricultural sector, accounting, on average, for about 16% of GDP and 10% of export earnings. India's arable land area of 159.7 million hectares (394.6 million acres) is the second largest in the world, after the United States. Its gross irrigated crop area of 82.6 million hectares (215.6 million acres) is the largest in the world. India is among the top three global producers of many crops, including wheat, rice, pulses, cotton, peanuts, fruits and vegetables. Worldwide, as of 2011, India had the largest herds of buffalo and cattle, is the largest producer of milk and has one of the largest and fastest growing poultry industries. 5.3 ????? Major Products and Yields The following table presents the 20 most important agricultural products in India, by economic value, in 2009. Included in the table is the average productivity of India's farms for each produce. For context and comparison, included is the average of the most productive farms in the world and name of country where the most productive farms existed in 2010. The table suggests India has large potential for further accomplishments from productivity increases, in increased agricultural output and agricultural incomes.The Statistics Office of the Food and Agriculture Organization reported that, per final number for 2009, India had grown to become the world's largest producer of the following agricultural products: ? Fresh Fruit ? Lemons and limes ? Buffalo milk, whole, fresh ? Castor oil seeds ? Sunflower seeds ? Sorghum

NSOU ? GE-GR-11 67 ? Millet ? Spices ? Okra ? Jute ? Beeswax ? Bananas ? Mangoes, mangosteens, guavas ? Pulses ? Indigenous buffalo meat ? Fruit, tropical ? Ginger ? Chick peas ? Areca nuts ? Other bastfibres ? Pigeon peas ? Papayas ? Chillies and peppers, dry ? Anise, badian, fennel, coriander ? Goat milk, whole, fresh ? Wheat ? Rice ? Fresh vegetables ? Sugar cane ? Groundnuts, with shell ? Lentils ? Garlic ? Cauliflowers and broccoli

68 NSOU ? GE-GR-11 ? Peas, green ? Sesame seed ? Cashew nuts, with shell ? Silk-worm cocoons, reelable ? Cow milk, whole, fresh ? Tea ? Potatoes ? Onions ? Cotton lint ? Cotton seed ? Eggplants (aubergines) ? Nutmeg, mace and cardamoms ? Indigenous goat meat ? Cabbages and other brassicas ? Pumpkins, squash and gourds In 2009, India was the world's third largest producer of eggs, oranges, coconuts, tomatoes, peas and beans.In addition to growth in total output, agriculture in India has shown an increase in average agricultural output per hectare in last 60 years. The table below presents average farm productivity in India over three farming years for some crops. Improving road and power generation infrastructure, knowledge gains and reforms has allowed India to increase farm productivity between 40% to 500% over 40 years. India's recent accomplishments in crop yields while being impressive, are still just 30% to 60% of the best crop yields achievable in the farms of developed as well as other developing countries. Additionally, despite these gains in farm productivity, losses after harvest due to poor infrastructure and unorganised retail cause India to experience some of the highest food losses in the world. India and China are competing to establish the world record on rice yields. Yuan Longping of China National Hybrid Rice Research and Development Centre set a world record for rice yield in 2010 at 19 tonnes per hectare in a demonstration plot. In 2011, this record was surpassed by an Indian farmer, Sumant Kumar, with 22.4 tonnes per
NSOU ? GE-GR-11 69 hectare in Bihar, also in a demonstration plot. These farmers claim to have employed newly developed rice breeds and system of rice intensification (SRI), a recent innovation in farming. The claimed Chinese and Indian yields have yet to be demonstrated on 7 hectare farm lots and that these are reproducible over two consecutive years on the same farm. Horticulture The total production and economic value of horticultural produce, such as fruits, vegetables and nuts has doubled in India over the 10-year period from 2002 to 2012. In 2012, the production from horticulture exceeded grain output for the first time. The total horticulture produce reached 277.4 million metric tonnes in 2013, making India the second largest producer of horticultural products after China.Of this, India in 2013 produced 81 million tonnes of fruits, 162 million tonnes of vegetables, 5.7 million tonnes of spices, 17 million tonnes of nuts and plantation products (cashew, cacao, coconut, etc.), 1 million tonnes of aromatic horticulture produce and 1.7 million tonnes of flowers (7.6 billion cut flowers).During the 2013 fiscal year, India exported horticulture products worth [1] 14,365 crore (US$2.1 billion), nearly double the value of its 2010 exports.Along with these farm- level gains, the losses between farm and consumer increased and are estimated to range between 51 and 82 million metric tonnes a year. Organic Agriculture Organic agriculture has fed India for centuries and it is again a growing sector in India. Organic production offers clean and green production methods without the use of synthetic fertilisers and pesticides and it achieves a premium price in the market place. India has 6,50,000 organic producers, which is more than any other country.India also has 4 million hectares of land certified as organic wild culture, which is third in the world (after Finland and Zambia).As non-availability of edible biomass is impeding the growth of animal husbandry in India, organic production of protein rich cattle, fish and poultry feed using biogas /methane/natural gas by cultivating Methyl coccuscapsulitis bacteria with tiny land and water foot print is a solution for ensuring adequate protein rich food to the population.India has seen a huge growth in cooperative societies, mainly in the farming sector, since 1947 when the country gained independence from Britain. The country has networks of cooperatives at the local, regional, state and national levels that assist in agricultural marketing. The commodities that are mostly handled are food grains, jute, cotton, sugar, milk, fruit and nuts.

70 NSOU ? GE-GR-11 Problems faced India lacks cold storage, food packaging as well as safe and efficient rural transport system. This causes one of the world's highest food spoilage rates, particularly during monsoons and other adverse weather conditions. Food travels to the Indian consumer through a slow and inefficient chain of traders. Consumers buy agricultural produce in suburban markets known as 'sabzi mandi' such as one shown or from roadside vendors. Indian agriculture includes a mix of traditional to modern farming techniques. In some parts of India, traditional use of cattle to plough remains in use. Traditional farms have some of the lowest per capita productivities and farmer incomes.Slow agricultural growth is a concern for policymakers as some two-thirds of India's people depend on rural employment for a living. Current agricultural practices are neither economically nor environmentally sustainable and India's yields for many agricultural commodities are low. Poorly maintained irrigation systems and almost universal lack of good extension services are among the factors responsible. Farmers' access to markets is hampered by poor roads, rudimentary market infrastructure, and excessive regulation. With a population of just over 1.2 billion, India is the world's largest democracy. In the past decade, the country has witnessed accelerated economic growth, emerged as a global player with the world's fourth largest economy in purchasing power parity terms, and made progress towards achieving most of the Millennium Development Goals. India's integration into the global economy has been accompanied by impressive economic growth that has brought significant economic and social benefits to the country. Nevertheless, disparities in income and human development are on the rise. Preliminary estimates suggest that in 2009-10 the combined all India poverty rate was 32 % compared to 37% in 2004- 05. Going forward, it will be essential for India to build a productive, competitive, and diversified agricultural sector and facilitate rural, non-farm entrepreneurship and employment. Encouraging policies that promote competition in agricultural marketing will ensure that farmers receive better prices. (World Bank: "India Country Overview 2011) A 2003 analysis of India's agricultural growth from 1970 to 2001 by the Food and Agriculture Organization identified systemic problems in Indian agriculture. For food staples, the annual growth rate in production during the six-year segments 1970-76, 1976–82, 1982–88, 1988–1994, 1994-2000 were found to be respectively 2.5, 2.5, 3.0, 2.6, and 1.8% per annum. Corresponding analyses for the index of total agricultural production show a similar pattern, with the growth rate for 1994-2000 attaining only 1.5% per annum.

NSOU ? GE-GR-11 71 Infrastructure India has very poor rural roads affecting timely supply of inputs and timely transfer of outputs from Indian farms. Irrigation systems are inadequate, leading to crop failures in some parts of the country because of lack of water. In other areas regional floods, poor seed quality and inefficient farming practices, lack of cold storage and harvest spoilage cause over 30% of farmer's produce going to waste, lack of organised retail and competing buyers thereby limiting Indian farmer's ability to sell the surplus and commercial crops. The Indian farmer receives just 10% to 23% of the price the Indian consumer pays for exactly the same produce, the difference going to losses, inefficiencies and middlemen. Farmers in developed economies of Europe and the United States receive 64% to 81%. Productivity Although India has attained self-sufficiency in food staples, the productivity of its farms is below that of Brazil, the United States, France and other nations. Indian wheat farms, for example, produce about a third of the wheat per hectare per year compared to farms in France. Rice productivity in India was less than half that of China. Another staples productivity in India is similarly low. Indian total factor productivity growth remains below 2% per annum; in contrast, China's total factor productivity growths is about 6% per annum, even though China also has smallholding farmers. Several studies suggest India could eradicate its hunger and malnutrition and be a major source of food for the world by achieving productivity comparable with other countries. Crop yields vary significantly between Indian states. Some states produce two to three times more grain per acre than others. The traditional regions of high agricultural productivity in India are the north west (Punjab, Haryana and Western Uttar Pradesh), coastal districts on both coasts, West Bengal and Tamil Nadu. In recent years, the states of Madhya Pradesh, Jharkhand, Chhattisgarh in central India and Gujarat in the west have shown rapid agricultural growth.The table compares the state-wide average yields for a few major agricultural crops in India, for 2001-2002. Crop yields for some farms in India are within 90% of the best achieved yields by farms in developed countries such as the United States and in European Union. No single state of India is best in every crop. Tamil Nadu achieved highest yields in rice and sugarcane, Haryana in wheat and coarse grains, Karnataka in cotton, Bihar in pulses, while other states do well in horticulture, aquaculture, flower and fruit plantations. These differences in agricultural productivity are a function of local infrastructure, soil quality, micro-climates, 72 NSOU ? GE-GR-11 local resources, farmer knowledge and innovations.The Indian food distribution system is highly inefficient. Movement of agricultural produce is heavily regulated, with inter-state and even inter-district restrictions on marketing and movement of agricultural goods.One study suggests Indian agricultural policy should best focus on improving rural infrastructure primarily in the form of irrigation and flood control infrastructure, knowledge transfer of better yielding and more disease resistant seeds. Additionally, cold storage, hygienic food packaging and efficient modern retail to reduce waste can improve output and rural incomes. The low productivity in India is a result of the following factors: ? The average size of land holdings is very small (less than 2 hectares) and is subject to fragmentation due to land ceiling acts, and in some cases, family disputes. Such small holdings are often over-manned, resulting in disguised unemployment and low productivity of labour. ? Adoption of modern agricultural practices and use of technology is inadequate in comparison with Green Revolution methods and technologies, hampered by ignorance of such practices, high costs and impracticality in the case of small land holdings. ? Illiteracy, general socio-economic backwardness, slow progress in implementing land reforms and inadequate or inefficient finance and marketing services for farm produce. ? Irrigation facilities are inadequate, as revealed by the fact that only 52.6% of the land was irrigated in 2003–04, which result in farmers still being dependent on rainfall, specifically the monsoon season. A good monsoon results in a robust growth for the economy, while a poor monsoon leads to a sluggish growth. 5.4 ????? Non-Farm Economy and Rural Development Introduction : It is a universally accepted fact that the agricultural sector is, by itself, incapable of creating additional opportunities of gainful employment in the wake of increasing population. As a result, the impetus for achieving sustained development in rural areas has to pivot around expanding the base of non-farm activities. If such a comprehensive planning approach can be evolved it could provide the solution to the problems of rural areas such as poverty, unemployment and out-migration of the rural work force. The significance of the non-farm sector is even more pronounced in the agriculturally backward and low productivity regions

NSOU ? GE-GR-11 73 such as the hill districts of Uttaranchal. It is important to go with the objective of examining the structure, growth, development potentials and the various problems which exists in the functioning of non-farm activities. It is important to investigate the possibilities and measures which need to be initiated for developing the non-farm activities for achieving employment and attaining a better quality of life for the people residing in the rural areas of India. It is a universally accepted fact that the agricultural sector is, by itself, incapable ofcreating additional opportunities of gainful employment in the wake of increasingpopulation. As a result, the impetus for achieving sustained development in ruralareas has to pivot around expanding the base of non-farm activities. If such acomprehensive planning approach can be evolved it could provide the solution to theproblems of rural areas such as poverty, unemployment and out-migration of therural work force. The significance of the non-farm sector is even more pronouncedin the agriculturally backward and low productivity regions in India. Structure and Growth : It reveals those manufacturing activities, both traditional and non-traditional, form a major part of the non-farm sector in the rural economy in general and the high altitude areas in particular. The manufacturing enterprises found in high altitude areas of Himalayas and middle altitude areas of plateau region are black smithy, basket and mat making, rope making and woollen enterprises and they are based on locally available raw materials. In the low areas activities such as carpentry, flour milling, tailoring, repairing and servicing units are dominant. However, over the years manufacturing activities in general and traditional household-based activities in paritcular, have been declining. On the other hand, non-farm activities such as trading, service and transportation have been developing over the years and that too in the rural areas in particular. A major factor affecting the decline in the growth of manufacturing activities is the lack of interest among the younger generation in these activities since they generate low levels of income. The other factor responsible for their plight is the shortages in the locally available raw materials. It was found that the establishment of rural non-farm enterprises in general, and manufacturing activities in particular, require very low levels of capital investment. The average capital investment in these activities works out to be around Rs.4550 per enterprise. In the case of the service sector it is around Rs.6150 and Rs.17,200 in trading and commercial activities. The highest investment of Rs.3.20 lakhs per unit was found in the transport sector. The turnover of these enterprises has a direct relationship with

74 NSOU ? GE-GR-11 the level of investment made in any specific enterprise. Consequently households engaged in the transport sector have the maximum turnover. A very little contribution of various rural development programmes, especially rural self employment oriented schemes has been visualized in motivating a little over 4 per cent of the households for establishing different non-farm activities through providing financial assistances in the form of subsidy cum loan facilities. Though, in real terms, around 15 per cent of the non-farm households were facilitated through providing financial assistance from different Government Departments, financial institutions and banks to set up their industrial enterprises. Also a little over of 3 per cent of the family members of the non-farm households had availed the vocational training for establishing non-farm activities. Employment Structure : Agriculture and its allied activities employ a major chunk of the total labour force in the different districts of the state. However, the significance of the non-farm sector, as a potential source of employment generation, has been increasing over the years. In fact, the shift of employment from farm to non-farm sector is quite evident. The share of employment in the farm sector was as high as around 75 per cent during 1971. By 1991 it had declined to around 65.5 per cent. Consequently, the corresponding share of non-farm employment had registered an increase from around 25 to 35 per cent between 1971 and 1991. Male workforce dominates the non-farm sector employment. Out of the total male workers their share in non-farm activities went up from around 37 per cent to 50 per cent between 1971 and 1991. In the case of females, on the other hand, the corresponding increase was from just below 4 per cent in 1971 to around 7 per cent in 1991. However, over the years, the concentration of women workforce has been increasing at much faster rate than the case of their male counterpart in non-farm employment. In absolute terms it is found that employment has been going up in both farms as well as non-farm activities. However, the growth is faster in the non-farm activities. However, the rate of growth is faster in the non-farm sector and this fact confirms the limitation of the farm sector to be able to consistently absorb the ever-increasing workforce. If we classify the workers in the non-farm sector among different activities, the major concentration is found in the service sector and is followed by the manufacturing sector. Participating Households and Factors Affecting Expansion : The growth of the non-farm sector has been positively influenced by access to locally available raw materials, traditionally developed means of production, lack of employment

NSOU ? GE-GR-11 75 opportunities in farm activities, improvements in infrastructure facilities such as roads and transport network etc. While the non-farm sector has benefited in general the sector to have been emitted most is the manufacturing sector in the rural backward areas. Road development has prompted people to move to the nearby urban locations for better paid jobs. The development of roads has also witnessed a shift in activities from traditional enterprises to the relatively higher earning activities such as trading, transport, tailoring, services and repairing etc. The traditional manufacturing activities in rural areas have also been adversely affected by deforestation as well as degradation of natural resources. In fact, certain local resource based units have closed down completely. The average size of the household engaged in the non-farm activities was found to be relatively higher as compared to those engaged in farm activities. Even the work participation rate in non-farm households is higher as compared to farm households. It is also observed that higher the size of the farm, lower is the household participation in non-farm activities. The non-farm sector, particularly manufacturing activities, has been playing an important role in the process of overall development by providing opportunities of employment to both skilled and unskilled workers. As a result of these employment opportunities the levels of household income have increased. Despite having a lower size of holdings, the non-farm households are better off economically than the farming households. Taking all the three locations together the average per capita income among non-farm households worked out to be around Rs.4200 while the same was Rs.3090 among farming households. In the case of non-farm households the income generated from non-farm activities was as high as 77 per cent. Structure of Rural Industries : The existing rural industrial enterprises which constitute the major part of the nonfarm sector comprise of both traditional and non-traditional activities. Activities such as blacksmith, basket making, rope making and wool-based activities thrive on locally available raw materials and constitute the traditional activities. As against these tailoring, comb making, iron and steel works, carpentry, flour milling, service and repair units form the non-traditional activities. In the case of the traditional activities woollen industry has been in the hands of backward households while the others are dominated by other backward households. For example, in basket making the average value of production is around Rs.6830 while in the case of a flourmill it is nearly Rs.23,500. Over the years the efficiency of different rural industrial enterprises, as seen in terms of their productivity level and contribution to household income, have shown a positive change. However, the extent of change is higher among non-traditional units as compared to traditional units. Even then, one must keep in mind the

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76 NSOU ? GE-GR-11 fact that some of these traditionally manufactured items can be developed effectively if a proper market can be identified for them. Constraints and Perspectives of Development : The two important factors which have contributed towards the unsatisfactory growth of industrial activities in different geographical locations are the scarcity of locally available raw materials and the inadequate development of an effective marketing network for selling the products of these units. Some of the other factors are outdated techniques of production, decline in local demand, lack of diversification and low levels of production. The households engaged in these activities are aware of their problems and limitations and are looking forward to some assistance from the government since as many as 61 per cent are willing to diversify their products, adopt new techniques and every go in for production of new goods altogether. Policy Recommendations : Since the potential of agricultural development in the rural areas is constrained because of factors like limited availability of arable land, problems of providing irrigation, small and fragmented holdings, terraced fields which limit the scope of mechanization, even increasing pressure of the growing population etc, the only recourse is to develop the non-farm sector keeping in mind environmental considerations, needs of the people, availability of resources, traditional crafts and the skills of the local people. The non-farm sector holds the key to the problems of unemployment, poverty and sustained development. In fact, various non- farm activities already exist in the hills and some of these have been traditional activities of rural households for several generations. However, they have not been given due weightage in the past and so not much efforts were made to strengthen and widen the base of these activities. (i) If the non-farm sector is to be developed effectively then a major role in achieving this objective can be achieved through the development of the road transport. The development of roads would open up avenues for the marketing of goods and services produced by the rural enterprises on one hand and for the procurement of different raw materials for the traditional as well as non-traditional units on the other. Thus the road network would provide a chain of forward and backward linkages and this will facilitate the development of the sector. (ii) Since the farm sector is very important and even in 1991 nearly 64.5 per cent of the workforce was engaged in this sector, it is equally important to give due weightage to the development of this sector as well. Therefore, it will be
NSOU ? GE-GR-11 77 appropriate to introduce an integrated approach for the development of the farm and non-farm sectors by developing common basic necessities and infrastructure facilities thereby ensuring development of both these sectors simultaneously. The agricultural sector can be suitably diversified to provide the necessary inputs for certain identified agro-based industries. (iii) The focus of rural development programmes should be aimed at promoting self-employment opportunities rather than wage-paid casual employment. The government can identify non-farm activities for different areas keeping in mind the comparative advantage which a specific area enjoys. The rural people can then be made aware of these activities and government can chalk out suitable schemes for providing technical and financial assistance for setting up such units. Some of the activities which can be promoted for development are: - diversified farm products, fruits, off-season vegetables, tea, honey, milk, meat, wool and woollen products, - nature and resources based products herbs and medicines, furniture and wooden products, minor forest produce like bamboo and rattan and natural fibre base products. Activities like tourism and adventure sports, hydropower also be developed: handicrafts which are made by skilled men and women with the help of locally available raw materials. (iv) The land areas under natural forests cover as well as the net cultivated land have been declining over all. It has given rise to increases in barren and cultivable waste, permanent pastures and grazing land, and fallow land. These categories of lands taken together account for a higher area than the total arable land. The rural people must therefore be encouraged by the government to put this land to optional use as far as possible by introducing afforestation programmes whereby high value commercial plants, trees and groves are planted. In time to come these plants will provide the resource base for various rural enterprises. The present problem related to scarcity of locally available raw materials can thus be dealt with quite effectively. To meet the ongoing crisis of shortage of raw materials the state government can step in and purchase such raw materials from area where there is a surplus and transfer the same to areas of scarcity. (v) It is equally important to upgrade the traditional techniques of production which are presently being employed by the rural people. This will provide the much- needed improvements in the productive efficiency of rural enterprises. This will not only lead to increase in output and improvement in the quality of the output itself. Once the quality of goods improves and total production also goes up these goods may be able to find a market in the urban Centres as well. In any

78 NSOU ? GE-GR-11 case they will provide to be an attraction to the tourists once the tourism sector is properly developed. (vi) Last but not least, introduction of additional goods, especially market oriented articles in the production system and widening marketing opportunities for the products through establishing co-operative marketing societies in and around of the areas where different rural industries are fairly largely concentrated and the sales counters/shops in nearby towns tourist centres and large cities outside state are also some important suggestive measures in favour of developing rural industrial activities in the state. 5.5 ????? Questions 1. Identify various rural economic bases. 2. What do you mean by agriculture and allied sectors ? Give examples. 3. What are non-farm activities. 5.6 ????? Suggested Readings ? "The Great Gene Robbery" by Claude Alvares ? Sharma, Shailendra D. (1999), Development and Democracy in India, Lynne Rienner Publishers, pp. 125-136 ? Agarwal, Ankit (2011), "Theory of Optimum Utilisation of Resources in agriculture during the Gupta Period", History Today 12, New Delhi

NSOU ? GE-GR-11 79 Unit 6 ????? Area Based approach to Rural Development Structure 6.1 Area Based Rural Development Approach 6.2 Rural Development Approaches in India 6.3 Drought Prone Area Programme 6.4 Pradhan Mantri Gram Sadak Yojana 6.4.1. Programme Objectives 6.5 Questions 6.6 Suggested Reading 6.1 ????? Area Based Rural Development Approach The term 'rural development' is a subset of the broader term development.

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The term rural development connotes overall development of rural areas with a view to improve the quality of life of the rural poor. In this sense, it is a comprehensive and multi-dimensional concept, encompassing the development of agriculture and allied activities, village and cottage industries including crafts, socio-economic infrastructure, community services and facilities, and above all, the human resource development in rural areas. As a phenomenon, rural development

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result of transactions between various physical, technological, economic, socio-cultural and institutional factors. As a strategy, it is designed to improve the economic and social wellbeing of the specific group of people- 'the rural poor'. As a discipline, it is multi-disciplinary in nature, representing an intersection of agricultural, social, behavioural, engineering and management sciences.

Rural development, as such, is nothing new to the third world countries. Many developing countries have been practicing or promoting rural development for a number of years and many of them have achieved significant success in their efforts. However, rural development has been attracting since long and special importance and attention is being given by the planners. Alongside, there has been considerable discussion of the need for and nature of shift in emphasis and approach called for in rural development in keeping with the objective of overall development policy for speedy alleviation of poverty. The concept of 'rural development' was born in the context of agriculture, and it remained, for a long time

80 NSOU ? GE-GR-11 coterminous with agricultural development in India. The Royal Commission on Agriculture (1928), for instance provides this kind of interpretation to 'rural development'. To quote from the report of the Commission: "We cannot too strongly state our conviction that the directorship of agricultural advances must in a very greatdegree depend upon the suitability of the officer appointed". Nearly half a century later, another committee viewed rural development in more or less similar way. The Planning Commission's Task Force on Integrated Rural Development observed in 1972: "After careful consideration, we have belatedly decided to take what might be considered rather restricted view of the expression 'rural development'. We have chosen to equate it with agricultural development in the widest sense so as to embrace besides crop, husbandry, and all the allied activities". Since the seventies, the concept of rural development has undergone a change, and has become more comprehensive. The concept of rural development, as enunciated by the World Bank, marks such a change. The World Bank defines "

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rural development as a strategy designed to improve the economic and social life of a specific group of people - The rural poor. Rural development involves extending the benefits of development to the poorest among those who seek livelihood in the rural areas. The group includes small-scale farmers, tenants and

the
land less." To quote from the World Bank Sector Policy Paper on Rural Development (1975): "A national programme of rural development should

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include a mix of activities including projects to raise agricultural output, create new employment, improve health and education, expand communications and improve housing". 6.2 ?????

Rural Development Approaches in India India has gained vast experience in the implementation of rural development programmes. The approaches to rural development and area planning have also changed over a period of time10. In the light of the experience gained by following a particular approach, a new approach has been evolved. The shift in emphasis is intended not only to accelerate the pace of growth in the rural sector but to ensure social justice by minimizing wastage and leakages. India has a very long history of experimenting with various approaches to rural development. The First Five Year Plan (1950-51 to 1955-56), adopted the Harrod-Domar model of capital accumulation and saving mobilization as its methodological approach towards planning. Under this approach, the process of economic development must start from the villages. In order to implement this ideology, the Community Development Porgamme
NSOU ? GE-GR-11 81 (CDP) was conceived. The National Extension Service, started in 1952 by the Government of India with the establishment of 55 Community Development Programmes, was extended to cover the entire country by a network of 5,265 Community Development Blocks15. The block administration was created as a centre of rural development activities. This programme failed, as blocks were quite big and left the weaker sections untouched. It was opined that the resources available for the programme were too meager compared with the need and spread. The Second Five Year Plan (1955-56 to 1960-61) was based on Feldman - Mahalnobis model of sectoral growth. This strategy emphasized investment in heavy industries to achieve industrialization, which was assumed to be the basic condition for rapid economic development. A good deal of reliance was placed on cottage and small industries with the aim of reducing rural underemployment, unemployment. As against this background, no important specialized rural development programme was launched during the second plan period16. However, steps were taken to strengthen the ongoing Community Development Programme. In this respect, the need for viable institutional base was felt and the Panchayat Raj System was introduced during the plan period. In addition to this, specialized rural economic development programmes like 'Intensive Agricultural District Programme' (IADP), 'Khadi and Village Industries programme' (KVI), Multi purpose Tribal Development, and Village Housing Projects/Schemes were also introduced in rural areas of the country. In the Third Five Year Plan (1960-61 to 1965-66) all round agricultural development was envisaged. Increased agricultural production in the farm sector and activities allied to agriculture received top most priority during the plan period. The important agricultural development programmes bringing green revolution strategy like Intensive Agricultural Area Development Programme (IADP) and High Yield Varieties Programme (HYVP) were implemented in the country. It is observed that, the benefits accrued only to the rich and progressive peasants. Once again, landless and agricultural labourers were left untouched. During the Annual Plans (1966-1969), few more programmes were implemented to achieve all round development. Important programmes like 'Farmers

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Training and Education Programme', 'Well construction Programme', 'Rural works programme' (RWP), 'Tribal Development Block', 'Rural Manpower Programme', 'Composite Programme for Women and

Primary School Children' were introduced18. The Fourth Five Year Plan (1969-74), in the name of "Growth with Social Justice" initiated efforts towards uplifting the vulnerable sections of rural society. The publication of 82 NSOU ? GE-GR-11 Dandekar and Rath study19 also had a material impact on the framework. In this connection a number of 'Area Development Oriented' and 'Target Oriented' programmes were introduced. Programmes such as

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Small Farmers Development Agency (SFDA), Marginal Farmers and Agricultural Labourers Development Agency (MFAL), Drought Prone Area Programme (DPAP),

Tribal Area Development Programme (TADP) were introduced as the important rural development programmes. These rural development programmes did succeed, but only in limited areas and numbers. This plan paved the path for a number of rural development and poverty alleviation programmes in the country. These programmes were implemented through the existing administrative apparatus at block and village levels. Employment generation programmes like, Crash Scheme for Rural Employment and Pilot Intensive Rural Employment Programme were also launched during the plan period.The Fifth Five Year Plan (1974-79), based on the Inter-sectoral transactions model of Leontief, which has emphasized the strengthening the inter-sectoral linkages for balanced growth in sectors21. The most important objectives of the Fifth Plan period were; i) removal of poverty and ii) achievement of self-reliance. In order to attain these objectives, the (MNP), Food for work programme (FFW) were introduced during the plan period. In addition to this, in order to promote small scale, village and cottage industries, the 'District Industrial Centres' (DICs) were set up in all the districts of the country. The 20-point Economic programme was also introduced during the said plan period. The Sixth Five Year Plan (1980-85), aimed at the removal of poverty, growth, modernization, self-reliance and social justice. In order to attain all-round development in rural areas, one single integrated programme called 'Integrated Rural Development Programme' (IRDP) was conceived. The programme has been in operation since 1978- 79 and has been made the centrepiece of the anti-poverty strategy in the Sixth Five Year Plan. IRDP is regarded as a multi-level, multi-sector and multi-section concept of rural development. As a multi-level concept, it encompasses rural development at various levels such as viable cluster of village communities, districts and blocks. As a multi-sector concept, it embraces development in various sectors and sub-sectors of the rural areas such as agriculture, industry, education, health and transportation etc. As a multi-section concept, it encompasses socio-economic development of various sections and sub-sections of rural population such as small farmers, marginal farmers, landless and agricultural labourers, artisans, Scheduled Castes and Scheduled Tribes. Besides IRDP, employment generation programmes like, National Rural Employment Programme (NREP), Rural Land less
NSOU ? GE-GR-11 83 Employment Guarantee Programme (RLEGP), Economic Rehabilitation of Rural Poor (ERRP), Training of Rural Youth for Self-Employment (TRYSEM), Self-Employment for the Educated Unemployed Youth (SEEVY),

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Development of Women and Children in Rural Areas (DWCRA) etc.,

were also introduced during the said plan period. The important objectives of the Seventh Five Year Plan (1985-90) were; building an independent self-reliant economy, establishment of social system based on equity and justice, reduction of regional imbalance and programmes, like, Command Area Development Programme (CADP), Hill Area Development programmes (HADP), Minimum Needs Programme adoption of advanced technologies. The plan intended to continue the rural development programmes launched during the Sixth Five Year Plan. In addition to this, some rural infrastructural development programmes like, Indira AwazYojan (IAY), Integrated Rural Energy Planning Programme (IREP), Jawahar Rozgar Yojana (JRY), and Million Wells Scheme (MWS) etc; were implemented as the special rural development programmes during the plan period. In the Eighth Five Year Plan (1992-97), generation of adequate employment opportunities, universalisation of elementary education, provision of safe drinking water and primary health care facilities, and strengthening the infrastructures etc; were the important objectives. In order to strengthen the earlier employment generation programmes the new and culmination programmes like, Intensified Jawahar Rozgar Yojana (IJRY), Employment Assurance Scheme (EAS), Operation Black Board (OBB), and District Primary Education Programme (DPEP) were introduced. The Ninth Five Year Plan (1997-2002), aimed at generating employment opportunities in the secondary sector, all-round development of agricultural sector, strengthening the rural economy through the development of agro-based industries, small-scale village and cottage industries and elimination of poverty. As against these objectives, the programmes for self- employment, and supplementary wage employment along with other programmes were intended to continue during the Ninth Plan with some modifications. These important antipoverty programmes include the IRDP, TRYSEM, JRY, IAY, IJRY, DPAP and EAS etc. The IRDP, DWCRA, TRYSEM, MWS were in operation till the end of 1998-99. It was felt that, this fragmented approach with a multiplicity of schemes was not able to focus on the needs of the rural poor in a coherent manner. Hence these schemes were amalgamated by the Government of India and merged into a single new scheme called Swamajayanthi Gram Swarojgar Yojana (SGSY). A more specific limited-purpose approach was considered to be the way out.
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Growth Oriented Strategy This is based on the philosophy that rural people,

like any other people, are rational decision makers, who, when given adequate opportunity and a proper environment, will try to maximize their incomes. The critical assumption of this strategy is that the benefits of increased production will gradually 'trickle down' to the poor. The regulation and coordination of the activities of the private and public agencies is primarily through market mechanisms. This

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paradigm formed the basis of the predominant agricultural development strategy of the 1960s, when programmes like the Intensive Agriculture District Programme (IADP),

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the Intensive Cattle Development Programme (ICDP), the High Yielding Varieties Programme (HYVP), were launched. This strategy led to 'Green Revolution' in India. But, this approach helped only the richer farmers in the rural areas, so its utility was limited andthe green revolution failed to bring any greenery to the rural poor who continued to remain pale. Target Group Strategy In this approach, a particular group is taken up for studies and plan priorities are accordingly modified. Recognizing that the small farmers/marginal farmers and landless agricultural labourer's problems are different to those of the bigger ones, separate programmes like the SFDA/MFAL were started for their development. The Antyodaya Schemes (betterment of the last in line) is a target approach. This approach produced a client-oriented design and the ultimate goal is to transfer all the responsibilities of planning and development to the clientele themselves. Area Development Strategy Under this strategy, emphasis is laid on the development of the backward regions. The area development approach presumes that the growth centres have an even geographical spread effect and that the benefits of development percolate to spread effect and that the benefits of development percolate to the lower levels over a period of time. Under this strategy, a pinpointed area is taken for development. A backward area is identified for concentrated efforts, such as Drought Prone Area Programme (DPAP), Tribal Area Development Programme (TADP), Command Area Development Programme (CADP), Hill Area Development Programme etc, which comes under this approach. This approach has three major potential dangers: 1. The schemes may concentrate a disproportionate share of the resources on providing benefits to a group that is relatively small in relation to the overall size of the national target group.

NSOU ? GE-GR-11 85 2. The schemes tend to suffer from a programme design that is too ambitious and complex, calling for exceptional leadership that cannot always be made available on a sustained basis. There may be distorted priorities in the allocation of resources among sectors. The success of this approach depends upon the removal of these three basic constraints. Spatial Planning Strategy The need for appropriately locating all the special programmes in their respective fields, the induction of production plans, the full employment schemes and the supply of basic needs of the rural population, all demand that the plan formulation and implementation strategy should be rural oriented. In the Fifth Plan, multi level planning was very much emphasized and it was argued that since more intimate, precise and detailed knowledge about physico-geographical, techno-economic, socio-political and organizational administrative conditions is available for planning activities which have strong local foci is more fruitfully undertaken at the district level, therefore, under this approach, progress was too slow, owing to a number of other factors affecting the national plan formulation . The paucity of the techniques and the weakness in conceptualizing area-level-improvement in the national context, led to the compilation of all the visualized needs as a district plan. Generally, the attempts ended up in a desegregation of the state plan allocation district-wise and department-wise. Now, block plans are advocated not as the best for rural development unless all the programmes are related to a spatial level and the projects included as a part of the block plan, a well-meaning and well synchronized rural plan of action will become difficult. The approach was to bring under close action strategies relevant to the acceleration of integrated area development around potential growth centers but the scheme was not pursued beyond the pilot stage. Spatial planning in India, is at the cross roads and the efforts made so far can at best be said to be half-hearted, sporadic and often self-defeating. Integrated or Holistic Strategy It has been realized that development should be an integrated one. This is possible when "sectoral development programmes, human resources development programmes, social welfare schemes and infrastructural development programmes" are brought within the framework of a prospective plan for implementation, where each programme reinforces the other through linkages. Integrated

79%	MATCHING BLOCK 42/223	SA	Chapter - Vi first draft Rural Development Pro ... (D40434799)

Strategy combines all the positive features of the earlier strategies, and is designed to simultaneously achieve the goals of growth, welfare, equity, and community participation. This paradigm takes a very comprehensive but integrated view of the basic problems of poverty, unemployment and inequality, and seeks to address 86 NSOU ? GE-GR-11 the physical, economic, technological, social, motivational, organizational and political bases of these problems. The multiple goals of this strategy are sought to be achieved by building the capacity of the community to involve itself in development in partnership with the government. The anti-poverty programmes launched in India in the 1970s, particularly the IRD programme, National Rural Employment Progrmme and Training of Rural Youth for Self-Employment were intended to follow this paradigm. It has been rightly observed by John.P.Lewis: "A serviceable rural development programme in India must deal with the several aspects of the rural economy in an integrated fashion. An isolated agricultural development effort unrelated and unsupported by other kinds of rural policies would be doomed to failure almost surely" 34. On account of IRD programmes, the number of persons living below the poverty line has been considerably reduced; still, however, much remains to be done for these poverty-stricken people. Participatory Strategy During the last two decades several new approaches like 'top-down planning', 'planning from below', 'bottom up planning', 'micro level planning', and 'multi-level planning' have been thought of in the context of involving the people in every phase of development. In the current plan (Xth Five Year Plan), the government has devised participatory strategy to promote rural development. Provision has been made to expand economic and social opportunity for individuals and groups by encouraging greater participation in decision making. Right now we have the 'Swamajayanthi Gram Swarozgar Yojana', which has replaced the earlier programmes like IRDP, TRYSEM, etc. It is a single self-employment programme for the rural poor. The various programmes and strategies that have been examined by the experts confirm that no single package or formula is sufficient for effective rural development. Mere extension of approaches and strategies which are far from reality would not serve the purpose and a major re-thinking is required to develop rural India. The entire strategy calls for adaptation, modification, and experimentation, depending upon the exigencies of the situation in our country. 6.3 ????? Drought Prone Area Programme Inadequate and erratic rainfall was the main cause of drought and, therefore, the Drought Prone Areas were delineated on the basis of rainfall data and percentage of irrigated area to the net cropped area. The recurrence of drought had adverse effects on national resources resulting in degradation of environment. In view of this, the erstwhile NSOU ? GE-GR-11 87 Rural Works Programme of 1971-72 was re-designated as the DPAP during the Fourth Five Year Plan (1969-74). It was launched in 1973-74 with 50 percent central allocation. At the instance of Planning commission, the Programme Evaluation Organisation undertook the study to examine the extent of drought proofing achieved, the adoption of micro- watershed approach and the existing arrangements for monitoring and evaluation of the programme. The Drought Prone Areas Programme (DPAP) and the Desert Development Programme (DDP) have been designed to restore ecological balance through soil and moisture conservation on watershed basis within the framework of area development plans. In practice, however, these Programmes have been implemented in a fragmented manner by different departments through rigid guidelines without any well-designed plans prepared on watershed basis by involving the inhabitants'. Except in a few places, in most of the Programme areas the achievements have been dismal. Ecological degradation has been proceeding unabated in these areas with reduced forest cover, receding water table and shortage of drinking water, fodder and fuel-wood. Clearly, these Programmes have failed to neutralise the adverse impact of the overall processes of degradation on account of increased pressures on the fragile eco-systems from growing population, poverty and affluence. Inadequate attention to the development of infrastructure for generating income- earning opportunities by using indigenous resources and skills and the heavy subsidization of electricity resulting in pumping of water at a rate higher than the rate of recharge have also contributed significantly to the degradation of environment. Substantial areas of our country periodically experience droughts leading to considerable loss of agricultural production and livestock wealth, besides causing misery to people inhabiting these areas. Large sums have been spent by the Government for providing relief after the occurrence of droughts. But, such expenditure has not helped solve the basic problem of increasing the productivity of these areas by conserving soil and moisture and thereby reducing the impact of the severity of the droughts to the human and cattle population. Ecological degradation on account of denudation of forests and excessive grazing has resulted in soil erosion and decline in the productivity of the land. Because of the increase in population, both human and cattle, even the marginal lands unsuitable for cultivation have been brought under the plough. Mitigation of distress caused by droughts were mainly restricted to adhoc relief works to create employment for increasing the purchasing power of the people which provided some immediate relief. Systematic efforts at long-term ameliorative measures to tackle these problems of drought started only after planning for economic development was launched in the country.

88 NSOU ? GE-GR-11 The first step towards a systematic effort to tackle the problem of drought and desertification was the establishment of a Research Centre at Jodhpur in 1952 to carry out research on certain core needs of desert areas such as sand-dune stabilisation, shelter-belt plantation, afforestation etc. In 1959, the entire responsibility for Research on arid areas was entrusted to the Centre which was then designated as Central Arid Zone Research Institute(CAZRI). During the Second and Third Five Year Plans, the problem of drought- affected areas was mainly sought to be solved by launching Dry Farming Projects, which spread over a few areas with emphasis on moisture and water conservation measures.The origin of the Drought Prone Areas Programme can be traced to the Rural Works Programme launched in 1970-71 with the object of creating assets designed to reduce the severity of drought in affected areas. The Programme spelt out long-term strategy in the context of the conditions and potentials of the drought prone districts. In all, 54 districts in the country together with parts of another 18 districts contiguous to them were identified as drought- prone for purposes of the Programme. The Programme covered 12% of the country's population and nearly ope-fifth of the area in the country. Labour-intensive schemes such as medium and minor irrigation, road construction, soil conservation and afforestation were taken up under this Programme. The Mid-Term Appraisal of the Fourth Plan redesignated the Programme as the Drought Prone Areas Programme. The first step towards a systematic effort to tackle the problem of drought and desertification was the establishment of a Research Centre at Jodhpur in 1952 to carry out research on certain core needs of desert areas such as sand-dune stabilisation, shelter-belt plantation, afforestation etc. In 1959, the entire responsibility for Research on arid areas was entrusted to the Centre which was then designated as Central Arid Zone Research Institute(CAZRI). During the Second and Third Five Year Plans, the problem of drought- affected areas was mainly sought to be solved by launching Dry Farming Projects, which spread over a few areas with emphasis on moisture and water conservation measures. The origin of the Drought Prone Areas Programme can be traced to the Rural Works Programme launched in 1970-71 with the object of creating assets designed to reduce the severity of drought in affected areas. The Programme spelt out long-term strategy in the context of the conditions and potentials of the drought prone districts. In all, 54 districts in the country together with parts of another 18 districts contiguous to them were identified as drought-prone for purposes of the Programme. The Programme covered 12% of the country's population and nearly one-fifth of the area in the country. Labour-intensive schemes such as medium and minor irrigation, road construction, soil conservation and afforestation were taken up under this Programme. The Mid-Term Appraisal of the Fourth Plan

NSOU ? GE-GR-11 89 redesignated the Programme as the Drought Prone Areas Programme. Instead of beneficiary-oriented schemes, the Task Force recommended the provision of subsidy on predominantly area development schemes irrespective of the size of the holding and for schemes involving community participation such as farm forestry, water harvesting etc. The Task Force, however, suggested a general rate of subsidy, the larger holdings getting somewhat less than the smaller ones. For income generating schemes such as minor irrigation and land development, the Task Force recommended assistance to be limited to small and marginal farmers. Inter-sectoral priorities were also laid down. The main thrust of the Programmes in the successive Plans continued to be income generating and infrastructure oriented schemes and the scope of the activities taken up under the Programmes became sufficiently wide to cover expenditures on staff and establishment, feed mixing plants, liquid nitrogen plants, veterinary hospitals and dispensaries, construction of road for transportation of milk, cross-breeding programmes, establishment of livestock and poultry farms', silk rearing units, ground water survey, purchase of rigs etc. In the process, it was observed that the Programmes deviated considerably from the avowed objective of ecologically integrated development of drought-prone and desert areas through drought-proofing and control of desertification. The area treated under DPAP so far comes to about 5 million hectares which constitutes only about 10% of the geographical area of the blocks selected for DPAP. The area treated under DDP comes to only about 0.4 million hectares 'which accounts for only about 1 percent of the total area in the blocks selected for DDP. Although it would be necessary to cover only a part of the area in the selected blocks for treatment under the Programmes, it is reasonable to conclude that a very large part of the eligible area still remains uncovered by the Programmes. It becomes obvious then that with such a small coverage, one cannot expect to make a real dent in the development of drought prone and desert areas.Since the activities under DPAP /DDP are not spread over the entire length and breadth of the problem areas, but are restricted to identified smaller areas, it would be logical to expect the impact of these programmes only over such limited areas. Despite the fact that the Drought Prone Areas Programme and the Desert Development Programme have been in operation for almost two decades, it has been observed that the Programmes have not made a substantial impact. On the other hand, it is widely believed that drought conditions in the country are increasing and ecological degradation is proceeding unabated especially in drought prone and desert areas. The main reasons for this degradation have been large scale denudation of forest cover leaving the land vulnerable to soil and

90 NSOU ? GE-GR-11 water erosion. In Rajasthan, 18 drought years of different magnitudes have been observed in the past 32 years. Another study in Rajasthan reveals that, on an average, as much as 40.4% of precipitation or rain water goes untapped, and only 6.9% is used for recharging the ground water. In some districts of Tamil Nadu, water table is reportedly going down by 1 ft. every year. It has been reported to us that in the dark blocks in Uttar Pradesh where more than 75% of groundwater has been exploited and where rainfall level is 700 mm, as much as 50-70% run-off from rainfall is wasted. Despite the fact that nearly 2,000 crores of rupees have been spent on these programmes since their inception and despite the recommendations of the Central Sanctioning Committee to commission evaluation studies from reputed non-official institutions, no such evaluation has been undertaken at the micro-level. Therefore, the Committee had to depend basically on field visits and discussions with the beneficiaries and officials at the field level for evaluating the performance of these programmes. As per guidelines of DPAP and DDP, micro-watershed should be the management unit and in each selected block the micro- watersheds may be classified into high, medium and low priority areas according to their vulnerability to droughts. The highly vulnerable areas should be taken up for development on a priority basis. However, in actual practice, due to lack of adequate data and to pressures from vested interests, selection and finalisation of watersheds for development gets considerably delayed. There is no appropriate multi-disciplinary agency at the district, block and the watershed level to prepare integrated plans which could be taken up for implementation. Most of the schemes taken up are of adhoc nature and without due consideration of cost-benefit ratios. Essential data which are crucial for watershed planning are rarely available with the planners at the district and block levels. Perspective planning for micro-watersheds is seldom done and the plans are mainly prepared on annual basis. Also, the annual plan is prepared on the presumption that rainfall will not exceed the average rainfall of the area. Whenever there is a good rainfall, the administration is caught unprepared and finds itself unable to make use of the excess water available in the area. The excess of rain water runs off causing considerable soil erosion. In the absence of perspective planning, the outlays on drought relief are also not spent wisely on the construction of assets required for mitigation of drought. For integrated development, it is necessary to dovetail other central and state schemes in each selected watershed. Pooling of funds and implementation of the Programmes planned for the area through a single multi-disciplinary agency has not been observed at many places. Various developmental programmes are taken up by Departments/Agencies in drought/desert areas which may even run counter to the objective of drought proofing NSOU ? GE-GR-11 91 or control of desertification. Thus, while some programmes may stress restoration of ecological balance, others such as promotion of tourism, industrialisation of the area etc. may cause influx of population. Against the background of the foregoing discussions, the Committee is of the view that determined efforts and concrete steps are required to promote voluntarism in evolving and implementing DPAP and DDP. Initiatives are needed to catalyse promotional efforts towards this end by the State Level Committee. This would mean not only the involvement of the existing voluntary organisations who are genuine and competent, but creating conditions, through favourable policy and bureaucratic receptivity, for the proliferation of local groups consisting of motivated and dedicated people for undertaking such responsibilities. Hence, it would be desirable to move towards the goal of entrusting ultimately 25 per cent of watersheds to the voluntary organisations for the implementation of DPAP and DDP programmes. Keeping this objective in view, the Committee makes the following specific recommendations for facilitating effective people's participation through Voluntary Organisations in the implementation of these programmes: - i) The State Governments concerned may constitute State Level Committees for the Promotion of Voluntary Action for DPAP and DDP. The Chief Minister of the State may Chair the Committee which may consist predominantly of representatives of established Voluntary Organisations composed of senior officers of the Government Departments concerned. ii) The State Government concerned may give adequate publicity to DPAP and DDP and invite applications district-wise from Voluntary Organisations for taking up these programmes. iii) Secretary of the Department of Rural Development may be the Member- Convener of the State Level Committee. iv) The State Level Committee may from time to time approve the list of Voluntary Organisations which can be entrusted with the DPAP and DDP. The Committee may lay down the general guidelines for the functioning of Voluntary Organisations and also evolve appropriate policy measures for promoting voluntary action. v) Wherever reputed Voluntary Organisations are forthcoming, implementation of 25 per cent of the DPAP /DDP watersheds in a district may be entrusted to them. A Committee at the district level under the Chairmanship of the District Collector consisting mainly of representatives of Voluntary Organisations may be constituted for the purpose.

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92 NSOU ? GE-GR-11 vi) The District Level Committee shall encourage Voluntary Organisations to take up implementation of the programmes. vii) The District Level Committee may approve the project proposals including the financial outlays of Voluntary Organisations for implementing the programmes. The project proposals may either be for awareness-raising/training the people and local functionaries for evolving and implementing the programmes or for the whole process of formulation and implementation of watershed-based plans involving the local people, especially the beneficiaries. viii) Based on the decisions/ recommendations of the District Level Committee, funds for implementing the programmes will be released to the Voluntary Organisations directly by the State Government/ Zilla Parishad/DRDA, as the case may be. This arrangement could be formalised in the form of a Memorandum of Understanding broadly on the pattern being implemented by the Department of Agriculture & Cooperation in respect of Centrally Sponsored Scheme of National Watershed Development Programme for Rainfed Areas (NWDPRA). ix) The Voluntary Organisations entrusted with the implementation of the project will be fully responsible for its completion in terms of the project proposals and shall submit audited accounts annually to the prescribed authorities. The VOs may be permitted up to 10 per cent of the project cost to man their staff. x) For effective mobilisation of local people's participation in the programmes, the Voluntary Organisations shall constitute Watershed Development Teams for the implementation of the programme and shall share the accounts for the grants given for watershed development with the General Body. xi) The functionaries of the line Departments of the Governments may extend their full cooperation, especially in providing the necessary technical guidance in the preparation and implementation of the programmes. xii) The assets and benefits accruing from the programmes shall vest entirely with the beneficiaries/local communities which will be responsible for the proper maintenance of the assets created including plantations etc. xiii) The District Level Committee may periodically monitor the functioning of the Voluntary Organisations in the implementation of the programmes and take appropriate action in order to ensure that the programmes are implemented in terms of the approved project proposal.
NSOU ? GE-GR-11 93 6.4 ?????

98%	MATCHING BLOCK 43/223	SA	Commerce Conference 202. Rural Development Adr ... (D16863539)

Pradhan Mantri Gram Sadak Yojana The Pradhan Mantri Gram Sadak Yojana (PMGSY) is a nationwide plan in India to provide good all-weather road connectivity to

its unconnected villages. 178,000 (1.7 lakh) habitations with a population of above 500 in the plains and above 250 in the hilly areas one planned to be connected by all-weather roads, 82% were already connected by December 2017 and work-in-progress on the remaining 47,000 habitations was on-track for completion by March 2019 (c. December 2017). This Centrally Sponsored Scheme was introduced in 2000 by the then-prime minister of India Late Shri Atal Bihari Vajpayee The Assam Tribune has reported that the scheme has started to change the lifestyle of many villagers as it has resulted in new roads and upgrade of certain inter-village routes in Manipur.

100%	MATCHING BLOCK 44/223	SA	parveen walia thesis.pdf (D40589667)

Rural Road Connectivity is not only a key component of Rural Development by promoting access to economic and social services and thereby generating increased agricultural incomes and productive employment opportunities in India, it is also as a result, a key ingredient in ensuring sustainable poverty reduction. Notwithstanding the efforts made, over the years, at the State and Central levels, through different Programmes, many Habitations in the country are still not connected by All-weather roads. It is well known that even where connectivity has been provided, the roads constructed are of such quality (due to poor construction or maintenance) that they cannot always be categorised as All- weather roads. With a view to redressing the situation, Government had launched the Pradhan Mantri Gram Sadak Yojana on 25th December, 2000 to provide all-weather access to eligible unconnected habitations. The Pradhan Mantri Gram Sadak Yojana (PMGSY) is a 100% Centrally Sponsored Scheme. ' 6.4.1.

Programme Objectives

100%	MATCHING BLOCK 45/223	SA	parveen walia thesis.pdf (D40589667)

The primary objective of the PMGSY is to provide Connectivity, by way of an All- weather Road (with necessary culverts and cross-drainage structures, which is operable throughout the year), to the eligible unconnected Habitations in the rural areas with a population of 500 persons and above in Plain areas. In respect of the Hill States (North- East, Sikkim, Himachal Pradesh, Jammu & Kashmir and Uttarakhand), the Desert Areas (as identified in the Desert Development Programme), the Tribal (Schedule V) areas and Selected Tribal and Backward Districts (as identified by the Ministry of Home Affairs and Planning Commission) the objective would be to connect eligible unconnected Habitations with a population of 250 persons and above. 94

NSOU ? GE-GR-11 The PMGSY will permit the upgradation (
to prescribed standards) of the existing roads in those districts where all the
eligible

92%	MATCHING BLOCK 46/223	J	

habitations of the designated population size have been provided all-weather road connectivity. However, it must be noted that upgradation is not central to the Programme.

In upgradation works, priority should be given to roads which carry more traffic.

98%	MATCHING BLOCK 47/223	SA	parveen walia thesis.pdf (D40589667)

The spirit and the objective of the Pradhan Mantri Gram Sadak Yojana (PMGSY) is to provide good all-weather road connectivity to the eligible unconnected habitations. A habitation which was earlier provided all-weather connectivity would not be eligible even if the present condition of the road is bad. The unit for this Programme is a habitation and not a Revenue Village or a Panchayat. A Habitation is a cluster of population, living in an area, the location of which does not change over time. Desam, Dhanis, Tolas, Majras, Hamlets etc. are commonly used terminology to describe the Habitations. An Unconnected Habitation is one with a population of designated size located at a distance of at least 500 metre or more (1.5 km of path distance in case of Hills) from an All-weather road or a connected Habitation. In the blocks bordering international boundary in the hill States (as identified by the Ministry of Home Affairs), however, all habitations within a path distance of 10 km may be treated as a cluster for this purpose.

The population, as recorded in the Census 2001, shall be the basis for determining the population size of the habitation. The population of all Habitations within a radius of 500 metre (1.5 km of path distance in case of Hills) may be clubbed together for the purpose of determining the population size.

100%	MATCHING BLOCK 50/223	SA	parveen walia thesis.pdf (D40589667)

In the blocks bordering international boundary in the hill States (as identified by the Ministry of Home Affairs), however, all habitations within a path distance of 10 km may be treated as a cluster for this purpose.

The eligible
Unconnected Habitations are to be connected to nearby Habitations already connected by an All-weather road or to another existing All-weather road so that services (educational, health, marketing facilities etc.), which are not available in the unconnected habitation, become available to the residents.

100%	MATCHING BLOCK 48/223	J

The PMGSY shall cover only the rural areas. Urban roads are excluded from the purview of this Programme. Even in the rural areas, PMGSY covers only the Rural Roads i.e., Roads that were formerly classified as 'Other District Roads' (

ODR) and 'Village Roads' (VR).

91%	MATCHING BLOCK 49/223	J

Other District Roads (ODR) are roads serving rural areas of production and providing them with outlet to market centres, taluka (tehsil) headquarters, Block headquarters or other main roads. Village Roads (VR) are roads connecting villages / Habitation or groups of Habitations with each other and to the nearest road of a higher category. Major District Roads, State Highways and National Highways cannot be covered under the PMGSY, even if

proper planning is imperative to
NSOU ? GE-GR-11 95 achieve the objectives of the Programme in a systematic and cost-effective manner. The Manual for the Preparation of District Rural Roads Plan and the Core Network, shall be treated as part of the Guidelines and would stand amended to the extent modified by the present Guidelines. The Manual lays down the various steps in the planning process and the role of different Agencies including the Intermediate Panchayat, the District Panchayat as well as the State Level Standing Committee. In the identification of the Core Network, the Pradhan Mantri Gram Sadak Yojana priorities of elected representatives, including MPs and MLAs, are expected to be duly taken into account and given full consideration.

100%	MATCHING BLOCK 51/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

The Rural Roads Plan and the Core Network would constitute the basis for all planning exercises under the PMGSY. 4.2 The

District Rural Roads Plan would indicate the entire existing road network system in the District and also clearly identify the proposed roads for providing connectivity to eligible Unconnected Habitations, in an economic and efficient manner in terms of cost and utility. The Core Network will identify the roads required to assure each eligible Habitation with a Basic Access (single all-weather road connectivity) to essential social and economic services. Accordingly, the Core Network would consist of some of the existing roads as well as all the roads proposed for new construction under the PMGSY. 4.3 In proposing the new links under the District Rural Roads Plan, it would be first necessary to indicate the weightage for various services. The District 6 Panchayat shall be the competent authority to select the set of socio-economic / infrastructure variables best suited for the District, categorises them and accord relative weightages to them. This would be communicated to all concerned before commencing the preparation of the District Rural Roads Plan. Key Words : Rural Development, Economic Development, Lewis Model, Big push theory, Mydral's Model, Gandhian approach to rural development, Rural economic base, Agriculture, Non- firm sector, Rural Cooperatives, Agricultural Marketing, Area specific rural development, Approaches to rural development, Draught Prone Area Programmes, Pradhan Mantri Gram Sadak Yojona (PMGSY). 6.5 ????? Questions 1. What do you understand by Area Based Approach to Rural Development? 2. Identify the highlights of Drought Prone Area Programme. 3. What are the major components of Pradhan Mantri Gram Sadak Yojana?
96 NSOU ? GE-GR-11 6.6 ????? Suggested Readings 1.

65%	MATCHING BLOCK 52/223	SA	Abhishek Mitra.pdf (D135026886)

Singh Katar, "Rural Development Principles, Practice and Management" Sage Publications, New Delhi,(1998), pp.21-22 2. Report of "The

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Royal Commission on Agriculture", Government of India, New Delhi, (1928). 3. Government of India, "The Planning Commission's Task Force on Integrated Rural Development", Government of

79%	MATCHING BLOCK 53/223	SA	parveen walia thesis.pdf (D40589667)

India, New Delhi, (1972). 4. Deb.K, 'Rural Development in India since Independence", Sterling Publishers Pvt. Ltd; New Delhi, (1986). 5.

Report of, "Rural Development Sector Policy Paper of World Bank", February, Washington, (1975). 6. Dhingra I.C, "Rural Economics", Sultan Chand and Sons Publishers, New Delhi, (1988). 7. "Training Strategies for Integrated Rural Development", Asian and Pacific Development Administration Centre, Kaulalampur, Malaysia, (1977), pp.14-15. 8. Lipton Michael, "Why poor people stay poor? - A Study of Urban Bias in World Development", Heritage Publishers, New Delhi, (1982). 9. Rao.V.M. "Barriers in Rural Development, Economic and Political Weekly, Vol.XVIII, 2 July (1983). 10. Satya Sundaram I., "Rural Development", Himalaya Publishing House, New Delhi, (2002). 11. Jain Gopal Lai, "Rural Development", Mangal Deep Publications, Jaipur (1997). 12. Goswami U.P. and Roy S.C, "Approaches to Community Development: A Symposium Introductory to Problems and Methods of Village Welfare in Underdeveloped Areas", W.Van Hove Ltd., The Hauge (1953), p.21.
NSOU ? GE-GR-11 97 MODULE–2 : Learning Objectives : The Learners will learn the following topics from this Module : i) The concept and programmes of target groups. ii) The physical and socio-economic access and services. iii) The elementary education, health, micro-credits. iv) The concept of Panchayati raj system as rural governance. v) The rural development policies and programmes in India. vi) The concept of rural infrastructural development like electrification, housing, transport, etc. vii) Some special rural development programmes for women and children.
98 NSOU ? GE-GR-11 Unit 7 ????? Target Group Approach To Rural Development Structure 7.1 Target Group Approach to Rural Development 7.2 Approaches to Rural Development since Independence 7.3 Types of Target Groups 7.4 Swarnjayanti Gram Swarozgar Yojana 7.4.1 Objectives 7.4.2 Main Features 7.5 Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) 7.5.1 Objectives 7.5.2 Main Features 7.6 Pradhan Mantri Jan Dhan Yojana 7.6.1 Objectives 7.6.2 Main Features 7.1 ????? Target Group Approach to Rural Development As per the Census 2011 68.84 per cent people live in rural areas in India. Vast majority of India's poorest people are located in rural areas. The basic problems faced by rural India arerapid growth of population, rising unemployment and underemployment, low per capita resource availability, widespread poverty, growing inequality. All these result in stagnation and decay of economic and social life in rural areas. Most social and economic indicators consistently show gross disparity between urban and rural sectors of the country. It is at the rural level that problems of hunger, ignorance, ill health and high mortality are more acute. Therefore, if development is to take place and become self-sustaining, it will have to be rooted in and started from the rural areas.

56%	MATCHING BLOCK 54/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

Development of rural areas has been at the core of the planning process in the country. The term 'rural development' is a

subset of a broader term 'development'. Rural development is a broad and inclusive term, which connotes overall development of rural
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100%	MATCHING BLOCK 55/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

areas with a view to improve the quality of life of rural people.

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83%	MATCHING BLOCK 56/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

The basic objectives of rural development programme have been alleviation of poverty and unemployment through creating basic social and economic infrastructure, training to rural unemployed youth and

to provide employment to marginal farmers/labourers, so as

90%	MATCHING BLOCK 57/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

to discourage seasonal and permanent migration to urban areas. Rural development

also includes strengthening the democratic fabric of society through local level governments/ institutions, improvement of

83%	MATCHING BLOCK 58/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

rural infrastructure, income of rural households and service systems pertaining to education,

health and safety net mechanisms. However, Poverty alleviation has a key component of rural development in India. 7.2 ????? Approaches to Rural Development since Independence Since 1951 till today, various approaches have been adopted by the Government of India to find a suitable strategy towards the achievement of rural prosperity, equality and employment generation for rural people. The approaches are mentioned below. 1. Multi-purpose Approach: In early fifties, rural development efforts began with multi-purpose approach which included activities related to agriculture, animal husbandry, co-operation, irrigation, village and small scale industries, health, sanitation, housing, transport and communication, welfare of women, andrural employment. The Community Development Programmes (CDP) and the National Extension Service (NES) initiated in 1952 fell under this approach. Though the CDP, as a holistic approach, did not succeed asexpected. The impact of programme was ephemeral. It was said that the community development programme has been like film of butter spreadover a large loaf, thus provide ineffective in a complex society. Hence, itcould not make a dent into social fabric as was expected. The critics also point out that; i) It brought about a great disparity between the rich and the poor, ii) It hardly touched the problem of meeting the felt needs of the people, iii) It failed to bring about the process of modernization through socialeducation, and iv) Lack of people's participation. In spite of the criticisms leveled against CDP and NES, the fact cannot be denied that the programme added a new dimension to the process of change and generated

100 NSOU ? GE-GR-11 community consciousness to solve community problems. The multi-purpose approach was a significant approach, which laid the foundation stone for the upliftment of rural India. 2. Sectoral Approach to Rural Development: By 1960's the situation was rather critical on the food front. Theneed for great concentration on food production led to strategy for locating potential sectors and well-endowed districts and areas capable of yielding higher agricultural production. More attention was paid in improving productivity per acre than on extending the acreage. Thus, in 1960 the Intensive Agriculture Development Programme (IADP) and later in 1963 Intensive Agricultural Area Programme (IAAP) were launched. Both IADP and IAAP constituted landmarks not only in the development of agriculture, but also in the development of the rural sector in India. The programmes placed agriculture on a qualitatively different footing with wide ranging impacts on rural scenario. 3. Target Group Approach:In order to accommodate the lagging sectors/regions rural development was re-conceptualised to highlight the improvement of the social and economic life of a specialised group of people. The target group comprised of marginal and small farmers, landless agricultural labourers for whom special programmes, such as the Small Farmers Development Agencyand the Marginal Farmers and Agricultural Laborers Development Agency were started in 1969. It was noticed that the target group approach showed a better results where information facilities were satisfactory and administrative and organisational arrangements were reasonably strong. 4. Area Development Approach: Area development approach was for correction of regional imbalance. In this connection, mention may be made about the Tribal Area Development Programme (1972), the Hill Area Development Programme (1974-75), the Drought Prone Area Programme (1970), the Desert Development Programme (1977- 78), and the Command Area Development Programme (1975). These programmes were fairly successful in terms of implementation. 5. Basic Needs Approach: The basic needs approach gives primacy to the need for a minimum standard of living of the poor as a central concern of development planning. It contributes to the formulation of a development strategy, which aims at reducing poverty and inequality, promoting growth of employment and distributive justice. The basic needs concept is a wider scope covering personal and social consumption and also human rights, people's participation, employment and growth with justice. The Minimum Needs

NSOU ? GE-GR-11 101 Programme (MNP) in India was introduced in1972 during the first year of fifth plan period with the objectives of establishing network of basic services and facilities of social consumption in all areas of upto nationally acceptednorms within in a specified time frame. 6. Employment-oriented Integrated Approach to Rural Development: With a view to overcome the limitations of earlier approaches and to improve the quality of life of the poor living in the rural areas, a multi-level,multi-sector and multi-section concept of integrated rural development was launched in 1978-79. Different programmes were brought under single umbrella of the Integrated Rural Development Programme (IRDP). It aimed at ensuring accelerated welfare and development of the poorest of the poor based on the Gandhian concept of Antyodaya. Several programmes for providing employment to rural poor,namely, the Rural Works Programme (1970-71), the Rural Landless Employment Guarantee Programme (1983),

76%	MATCHING BLOCK 60/223	SA	Literature Review.docx (D149220814)

the Training Rural Youth for Self-employment (1979), the Development of Women and Children in Rural Areas (1982) and the Jawahar Rozgar Yojana (1989)

were introduced. The Target Group Approach The selection of target groups for extension programmes often results in a highly emotional debate. Selection is generally determined by government policy, although government policy does not always represent the attitudes and philosophies of all individuals in society. Selection of target groups may precipitate debates which range from ideological/ philosophical posturings to pragmatic assessments of a nation's capability of providing extension services dictated by a particular philosophy. Extension services represent a large investment with returns occurring over the long-term. Rarely are returns immediate in nature. Budgetary resources may not permit the level of investment which a sense of moral obligation to strive for social justice may require. Target groups can be identified and categorised in several ways. In many countries policy debates are common on whether to carry out extension with the purpose of maintaining low consumer prices, or helping rural producers to achieve higher standards of living through higher prices for their commodities. A second policy issue revolves around emphasis on private producers or cooperatives. Often the argument is phrased as a decision to work primarily with large or small scale farmers. This decision is closely related to national philosophies on economic development strategies.

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102 NSOU ? GE-GR-11 7.3 ????? Types of Target Groups 1. Private Producers- Some countries identify private producers as the targets for extension activities. Private producers are farmers who work for themselves, receive benefits from their management and control of the aquaculture enterprise, and assume the consequences of any wrong decision. Private producers can be small-scale farmers working individually, or large-scale commercialised farmers. The common denominators are the private ownership and management control of the farm. Private producers have strong incentives to adopt those technologies which will benefit them the most, and from which a tangible reward can be obtained for their efforts. 2. Cooperatives- Many development efforts of international assistance agencies have been oriented towards cooperative groups. In this approach individuals are not favoured with special privileges, and extension resources are used efficiently by working with a group of people rather than one person at a time. Socio-economic homogeneity, and socially esteemed and influential leaders (but not rich) are factors which contribute to the success of group projects. 3. Subsistence Producers- A common debate in development philosophy related to extension is whether to work directly with the poorest people, or to work with wealthier farmers and hope that the technology 'trickles down' to lower economic strata. In societies which are highly stratified in economic and social terms, choosing to work only with the wealthier class prevents the technology from reaching the poorer strata. In practice the "trickle down" theory rarely works. In 1979 the World Conference on Agrarian Reform and Rural Development declared that "... most development efforts have not yet succeeded in satisfying the aspirations of peoples and their basic requirements consistent with principles of human dignity and international social justice and solidarity, especially in the rural areas of developing countries. Rural development strategies can realise their full potential only through the motivations, active involvement, and organization at the grass-roots level of rural people, with special emphasis on the least advantaged." Efforts directed towards the 'poorest of the poor' meet with enormous obstacles. Many of the world's farmers are landless or tenants. Poverty itself indicates a very low level of resources to work with to provide both food and income for the family. In India post-independence rural development initiatives essentially and effectively considered the rural poor as target group for various socio-economic development.
NSOU ? GE-GR-11 103 Efforts were made to promote the target groups sometimes by paving ways for supplementary income generation, sometimes by facilitating self-employment, sometimes by assuring a minimum number of days of guaranteed employment, sometimes by a compulsory financial inclusion method or something else. Three of the major projects having the target group approach have been discussed in the following part. 7.4 ?????

95%	MATCHING BLOCK 59/223	J

Swarnjayanti Gram Swarozgar Yojana The Swarnjayanti Gram Swarozgar Yojana (SGSY) is a

major programme for the self- employment of rural poor. It started on 01.04.1999 after restructuring the erstwhile

85%	MATCHING BLOCK 61/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

Integrated Rural Development Programme (IRDP) and its allied programmes, namely Training of Rural Youth for Self Employment (TRYSEM), Development of Women and Children in Rural Areas (DWCRA),

Supply of
Toolkits in Rural Areas (
SITRA)
and Ganga Kalyan Yojana (GKY),
besides Million Wells Scheme (MWS).
The

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100%	MATCHING BLOCK 62/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

SGSY is being implemented by the District Rural Development Agencies (DRDAs), with the active involvement of Panchayati Raj Institutions (PRIs), the Banks, the Line Departments and the Non-government Organizations (NGOs).

The SGSY was renamed as National Rural Livelihood Mission in 2011. Finally in 2015 the National Urban Livelihood Mission and National Rural Livelihood Mission and the new scheme was named as the Deen Dayal Upadhyaya Antyodaya Yojana. Since the inception of the programme 22.52 lakh self-help groups (SHGs) have been formed covering 66.97 lakh swarozgaris. These include 35.54 lakhs members of the SHGs and 31.43 lakh individual swarozgaris who have been assisted with a total investment of Rs.14403.73 crore. Out of total Swarozgaris assisted, SCs/STs were 45.54 per cent and women 47.85 per cent. 7.4.1 Objectives

78%	MATCHING BLOCK 63/223	SA	CHAP-1.pdf (D110896322)

The basic objective of the SGSY is to bring the assisted poor families (Swarozgaris) above the Poverty Line by ensuring appreciable increase in income over a period of time. This

would be done

90%	MATCHING BLOCK 64/223	SA	Abhishek Mitra.pdf (D135026886)

by providing them income-generating assets through a mix of bank credit and governmental subsidy. It covers all aspects of self-employment of rural poor,

including organisation of rural poor into Self-help Groups (
SHG), capacity building of
the Group through financial assistance, training, selection of key activities, infrastructure build up, technology and marketing support.

91%	MATCHING BLOCK 65/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

The SGSY emphasises assistance to the Swarozgaris for those activities which have been identified and selected as key activities in terms of their economic viability in the area. Each block

may select about 10 key activities but focus
104 NSOU ? GE-GR-11 should be

100%	MATCHING BLOCK 66/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

on 4-5 key activities based on local resources, occupational skills of the people and availability of markets so that the Swarozgaris can draw sustainable incomes from their investments. The

programme
aims

77%	MATCHING BLOCK 67/223	SA	CHAP-1.pdf (D110896322)

at establishing a large number of micro enterprises in rural areas based on the ability of the poor

and potential of each area. 7.4.2

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Main Features 1. Emphasis is on social mobilisation of rural poor to enable them to organise into Self-help Groups. 2. SGSY is a credit-cum-subsidy scheme where credit is critical component and subsidy is only an enabling element which is linked with credit. 3. Participatory approach in selection of key activities and project approach for each key activity have to be adopted. 4. Emphasis on development of activity clusters to ensure proper forward and backward linkages. 5. Strengthening of groups through Revolving Fund Assistance (RFA) is practised. Active role of non-governmental organisations (NGO) in formation and capacity building of SHGs is appreciated. 6. There is provision of

71%	MATCHING BLOCK 68/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

training of beneficiaries in group dynamics and skill development for taking up micro enterprises. 7. Marketing support with emphasis on market research, upgradation/ diversification of products, packaging, creation of market facilities,

etc. is provided. 8. There is provision for development of infrastructure to provide missing critical link and 20% fund (in case of NE State 25%) is earmarked for infrastructure development. 9. Focus is on vulnerable groups i.e. SC, ST, women, minorities and disabled persons. 10. 15% fund is earmarked for Special Projects

93%	MATCHING BLOCK 69/223	SA	BDO Chapter I.doc (D19274323)

to ensure a time-bound programme for bringing a specific number of Below Poverty Line (BPL) families above the poverty line through self-employment

generation. 11.

86%	MATCHING BLOCK 72/223	SA	Reyaz Ahmad Pandit, final complete thesis.pdf (D31212673)

Funds under SGSY are shared between the Centre and the States in the ratio of 75:25. The

ratio of sharing of funds between the Centre and the North Eastern States including Sikkim is 90:10.
NSOU ? GE-GR-11 105 7.5 ?????

100%	MATCHING BLOCK 70/223	W

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) The National Rural Employment Guarantee Act, 2005 (

NREGA),
notified on September 7, 2005 and later renamed as the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in 2009, is an Indian labour law and social security measure that aims to guarantee the 'right to work'.The Ministry of Rural Development (MRD), Government of India, in association with state governments, is in charge of monitoring the entire implementation of this scheme.In its World Development Report 2014, the World Bank termed it a 'stellar example of rural development'.In 2018-19 financial year total number of job-cards issued under the MGNREGA was 1323.77 lakh and total number of workers were 2679.27 lakh and person-days generated was 268.01 crore. Productive absorption of underemployed and surplus labour-force in the rural sector has been a major focus of planning for rural development.

96%	MATCHING BLOCK 71/223	J

In order to provide direct supplementary wage-employment to rural poor through public works

a large number of programmes were introduced by the Government of India.

90%	MATCHING BLOCK 75/223	SA	Reyaz Ahmad Pandit, final complete thesis.pdf (D31212673)

Programmes like National Rural Employment Programme, Rural Landless Employment Guarantee Programme,

JawaharRozgarYojona, SampoornaGrameenRozgarYojona have been implemented all over the country to provide supplementary wage-employment in rural areas, to create durable rural infrastructure and also to ensure food security. However, there has been inadequacy in rate of employment generation under these schemes on one hand and the situation of unemployment has been compounded by the absence of any social security mechanism on the other hand. In this context with a view to provide at least some minimum days of employment in the shape of manual labour to every household in rural areas the National Rural Employment Guarantee Bill was passed in 2004, which became an act in 2005. 7.5.1 Objectives

98%	MATCHING BLOCK 76/223	SA	Monuj Dutta First Chapter.docx (D34217208)

It is an act to provide for the enhancement of livelihood security of households in rural areas of the country by providing at least one hundred days of guaranteed wage employment in every financial year to every household whose adult members volunteer to do unskilled manual work.

It tries to provide strong

93%	MATCHING BLOCK 73/223	J

social safety net for the vulnerable groups by providing a fall-back employment source, when other employment alternatives are scarce or inadequate. It

attempts to achieve sustainable development of an agricultural economy.
106 NSOU ? GE-GR-11 Through the process of providing employment on works that address causes of chronic poverty such as drought, deforestation and soil erosion, the act seeks to strengthen the natural resource base of rural livelihood and create durable assets in rural areas. Another aim of the MGNREGA is to create durable assets (such as roads, canals, ponds and wells). The MGNREGA seeks to go for

83%	MATCHING BLOCK 74/223	W

new ways of doing business, as a model of governance reform anchored on the principles of transparency and

grassroot democracy. Thus the MGNREGA fosters conditions for inclusive growth ranging

100%	MATCHING BLOCK 77/223	SA	Mithlesh_Rural Development Management.docx (D119259395)

from basic wage security and recharging rural economy to a transformative empowerment process of democracy.

It envisages empowerment of rural poor through the processes of a rights- based Law. 7.5.2 Main Features 1. The MGNREGA is to be implemented mainly by gram panchayats (GPs).

97%	MATCHING BLOCK 78/223	SA	Chapter - Vi first draft Rural Development Pro ... (D40434799)

Adult members of a rural household, willing to do unskilled manual work, may apply for registration in writing or orally to the local Gram Panchayat. The Gram Panchayat after due verification will issue a Job Card. 2.

Apart from providing economic security and creating rural assets, NREGA can help in

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100%	MATCHING BLOCK 79/223	SA	parveen walia thesis.pdf (D40589667)

protecting the environment, empowering rural women, reducing rural-urban migration and fostering social equity, among others. 3.

90%	MATCHING BLOCK 82/223	SA	Chapter - Vi first draft Rural Development Pro ... (D40434799)

Employment will be given within 15 days of application for work, if it is not then daily unemployment allowance as per the Act, has to be paid liability of payment of unemployment allowance is of the States. 4. Work should ordinarily be provided within 5 km radius of the village. In case work is provided beyond 5 km, extra wages of 10% are payable to meet additional transportation and living expenses 5. Wages are to be paid according to the Minimum Wages Act 1948 for agricultural labourers in the State, unless the Centre notifies a wage rate which will not be less than Rs. 60/ per day. Equal wages will be provided to both men and women. 6. At least one-third beneficiaries shall be women who have registered and requested work under the scheme. 7.

84%	MATCHING BLOCK 80/223	W

Work site facilities such as crèche, drinking water, shade have to be provided.

NSOU ? GE-GR-11 107 8.
The shelf of

100%	MATCHING BLOCK 81/223	J

projects for a village will be recommended by the gram sabha and approved by the

zillapanchayat. 9.

100%	MATCHING BLOCK 85/223	SA	Chapter - Vi first draft Rural Development Pro ... (D40434799)

Permissible works predominantly include water and soil conservation, afforestation and land development

works. 10.

90%	MATCHING BLOCK 83/223	J

A 60:40 wage and material ratio has to be maintained. No contractors and machinery is allowed. 11. The Central Government bears the 100 percent wage cost of unskilled manual labour and 75 percent of the material cost including the wages of skilled and semi-skilled workers 12. Social Audit has to be done by the Gram Sabha. 13.

100%	MATCHING BLOCK 84/223	J

Grievance redressal mechanisms have to be put in place for ensuring a responsive implementation process 14.

100%	MATCHING BLOCK 86/223	SA	Chapter - Vi first draft Rural Development Pro ... (D40434799)

All accounts and records relating to the scheme should be available for public scrutiny. 7.6 ?????

Pradhan Mantri Jan Dhan Yojana Pradhan Mantri Jan DhanYojana (PMJDY), one of the biggest financial inclusion initiatives in the world, was announced on 15th August 2014. The aim is to liberate the poor people from a vicious cycle by involving them in economic activity. The Pradhan Mantri Jan Dhan Yojana has a structured monitoring mechanism from Central to District level. At the Centre, Finance Minister is the Mission head along with a Steering Committee and a Mission Director. The programme is monitored at state level by a State Implementation Committee and in the districts by a District Implementation Committee.Upto September 2019 there has been 21.72 crorebeneficiaries at rural/ semi-urban centre bank branches, 37.22 crore total beneficiaries, total deposit of Rs. 104893.56 crore in accounts and 29.45 croreRupay Debit Cards issued to beneficiaries. 7.6.1 Objectives Pradhan Mantri Jan DhanYojana is a National Mission on Financial Inclusion which has an integrated approach to bring about comprehensive financial inclusion and provide banking services to all households in the country. The scheme ensures access to a range of financial services like availability of basic savings bank account, access to need based credit, remittances facility, insurance and pension.
108 NSOU ? GE-GR-11 7.6.2 Main Features 1. It proposes universal access to banking facility. 2. Account can be opened in any bank branch or Business Correspondent (Bank Mitr) outlet at zero balance. Every bank account is on Core Banking System (CBS) of banks. 3. Mobile banking using USSD facility available on even basic feature phones is also being supported. 4. There is an overdraft facility of Rs. 5,000 for Aadhar-linked accounts and a RuPay debit card with inbuilt Rs. 1 lakh accident insurance cover. 5. For accounts opened between 15th August 2014 and 26th January 2015, a Life Insurance cover of Rupees 30,000 is available to the eligible beneficiaries. 6. Financial literacy programme aims to take financial literacy upto village level for better understanding of the whole mechanism. 7. The mission also envisages extension of Direct Benefit Transfer (DBT) under various Government Schemes through bank accounts of the recipients. The Kisan Credit Cards (KCC) are also being linked with RuPay platform. Micro insurance to the people, and unorganised sector Pension schemes like Swavalamban through the Business Correspondents have also been included for the second phase of the programme.
NSOU ? GE-GR-11 109 Unit 8 ????? Provision of Services Structure 8.1 Provision of Services: Physical and Socio-economic Access 8.2 Elementary Education 8.2.1 Sarva Shiksha Abhiyan 8.2.2 Mid-Day Meal Scheme 8.2.3 Mahila Samakhya Programme 8.2.4 Scheme to Provide Quality Education in Madrasas 8.2.5 Samagra Siksha 8.2.6 School Education Shagun 8.3 Draft National Education Policy 2019 8.4 Healthcare 8.5 National Rural Health Mission 8.6 Ayushman Bharat Yojana 8.7 Rural Healthcare System 8.8 Micro Credit 8.9 Provision of Urban Amenities to Rural Areas 8.1 ????? Provision of Services: Physical and Socio-economic Access Rural services are essential to the carrying out of a wide variety of economic and social activities in non-urban areas, where the majority of the world's poor live. Services such as credit, market information, research, infrastructure and extension are key assets to development and poverty reduction in rural areas. Yet, the rural poor generally face interlocking barriers to economic, social, and political opportunities as well as limited access to infrastructure, financial, extension, and other services. Combined with income poverty, lack of access and weak provision of rural services hinder productivity of rural
110 NSOU ? GE-GR-11 areas and prevent rural households from becoming economically viable. Rural regions face a particular challenge in the form of relatively high costs of service delivery due to a number of factors: ? Lower density population, ? Larger distances that have to be travelled by service users and service providers, ? Small number of people in any location that preclude economies of scale. Through its various activities, the initiative on rural Services contributes to knowledge sharing and learning by reviewing the state of existing supply of rural services (both in terms of quantity and quality), the major weaknesses and constraints to rural service provision, and the mechanisms necessary to ensure that services reach farmers and the rural poor more effectively (including the respective roles of the public and private sectors). The initiative also seeks to promote awareness and understanding of the importance of rural services for increase in productivity and sustainability of production, thereby fostering rural development. It also aims to increase the interface between, and integration among, various levels of government, community involvement, and the private sector in funding and provision of services. Finally, the importance of adequate financial and institutional arrangements and rural groups' participation in the planning, provision, maintenance, and monitoring of such services is also emphasised. Strategies to improve rural service delivery are stated below. ? Placing end users at the community level are an integral part of the process ? Consolidation of services by concentrating customers on a smaller number of service locations is essential. ? Basic overhead costs such as energy, security and administrative expenses, can be pooled, generating economies of scale Co-location of services. ? Merging merge similar or substitute services and combines them into a single entity is a cost-effective way. ? Where the demand for services is widely dispersed, it may be more efficient to bring the service to the user. ? Community-based solutions for different types of providers is beneficial.

NSOU ? GE-GR-11 111 Villagers comprise the core of Indian society and also represent the real

97%	MATCHING BLOCK 87/223	W

India. India is a country of villages and about 50% of the villages have very poor socio-economic conditions. Since the dawn of independence, concerted efforts have been made to ameliorate the living standard of rural masses. So, rural development is an integrated concept of growth and poverty elimination has been of paramount concern in all the consequent five year plans. Rural Development (RD) programmes comprise

of

100%	MATCHING BLOCK 88/223	W

following: ? Provision of basic infrastructure facilities in the rural areas e.g. schools, health facilities, roads, drinking water, electrification etc. ? Improving agricultural productivity in the rural areas. ? Provision of social services like health and education for socio-economic development. ? Implementing schemes for the promotion of rural industry increasing agriculture productivity, providing rural employment etc. ? Assistance to individual families and Self Help Groups (SHG) living below poverty line by providing productive resources through credit and subsidy. 8.2 ?????

Elementary Education With the formulation of National Policy on Education, India initiated a wide range of programmes for achieving the goal of Universal Elementary Education through several interventions, such as ? Sarva Shiksha Abhiyan ? Mid Day Meal ? Mahila Samakhya ? Strengthening for providing quality Education in Madrassas 8.2.1 Sarva Shiksha Abhiyan

88%	MATCHING BLOCK 89/223	SA	Reyaz Ahmad Pandit, final complete thesis.pdf (D31212673)

Sarva Shiksha Abhiyan (SSA) is a flagship programme of the Government of India

aimed at the universalisation of elementary education "in a time bound manner", asmandated by the 86

63%	MATCHING BLOCK 92/223	W

th Amendment to the Constitution of India making free and compulsory education to children between the ages of 6 and 14 a fundamental right.

As an intervention programme, it started on 2002, though SSA has been operational since 2000-2001. However, its origin

112 NSOU ? GE-GR-11 goes back to 1993-1994, when the District Primary Education Programme (DPEP) was launched, with an aim of achieving the objective of universal primary education. The Central share was funded by a number of external agencies, including the World Bank, Department for International Development (DFID) and UNICEF. In 2018-19 total number of educational institutes was 10426, which include an enrolment of 517115 girls and 1316060 boys. Objectives SSA aims to provide for a variety of interventions for universal access and retention, bridging of gender and social category gaps in elementary education and improving the quality of learning. SSA interventions include inter alia, opening of new schools and alternate schooling facilities, construction of schools and additional classrooms, toilets and drinking water, provisioning for teachers, regular teacher in service training and academic resource support, free textbooks and uniforms, and support for improving learning achievement levels/ outcome. As the Right to Education Act (RTE) came into force on 1 April 2010, changes have been incorporated into the SSA approach, strategies and norms. The changes encompass the vision and approach to elementary education, guided by the following principles: Holistic view of education, as interpreted in the National Curriculum Framework 2005, with implications for a systemic revamp of the entire content and process of education with significant implications for curriculum, teacher education, educational planning and management. Equity, to mean not only equal opportunity, but also creation of conditions in which the disadvantaged sections of the society, children of SC, ST, Muslim minority, landless agricultural workers and children with special needs, etc., can avail of the opportunity. 'Padhe Bharat Badhe Bharat', launched in 2014 by the Ministry of Human Resource Development, is a nationwide sub-programme of the SarvaShikshaAbhiyan. Children who fail to read in early education lag behind in other subjects.Theprogramme is designed to improve comprehensive early reading, writing and early mathematics programme for children in Classes I and II. The programme will not only provide print rich environment, timely distribution of books but will also include new teacher mentoring and appraisal system. In 2018, the SarvaShikshaAbhiyan along with the RashtriyaMadhyamikShikshaAbhiyan was launched to form SamagraShikshaAbhiyan. Main Features 1. The SarvaShikshaAbhiyan (SSA) is a programme for Universal Elementary Education.
NSOU ? GE-GR-11 113 2. This

92%	MATCHING BLOCK 90/223	W

programme is also an attempt to provide an opportunity for improving human capabilities to all children through provision of community-owned quality education in a mission mode. 3.

100%	MATCHING BLOCK 91/223	W

It is a response to the demand for quality basic education all over the country. 4. The SSA

attempts to provide quality elementary education including life skills with a special focus on the education of girls and children with special needs as well as computer education. 5. Centrality of teacher, to motivate them to innovate and create a culture in the classroom, and beyond the classroom, that might produce an inclusive environment for children, especially for girls from oppressed and marginalised backgrounds. 6. Moral compulsion is imposed through the RTE Act on parents, teachers, educational administrators and other stakeholders, rather than shifting emphasis on punitive processes. 7. Convergent and integrated system of educational management is pre-requisite for implementation of the RTE law. All states must move in that direction as speedily as feasible. 8.2.2 Mid-Day Meal Scheme With a view to enhancing enrolment, retention and attendance and simultaneously improving nutritional levels among children,

100%	MATCHING BLOCK 93/223	SA	Ishu_Economics_Chapter 5.docx (D53969364)

the National Programme of Nutritional Support to Primary Education (NP-NSPE)

was launched as a Centrally Sponsored Scheme on 15th August 1995. In 2001 Mid-Day Meal Scheme (MDMS) became a cooked Mid-Day Meal Scheme under which every child in every Government and Government aided primary school was to be served a prepared Mid Day Meal with a minimum content of 300 calories of energy and 8-12 gram protein per day for a minimum of 200 days. The Scheme was further extended in 2002 to cover not only children studying in Government, Government aided and local body schools, but also children studying in Education Guarantee Scheme (EGS) and Alternative Ä£ Innovative Education (AIE) centres. In September 2004 the Scheme was revised to provide for Central Assistance for cooking cost at the rateRs. 1 per child per school day to cover cost of pulses, vegetables cooking oil, condiments, fuel and wages and remuneration payable to personnel or amount payable to agency responsible for cooking. Transport subsidy was also raised from the
114 NSOU ? GE-GR-11 earlier maximum of Rs. 50 per quintal to Rs. 100 per quintal for special category states and Rs 75 per quintal for other states. Central assistance was provided for the first time for management, monitoring and evaluation of the scheme cost at the rate 2% of the cost of foodgrains, transport subsidy and cooking assistance. A provision for serving mid day meal during summer vacation in drought affected areas was also made. In July 2006 the Scheme was further revised to enhance the cooking cost to Rs. 1.80 per child/school day for States in the North Eastern Region and Rs. 1.50 per child / school day for other States and UTs. The nutritional norm was revised to 450 Calories and 12 gram of protein. In order to facilitate construction of kitchen-cum-store and procurement of kitchen devices in schools provision for Central assistance @ Rs. 60,000 per unit and @ Rs. 5,000 per school in phased manner were made. In October 2007, the Scheme was extended to cover children of upper primary classes (i.e. class VI to VIII) studying in 3,479 Educationally Backward Blocks (EBBs) and the name of the Scheme was changed from 'National Programme of Nutritional Support to Primary Education' to 'National Programme of Mid Day Meal in Schools'. The nutritional norm for upper primary stage was fixed at 700 Calories and 20 grams of protein. The Scheme was extended to all areas across the country from 1.4.2008. The Scheme was further revised in April 2008 to extend the scheme to recognise as well as unrecognised Madarsas / Maqtabs supported under SSA. 8.2.3 Mahila Samakhya Programme The MahilaSamakhyaprogramme was launched in 1988 to pursue the objectives of the National Policy on Education, 1986. The policy recognised that the empowerment of women is possibly the most critical pre-condition for the participation of girls and women in the educational process. The programme has been supported by State government, UNICEF, World Bank and others. Presently, MahilaSamakhya is active in 12,000 villages, over 60 districts in 9 states including Bihar, where UNICEF and MahilaSamakhya have been partners for a long time. Objectives The guiding principle of the programme is the centrality of education in empowering women to achieve basic equality. It strives to make women aware, empowered, capable and self-reliant.MahilaSamakhya has been particularly successful in targeting out-of-school girls by working with the community to create learning opportunities in alternative centres,
NSOU ? GE-GR-11 115 residential camps and early childhood development centres.The programme functions through Sanghas - village level women's collectives. The Sanghas have provided the collective strength for women, usually from poor & marginalized groups, to overcome barriers to their participation in and access to education and development. The process of mobilising and organising women is done by a Sahayogini who looks after 10 villages. The learning is built around broad issues such as access to government services, women's health, violence against women, rights and entitlements, women's role in Gram-sabhas and other local governance structures, livelihoods, and basic literacy. The Sanghas are formed into Federations at the block level. Main Features 1. To enhance self-esteem and self-confidence of women; 2. To buildi a positive image of women by recognizing their contribution to the society, polity and the economy; 3. To develop ability to think critically; 4. To foster decision making and action through collective processes; 5. To enable women to make informed choices in areas like education, employment and health (especially reproductive health); 6. To ensure equal participation in developmental processes; 7. To provide information, knowledge and skill for economic independence; 8. To enhance access to legal literacy and information relating to their rights and entitlements in society with a view to enhance their participation on an equal footing in all areas. 8.2.4 Scheme to Provide Quality Education in Madrasas Scheme to Provide Quality Education in Madrasas (SPQEM) is being implemented by the Ministry of Human Resource Development from the year 2008-09. The scheme seeks to bring about qualitative improvement in Madrasas to enable Muslim children attain standards of the national education system in formal education subjects. Objecives The objective of the Scheme is to encourage traditional institutions like Madrasas and Maktabs by giving financial assistance to introduce science, mathematics, social studies,

116 NSOU ? GE-GR-11 Hindi and English in their curriculum so that academic proficiency for classes I-XII is attainable for children studying in these institutions. Main Features 1. Training of such teachers every two years in new pedagogical practices. 2. Providing Science labs, Computer labs with annual maintenance costs in the secondary and higher secondary stage madrasas. 3. Provision of Science/Mathematics kits in primary/upper primary level madrassas. 4. Strengthening of libraries/book banks and providing teaching learning materials at all levels of madrasas. 5. The unique feature of this modified scheme is that it encourages linkage of Madrasas with National Institute for Open Schooling (NIOS), as accredited centres for providing formal education, which will enable children studying in such Madrasas to get certification for class 5, 8, 10 and 12. This will enable them to transit to higher studies and also ensure that quality standards akin to the national education system. 6. The NIOS linkage will be extended under this scheme for Vocational Education at the secondary and higher secondary stage of Madrasas. 7. For the monitoring and popularisation of the scheme it will fund State Madrasa Boards. Government of India will itself run periodic evaluations, the first within two years. 8.2.5 Samagra Siksha The Union Budget, 2018-19, has proposed to treat school education holistically without segmentation from pre-nursery to Class 12. SamagraSiksha is a sector-wide development programme, extending from pre-school to class 12, which subsumes the then existing Centrally Sponsored Schemes of Sarva Shiksha Abhiyan (SSA), Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and Teacher Education (TE) to help harmonising the implementation mechanisms and transaction costs at all levels, particularly in using state, district and sub-district level systems and resources, besides envisaging one comprehensive strategic plan for the development of school education at the district level. The scheme is under the Ministry of Human Resource Development, Government of India. An amount of NSOU ? GE-GR-11 117 Rs. 30780.81 crore has been sanctioned at Revised Estimates (RE) stage for the financial year 2018-19, out of which Rs. 29349.10 crore (95.35%) has been released as Central Share to States and Union Territories. The fund sharing pattern for the scheme between Centre and States is at present in the ratio of 90:10 for the 8 North-Eastern States and 3 Himalayan States viz. Jammu & Kashmir, Himachal Pradesh and Uttarakhand and 60:40 for all other States and Union Territories with Legislature. Objectives The major objectives of the scheme are provision of quality education and enhancing learning outcomes of students; bridging social and gender gaps in school education; ensuring equity and inclusion at all levels of school education; ensuring minimum standards in schooling provisions; promoting vocationalisation of education; support states in implementation of Right of Children to Free and Compulsory Education (RTE) Act, 2009; strengthening and up-gradation of State Councils of Educational Research and Training (SCERTs)/State Institutes of Education (SIE) and District Institute of Education and Training (DIET) as nodal agencies for teacher training. The main outcomes of the Scheme are envisaged as Universal Access, Equity and Quality, promoting Vocationalisation of Education and strengthening of Teacher Education Institutions (TEIs). Main Features 1. The Integrated Scheme envisages the 'school' as a continuum from pre-school, primary, upper primary, secondary to senior secondary levels. 2. The vision of the Scheme is to ensure inclusive and equitable quality education from pre-school to senior secondary stage in accordance with the Sustainable Development Goal (SDG) for Education. 3. The shift in the focus is from project objectives to improving systems level performance and schooling outcomes which will be the emphasis of the combined scheme along-with incentivising states towards improving quality of education. 4. The SamagraShiksha is implemented as a centrally sponsored through a single State Implementation Society (SIS) at the State/UT level. 5. It is 100% centrally sponsored for Union Territories without Legislature. This is in accordance with the recommendations of the Sub-Group of Chief Ministers on Rationalization of Centrally Sponsored Schemes received in October 2015. 6. The main emphasis of the Scheme is on improving quality of school education by focussing on the two T's – Teacher and Technology.

118 NSOU ? GE-GR-11 7. The strategy for all interventions under the Scheme is to enhance the Learning Outcomes at all levels of schooling. 8. The scheme proposes to give flexibility to the States and UTs to plan and prioritize their interventions within the scheme norms and the overall resource envelope available to them. 8.2.6 School Education Shagun The School Education Shagun is an over reaching initiative of the Department of School Education and Literacy under the Ministry of Human Resource Development, Government of India to improve the school education system. The initiative involves creating a repository for all portals and websites and online monitoring with the aim to capture and showcase innovations in the elementary sector of school education and continuously monitoring of the SarvaShiksha. Objectives Keeping in tune with the spirit of convergence in policy intervention through introduction of the SamagraShiksha, the School EducationShagun platform provides single point access to all portals and websites of the department. Relevant information pertaining to more than 1.5 million schools, 9 million teachers and 250 million students can be accessed through this platform. Recourse to this seamless and single source of access to information for all activities relating to school education will immensely benefit all the stakeholders. Parents and the general public will get comprehensive information on the school next door and will also have the option of giving feedback to the authorities on any pertinent issue thereby enhancing credibility and accountability. Teachers and heads of schools will be empowered to improve their classroom teaching by accessing effective teaching techniques Students will have access to e-content and learning portals. The researcher will have recourse to a vast reservoir of data on all aspects of school education. All these will help in achieving the vision of an accessible, inclusive and quality education system. Main Features 1. As part of an effective monitoring system real time data from each and every school is being collected through the UDISE+ system. 2. Detailed geographical, topographical and other vital information relating to the schools are provided to the general public through the School GIS system.
NSOU ? GE-GR-11 119 3. The Data Analytics site collates the data in an organised format to use it for analysis and evidence based decision making. 4. The PMS online monitoring system tracks the physical progress of the projects and the flow of funds to and expenditure incurred by the States and UTs. The Shagun online monitoring system collects information on several macro parameters relating to School Education system of the States and UTs. 5. The Performance Grading Index (PGI) is an automated system which grades the States and UTs on the basis of 70 indicators. 6. The e-learning platforms like e-Pathshala and National Repository of Open Educational Resources (NROER) are provided by the NCERT. 7. Digital Infrastructure for Knowledge Sharing (DIKSHA), a joint initiative of the States, UTs and the Central Government, is also a repository of e-Learning contents for students and teachers. 8.3 ????? Draft National Education Policy 2019 The Committee for Draft National Education Policy (Chairman: Dr. K. Kasturirangan) submitted its report on May 31, 2019. The Committee was constituted by the Ministry of Human Resource Development in June 2017. The report proposes an education policy, which seeks to address the challenges of: (i) access, (ii) equity, (iii) quality, (iv) affordability, and (v) accountability faced by the current education system. The draft Policy provides for reforms at all levels of education from school to higher education. It seeks to increase the focus on early childhood care, reform the current exam system, strengthen teacher training, and restructure the education regulatory framework. It also seeks to set up a National Education Commission, increase public investment in education, strengthen the use of technology and increase focus on vocational and adult education, among others. Key observations and recommendations on School Education include: Early Childhood Care and Education: In addition to problems of access, the Committee observed several quality related deficiencies in the existing early childhood learning programmes. These include: (i) curriculum that doesn’t meet the developmental needs of children, (ii) lack of qualified and trained teachers, and (iii) substandard pedagogy. Currently, most early childhood education is delivered through anganwadis and private- preschools. However, there has been less focus on the educational aspects of early
120 NSOU ? GE-GR-11 childhood. Hence, the draft Policy recommends developing a two-part curriculum for early childhood care and education. This will consist of: (i) guidelines for up to three-year-old children (for parents and teachers), and (ii) educational framework for three to eight-year- old children. This would be implemented by improving and expanding the anganwadi system and co-locating anganwadis with primary schools. The Right to Education Act, 2009 (RTE Act): Currently, the RTE Act provides for

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free and compulsory education to all children from the age of six to 14 years.

The draft Policy recommends extending the ambit of the RTE Act to include early childhood education and secondary school education. This would extend the coverage of the Act to all children between the ages of three to 18 years. In addition, the draft Policy recommends that the recent amendments to the RTE Act on continuous and comprehensive evaluation and the no detention policy must be reviewed. It states that there should be no detention of children till class eight. Instead, schools must ensure that children are achieving age-appropriate learning levels. Curriculum framework: The current structure of school education must be restructured on the basis of the development needs of students. This would consist of a 5-3-3-4 design comprising: (i) five years of foundational stage (three years of pre-primary school and classes one and two), (ii) three years of preparatory stage (classes three to five), (iii) three years of middle stage (classes six to eight), and (iv) four years of secondary stage (classes nine to 12). The Committee noted that the current education system solely focuses on rote learning of facts and procedures. Hence, it recommends that the curriculum load in each subject should be reduced to its essential core content. This would make space for holistic, discussion and analysis-based learning. School exam reforms: The Committee noted that the current board examinations: (i) force students to concentrate only on a few subjects, (ii) do not test learning in a formative manner, and (iii) cause stress among students. To track students' progress throughout their school experience, the draft Policy proposes State Census Examinations in classes three, five and eight. Further, it recommends restructuring the board examinations to test only core concepts, skills and higher order capacities. These board examinations will be on a range of subjects. The students can choose their subjects, and the semester when they want to take these board exams. The in-school final examinations may be replaced by these board examinations.
NSOU ? GE-GR-11 121 School infrastructure: The Committee noted that establishing primary schools in every habitation across the country has helped increase access to education. However, it has led to the development of very small schools (having low number of students). The small size of schools makes it operationally complex to deploy teachers and critical physical resources. Therefore, the draft Policy recommends that multiple public schools should be brought together to form a school complex. A complex will consist of one secondary school (classes nine to twelve) and all the public schools in its neighbourhood that offer education from pre-primary till class eight. The school complexes will also include anganwadis, vocational education facilities, and an adult education centre. Each school complex will be a semi-autonomous unit providing integrated education across all stages from early childhood to secondary education. This will ensure that resources such as infrastructure and trained teachers can be efficiently shared across a school complex. Teacher management: The Committee noted that there has been a steep rise in teacher shortage, lack of professionally qualified teachers, and deployment of teachers for non-educational purposes. The draft Policy recommends that teachers should be deployed with a particular school complex for at least five to seven years. Further, teachers will not be allowed to participate in any non-teaching activities (such as cooking mid-day meals or participating in vaccination campaigns) during school hours that could affect their teaching capacities. For teacher training, the existing B.Ed. programme will be replaced by a four-year integrated B.Ed. programme that combines high-quality content, pedagogy, and practical training. An integrated continuous professional development will also be developed for all subjects. Teachers will be required to complete a minimum of 50 hours of continuous professional development training every year. Regulation of schools: The draft Policy recommends separating the regulation of schools from aspects such as policymaking, school operations, and academic development. It suggests creating an independent State School Regulatory Authority for each state that will prescribe basic uniform standards for public and private schools. The Department of Education of the State will formulate policy and conduct monitoring and supervision. 8.4 ????? Healthcare Abstract Rural Health is one of vital elements of rural life. India being a nation of villages requires an intensive approach towards rural health. Nearly 75 per cent of health

122 NSOU ? GE-GR-11 infrastructure and other health resources are concentrated in urban areas. Even if several government programmes for growth of rural healthcare have been initiated, the procedural delay in implementation leads to its ineffectiveness. Rural areas have been infected with various contagious diseases like diarrhea, amoebiasis, typhoid, infectious hepatitis, worm infestations, measles, malaria, tuberculosis, whooping cough, respiratory infections, pneumonia and reproductive tract infections. The insanitary conditions of households aggravate expansion of these diseases which is further promoted by apathy of people and government. Although unit level institution under rural healthcare takes care of sanitation through its outreach services yet, there is a long milestone to upgrade our health scenario. Rural Health Care services in India are mainly based on Primary health care, which envisages attainment of healthy status for all. Major problems faced by rural health sector in India are mentioned below. 1. Inefficient physical infrastructure, 2. Underutilisation of existing rural hospitals, 3. Inadequate human resources, 4. Apathetic attitude of medical professionals, 5. Dominance of unregulated Private medical professionals, 6. Non-Preparedness to fight with epidemic in rural areas. 7. High neonatal mortality, 8. Inequitable immunization, 9. Inclination towards Home-based deliveries, 10. Lack of coordination between medical research institution and health service delivery institution and 11. Lack of community participation.

67%	MATCHING BLOCK 94/223	W

The importance of health in economic and social development and improving the quality of life has been recognised by the Government of India.

There the government has made several interventions. 8.5 ?????

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National Rural Health Mission The National Rural Health Mission (NRHM) was launched on 12

th April 2005,
to provide accessible, affordable and quality health care to the rural population, especially the
NSOU ? GE-GR-11 123 vulnerable groups. Under the NRHM, the Empowered Action Group (EAG) States, including Bihar, Jharkhand, Uttar Pradesh, Uttarakhand Madhya Pradesh, Chhattisgarh, Odisha and Rajasthan, as well as north-eastern states, Jammu and Kashmir and Himachal Pradesh have been given special focus. As per the 12th Plan document of the Planning Commission, the flagship programme of NRHM will be strengthened under the umbrella of National Health Mission. The focus on covering rural areas and rural population will continue along with up scaling of NRHM to include non-communicable diseases. The mission aims to raise public spending on the health sector to 2-3% of the Gross Domestic Product (GDP), by undertaking architectural correction of the health system and promote policies that strengthen public health management and service delivery in the country. At the National level, the NHM has a Mission Steering Group (MSG) headed by the Union Minister for Health & Family Welfare and an Empowered Programme Committee (EPC) headed by the Union Secretary for Health & FW. The EPC will implement the Mission under the overall guidance of the MSG. At the State level, the Mission would function under the overall guidance of the State Health Mission headed by the Chief Minister of the State. The functions under the Mission would be carried out through the State Health & Family Welfare Society. The National Health Mission (NHM) was launched by the government of India in 2013 subsuming the National Rural Health Mission and National Urban Health Mission. It was further extended in March 2018, to continue until March 2020. The Mission relates health to

92%	MATCHING BLOCK 96/223	W

segments of nutrition, sanitation, hygiene and safe drinking water. It also aims at bringing the Indian systems of medicine in the mainstream to provide better health care. Some major programmes associated with the NRHM are:- ? Reproductive and Child Health Programme ? National Vector Borne Disease Control Programme ? National Programme for Control of Blindness ? National Leprosy Eradication Programme ? Integrated Disease Survey Programme Objectives NRHM seeks to provide equitable

63%	MATCHING BLOCK 98/223	SA	Mithlesh_Rural Development Management.docx (D119259395)

health care to the rural population, especially the vulnerable groups. The thrust of the mission is on establishing a fully functional, community owned, decentralised health delivery system with inter-sectoral convergence at all levels,

human resources management, community involvement, rigorous monitoring and evaluation against standards, innovations and flexible financing and also interventions for improving the
124 NSOU ? GE-GR-11 health indicators

100%	MATCHING BLOCK 104/223	SA	Mithlesh_Rural Development Management.docx (D119259395)

to ensure simultaneous action on a wide range of determinants of health

such as water, sanitation, education, nutrition, social and gender equality.
NRHM focuses on Reproductive, Maternal, Newborn, Child Health and Adolescent Services. The emphasis here is on strategies for improving maternal and child health through a continuum of care and the life cycle approach. It recognises the inextricable linkages between adolescent health, family planning, maternal health and child survival. Moreover, the linking of community and facility-based care and strengthening referrals between various levels of health care system to create a continuous care pathway is also to be focussed. Main Features 1. To

91%	MATCHING BLOCK 99/223	W

train and enhance capacity of Panchayat Raj Institutions (PRIs) to own, control and manage public health services. 2.

To

100%	MATCHING BLOCK 100/223	W

promote access to improved healthcare at household level through the female health activist,

i.e. Accredited Social Health Activists (ASHA). ASHA is the first port of call for any health related demands of deprived sections of the population, especially women and children, who find it difficult to access health services in rural areas. 3. Health Plan for each village through Village Health Committee of the Panchayat along with

100%	MATCHING BLOCK 101/223	W

preparation and implementation of an inter-sectoral District Health Plan

prepared by the District Health Mission, including drinking water, sanitation & hygiene and nutrition.

100%	MATCHING BLOCK 102/223	W

Integrating vertical Health and Family Welfare Programmes at National, State, Block, and District levels. 4.

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To strengthen existing PHCs and CHCs, and provision of 30- 50 bedded. 5. The Rogi Kalyan Samiti (Patient Welfare Committee)/ Hospital Management Society is a management structure that acts as a group of trustees for the hospitals to manage the affairs of the hospital. Financial assistance is provided to these Committees through untied fund to undertake activities for patient welfare. 6. To strengthen

100%	MATCHING BLOCK 103/223	W
capacities for data collection, assessment and review for evidence based planning, monitoring and supervision. 7.		

To develop

100%	MATCHING BLOCK 105/223	W
capacities for preventive health care at all levels for promoting healthy life styles, reduction in consumption of tobacco and alcohol etc.		

NSOU ? GE-GR-11 125 8. To promote public-private partnerships for achieving public health goals and also promoting non-profit sector particularly in under-served areas. 9.

92%	MATCHING BLOCK 106/223	W
Regulation of private sector including the informal rural practitioners to ensure availability of quality service to citizens at reasonable cost		

and revitalising local health traditions including AYUSH services. 10. The NRHM has provided health care contractors to under-served areas, and has emphasised upon training to expand the skill of doctors and capacity building of nursing staff and auxiliary workers such as Auxiliary Nurse Midwives (ANMs). 11. To reorient medical education to support rural health issues including regulation of Medical care and Medical Ethics. 12.

100%	MATCHING BLOCK 107/223	W
Effective and viable risk pooling and social health insurance to provide health security to the poor by ensuring		

accessible, affordable, accountable and good quality hospital care. 8.6 ????? Ayushman Bharat Yojana The Ayushman Bharat Yojana or Pradhan Mantri Jan Arogya Yojana (PMJAY) or National Health Protection Scheme is a centrally sponsored scheme launched in 2018, under the Ayushman Bharat Mission of Ministry of Health and Family Welfar (MoHFW) in India. 26 states and union territories accepted the scheme except four states: Delhi, Odisha, West Bengal and Telangana. More than a lakh (100,000) people have taken benefit of the scheme till October 2018. By 26th November 2018 more than 825,000 e-cards had been generated and there was a push to recruit more private hospitals to the scheme. Objectives The scheme aims at making interventions in primary, secondary and tertiary care systems, covering both preventive and promotive health, to address healthcare holistically. It is an umbrella of two major health initiatives namely, Health and Wellness centres and National Health Protection Scheme (NHPS). Ayushman Bharat-National Health Protection Scheme, which will cover over 10 crore (one hundred million) poor and vulnerable families (approximately 50 crore (five hundred million) beneficiaries) providing coverage up to 5 lakh rupees ($7,100) per family per year for secondary and tertiary care hospitalisation. In case of Health and Wellness Centre Rs. 1200 crore ($170 million) allocated for 1.5 lakh

126 NSOU ? GE-GR-11 (150,000) health and wellness centres, Under this 1.5 lakh centres will be setup to provide comprehensive health care,including for non-communicable diseases and maternal and child health services, apart from free essential drugs and diagnostic services. Main Features Ayushman Bharat consists of two major elements. 1. National Health Protection Scheme ? Benefits of the scheme are portable across the country and a beneficiary covered under the scheme will be allowed to take cashless benefits from any public or private empaneled hospitals across the country. ? It will be an entitlement based scheme with entitlement decided on the basis of deprivation criteria in the Socio-Economic Caste Census (SECC) database. It will target about 10.74 crore poor, deprived rural families and identified occupational category of urban workers' families as per the latest SECC data covering both rural and urban. ? One of the core principles of Ayushman Bharat - National Health Protection Mission is to co-operative federalism and flexibility to states. ? For giving policy directions and fostering coordination between Centre and States, it is proposed to set up Ayushman Bharat National Health Protection Mission Council (AB-NHPMC) at apex level Chaired by Union Health and Family Welfare Minister. States would need to have State Health Agency (SHA) to implement the scheme. ? Covering almost all secondary and many tertiary hospitalisations (except a negative list). 2. Wellness Centres ? The government will upgrade existing Public Health Centres to Wellness Centres. ? Contribution of private sector and philanthropic institutions in adopting these centresis also envisaged. ? The list of services to be provided at Health and Wellness Centre include: 1. Pregnancy care and maternal health services 2. Neonatal and infant health services
NSOU ? GE-GR-11 127 3. Child health 4. Chronic communicable diseases 5. Non-communicable diseases 6. Management of mental illness 7. Dental care 8. Geriatric care emergency medicine 8.7 ????? Rural Healthcare System The health care infrastructure in rural areas has been developed as a three tier system as follows. Centre Population Norms Plain Area Hilly/Tribal/ Difficult Area Sub Centre 5000 3000 Primary Health Centre 30,000 20,000 Community Health Centre 1,20,000 80,000 1. Sub Centres The Sub Centre(SC) is the most peripheral and first contact point between the primary health care system and the community. Sub Centres are assigned tasks relating to interpersonal communication in order to bring about behavioral change and provide services in relation to maternal and child health, family welfare, nutrition, immunization, diarrhoea control and control of communicable diseases programmes. Each Sub Centre is required to be manned by at least one auxiliary nurse midwife (ANM) / female health worker and one male health worker. Under National Rural Health Mission (NRHM), there is a provision for one additional second ANM on contract basis. One lady health visitor (LHV) is entrusted with the task of supervision of six Sub Centres. Government of India bears the salary of ANM and LHV while the salary of the Male Health Worker is borne by the State governments.
128 NSOU ? GE-GR-11 There were 1, 56,231 Sub Centres functioning in the country as on 31st March, 2017. There is significant increase in the number of Sub Centres in the States of Rajasthan (3894), Gujarat (1808), Chhattisgarh (1368), Karnataka (1238), Jammu & Kashmir (1088), Odisha (761), Tripura (448), Madhya Pradesh (318) and Kerala (286). 2. Primary Health Centre The Primary Health Centre (PHC) is the first contact point between village community and the medical officer.The PHCs were envisaged to provide an integrated curative and preventive health care to the rural population with emphasis on preventive and promotive aspects of health care. The PHCs are established and maintained by the State governments under the Minimum Needs Programme (MNP)/ Basic Minimum Services (BMS) Programme. As per minimum requirement, a PHC is to be manned by a medical officer supported by 14 paramedical and other staff. Under NRHM, there is a provision for two additional staff nurses at PHCs on contract basis. It acts as a referral unit for 6 Sub Centres and has 4-6 beds for patients. The activities of PHC involve curative, preventive, promotive and family welfare services. There were 25,650 PHCs functioning in the country as on 31st March, 2017. At the national level, there is an increase of 2414 PHCs by 2017 as compared to that existed in 2005. Significant increase is observed in the number of PHCs in the States of Karnataka (678), Assam (404), Rajasthan (366), Jammu & Kashmir (303) and Chhattisgarh (268) and Bihar (251). 3. Community Health Centre The Community Health Centre (CHC) are being established and maintained by the State government under MNP/BMS programme.As per minimum norms, a CHC is required to be manned by four medical specialists i.e. surgeon, physician, gynecologist and pediatrician supported by 21 paramedical and other staff. It has 30 in-door beds with one OT, X-ray, labour room and laboratory facilities.It serves as a referral centre for 4 PHCs and also provides facilities for obstetric care and specialist consultations. As on 31st March, 2017, there were 5,624 CHCs functioning in the country. Significant increase is observed in the number of CHCs in the States of Uttar Pradesh (436), Tamil Nadu (350), West Bengal (254), Rajasthan (253), Odisha (139), Jharkhand (141), Kerala (126), Gujarat (91) and Madhya Pradesh (80).

NSOU ? GE-GR-11 129 8.8 ????? Micro Credit Micro-finance originated in Bangladesh with the institution of the Grameen Bank in 1983. The basic principles of micro finance that distinguish it from the earlier modes of credit delivery are small amounts of loan, lack of physical collateral but emphasis on social collateral or peer monitoring and focus on women borrowers. With these three factors, micro finance is expected to effectively tackle the three problems that are often encountered in any credit delivery programme designed for the poor namely, targeting, screening of borrowers, and enforcement of the credit contract. Under the model of micro finance promoted by the Grameen Bank, women borrowers are organised into Self-Help Groups (SHGs), which would be entitled to borrow from the lending institution either for their individual or group requirements. Such groups are normally created by women from similar socio-economic background that strengthen the solidarity among these women. The involvement of the entire group at each stage of seeking the loan and its repayment is essential in ensuring peer monitoring. In several countries across the world, micro finance originated from the activity of non-governmental organisations (NGOs) that were aided largely or partly by foreign donors for their lending operations. Inclusive development is one of the critical determinants of national growth and its importance increases manifold in a developing and vast country like India. The poor living in villages represent the country's vulnerability, arising out of their unequal access to financial literacy, products and services. As in other parts of the world, In India also micro finance is looked upon as means of credit-based poverty alleviation and financial inclusion.National Bank for Agriculture and Rural Development (NABARD), through its' Micro Credit Innovations Department has been the major facilitator and mentor of microfinance initiatives in the country. The overall vision of the department is to facilitate sustained access to financial services for the unreached poor in rural areas through various microfinance innovations in a cost effective and sustainable manner. NABARD has been continuously focusing on bringing in various stakeholders on a common platform and building their capacities to take the initiatives forward. It has been working towards bringing the excluded population into the formal banking system by addressing both demand and supply side constraints. As on 31st March 2018, there are 8.7 million SHGs out of which 5.02 million SHGs have outstanding bank loans of R75598 Cr to the Banks. The total deposits of SHGs with banks was to the tune of R19592 crore. There are more than 100 Scheduled
130 NSOU ? GE-GR-11 Banks, 300 DCCBs, 27 State Rural livelihood Missions and over 5000 NGOs engaged in the Self Help Group Bank Linkage Programme. Some of the major initiatives have been mentioned below. 1. The Self Help Groups Bank Linkage Programme (SHGBLP) has evolved as a cost-effective mechanism for providing financial services to the unreached and underserved poor households. It started simply as a bank outreach programme during 1992-93, but through the passage of time slowly metamorphosed into a holistic programme for financial, economic, social and of late, technological capital building in rural areas. The SHG movement started as a link between the unbanked and the formal banking system to cater to the credit needs of the poor. The SHGs which follow 'Panchsutras' viz. conduct of regular group meetings, regular savings within the group, internal lending based on the demand of members, timely repayment of loan and maintenance of proper books of accounts are considered to be of good quality and over years have proved themselves to be good customers of Banks. 2. Financing ofJoint Liability Groups (JLGs) was introduced as a pilot project in 2004-05. The scheme was later mainstreamed for the banking system in the year 2006. JLGs basically are Credit groups of small/marginal/tenant farmers/ asset less poor who do not have proper title of their farmland. Apart from extending refinance support of 100% to the financing Banks, NABARD also extends financial support for awareness creation and capacity building of all stakeholders under the Scheme. NABARD also extends grant support for formation and nurturing of JLGs to Banks and other JLG Promoting Institutions (JLGPIs). 3. Scheme for promotion of Women SHGs (WSHGs) in backward & LWE districts of India in association with Govt. of India is being implemented across 150 backward and Left Wing Extremism (LWE) affected districts of the country since March-April 2012. The scheme aims at saturating the districts with viable and self-sustainable WSHGs by involving anchor agencies who shall promote & facilitate credit linkage of these groups with Banks, provide continuous handholding support, enable their journey to livelihoods and also take the responsibility for loan repayments. Under the scheme, in addition to working as an SHPI, the

NSOU ? GE-GR-11 131 anchor agencies are also expected to serve as a banking / business facilitator for the nodal implementing banks. 4. Especially in the resource poor regions of the country identification of appropriate livelihood opportunities, improvement of their skills, mentoring, providing market linkages and enhanced credit access are more important than having a narrow focus on access to micro credit. NABARD started the Livelihood and Entrepreneurship Development Programme (LEDP) in 2015 for providing end- to-end solutions for sustainable livelihoods in the rural areas. 5. EShakti, the digitisation project for SHGs was taken up by NABARD in 2015 as a pilot project. The project aims to facilitate banks to expand their SHG portfolio by enabling mobile based book keeping of the SHGs and forging e- links of such SHGs with banks in terms of providing dynamic grading of the SHGs. 6. Other than championing the movement and providing promotional support, NABARD has enabled an entire ecosystem of support through policy advocacy at Bank and Government level, organising and sponsoring a large number of training & capacity building programmes, seminars & workshops for the benefit of all the stakeholders viz. the bankers, the Government agencies, the NGO partners and more importantly the SHG members themselves. Banks are also provided 100% refinance support by NABARD for financing of SHGs. 7. The Micro Units Development & Refinance Agency Ltd (MUDRA), NBFC set up by the Government of India in 2015 with its total focus on microenterprise, has to hand-hold and facilitate the development process of smaller Micro Finance Institutions (MFIs) and notfor profit MFIs as they are the ones who operate in remote locations and with the underserved populations. 8. RBI has taken steps to expand the banking space to ensure greater financial inclusion and in November 2014 issued guidelines for setting up Small Finance Banks and Payments Banks. On 16 September 2015, RBI granted in-principle approval to ten entities to start Small Finance Banks (SFBs) which would essentially undertake basic banking activities that include: accepting deposits, credit, insurance, remittances etc. and lending to under-served sections. 1.13 The establishment of Small Finance Banks.

132 NSOU ? GE-GR-11 8.9 ????? Provision of Urban Amenities to Rural Areas The Provision of Urban Amenities to Rural Areas (PURA) is a strategy for rural development in India. In pursuance to the announcement of Prime Minister on Independence Day, 2003, the Planning Commission submitted a proposal for approval of the Government to implement the PURA scheme. The scheme was approved by the Government in 'in-principle' in January 2004. Subsequently, Ministry of Rural Development implemented (MoRD) the PURA scheme on a pilot basis in seven clusters for a period of three years (2004-05 to 2006-07). It was approved with retrospective effect by the Cabinet in its meeting on 16.03.06 with the direction to restructure the PURA scheme. Based on the experience learnt during the pilot phase, evaluation conducted by the National Institute of Rural Development (NIRD) of pilot phase and the technical support of Asian Development Bank (ADB), the PURA scheme has been restructured. The restructured PURA scheme has been approved by the Government for implementation on a pilot basis during the 11 th five year plan. The PURA Scheme envisages rapid growth of rural India, given enhanced connectivity and infrastructure, the rural population would be empowered and enabled to create opportunities and livelihoods for themselves on a sustainable and growing basis. Funding for projects under the PURA scheme may come from four sources: MoRD schemes, non-MoRD schemes, private financing and Capital Grant under the PURA. The mission of the restructured PURA Scheme (2012) is holistic and accelerated development of compact

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areas around a potential growth centre in a Gram Panchayat (or cluster of			

contiguous Gram Panchayats) through the Public-Private Partnership (PPP) framework. The focus was on water supply, sanitation, and physical infrastructure rather than knowledge connectivity. The rural ministry plans to reform one of its ambitious yet not so successful programme – Provision of Urban amenities in Rural Areas (PURA) – to facilitate creation of urban infrastructure in around 2,000 new towns that have been identified by the 2011 decadal census. It is also trying to restructure the old PURA objectives. The Prestigious scheme proposed providing livelihood and urban amenities in compact areas around a potential growth center in Gram Panchayats through Public Private Partnership (PPP) framework to provide guarantee employment to rural areas so that they could have an assured income for at least 100 days of a year.

NSOU ? GE-GR-11 133 Objectives Lack of livelihood opportunities, modern amenities, and services necessary for decent living inrural areas results in a sense of deprivation and dissatisfaction amongst a large percentage of population and leads to migration of people to urban areas. In order to address these issues, the Government has, in the past, launched various schemes at different points of time. However, due to several reasons, the impact has not been very visible. Hence, in spite of several schemes, there continued to be a substantial flow of migration from the rural to urban areas. In order to catalyze the convergence between different infrastructure schemes and create a new model for management of urban services in the rural areas, the PURA Scheme has been developed. The basic vision of PURA is a holistic and accelerated development of compact

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areas around a potential growth centre in a Gram Panchayat (or

a group of Gram Panchayats) through Public Private Partnership (PPP) framework for providing livelihood opportunities and urban amenities to improve the quality of life in rural areas. The concept of development focuses, here, on the attempt to bridge the rural-urban divide, thereby reducing migration from rural to urban areas. Main Features 1. Simultaneous delivery of key infrastructure in villages leading to optimal use of resources 2. Provision of funds for operation and maintenance of assets for ten years post- construction, along with capital investment for creation of assets. 3. Transformation of several schemes into a single project, to be implemented as per set standards in a defined timeframe, with the requirements of each scheme being kept intact 4. Combining livelihoods creation with infrastructure development 5. Enforcement of standards of service delivery in rural areas almost at par with thoseobtaining in urban areas 6. Enforcement of service standards through a legally binding arrangement 7. To be implemented and managed by the private sector on considerations of economic viability but designed in a manner whereby it is fully aligned with the overall objective of rural development.

134 NSOU ? GE-GR-11 8. An illustrative list of amenities and economic activities proposed to be provided under the PURA are as follows:- Amenities to be provided Amenities to be Add-on Projects under MoRD Schemes provided under (revenue earning, people Non-MoRD Schemes centric projects) Water and sewerage Village street lighting Village linked tourism Construction and Telecom, Electricity etc. Integrated rural hub, maintenance of village rural market streets Drainage Agriculture– Common Solid waste management service centre, Skill development warehousing, etc. Development of economic Any other rural- activities economybased project 9. There exist two main relationships in the project, viz., (1) Relationship between the Gram Panchayat, the District Rural Development Authority (DRDA), and Project Special Purpose Vehicle (SPV) for the development of the PURA Project; and (2) Relationship between the Ministry of Rural Development (MoRD), the State Government and the Project SPV.

NSOU ? GE-GR-11 135 Unit 9 ????? Rural Governance: Panchayati Raj System Structure 9.1 Rural Governance: Panchayati Raj System in India 9.2 Origin and Evolution of Local Self-governance in India 9.3 Recommendations of the Balwant Rai Mehta Committee 9.4 Recommendations of the Asoka Mehta Committee 9.5 The 64 th and 65 th Constitutional Amendment Bills 9.6 The 73rd Constitutional Amendment Bill 9.7 Panchayats (Extension to the Scheduled Areas) Act, 1996 (PESA) 9.8 The Three Tier System 9.9 Number of District, Intermediate and Village Panchayats 9.1 ????? Rural Governance: Panchayati Raj System in India Governance implies those institutions and processes through which government, civil society organizations and private sector interact in shaping public affairs and through which citizens articulate their interests, mediate their differences and exercise their political, social and economic rights1. To understand major governance related issues at village level, we should know how it can be measured. Governance at the village level can be measured against the benchmarks such as delivery of basic services, transparency in functioning of Gram Panchayat and local government department, level of corruption and opportunities for citizens to participate principally to ensure accountability. An institutional set-up that ensures good governance usually has the following features: 1. Participation- All men and women should have a voice in decision-making, either directly or through legitimate intermediate institutions that represent their interests. Such broad participation is built on freedom of association and speech, as well as capacities to participate constructively. 2. Rule of Law- Legal frameworks should be fair and enforced impartially, particularly laws on human rights.

136 NSOU ? GE-GR-11 3. Transparency- Transparency is built on the free flow of information. Processes, institutions and information are directly accessible to those concerned with them, and enough information is provided to understand and monitor them. 4. Responsiveness- Institutions and processes try to serve all stakeholders. 5. Consensus Orientation- Good governance mediates differing interests to reach a broad consensus on what is in the best interests of the group and where possible, on policies and procedures. 6. Equity- All men and women have opportunities to improve or maintain their well-being. 7. Effectiveness and Efficiency- Processes and institutions produce results that make the best use of resources. 8. Accountability- Decision-makers in government, the private sector and civil society organisations are accountable to the public, as well as to the institutional stakeholders. This accountability differs depending on the organisation and whether the decision is internal or external to an organisation. 9. Strategic Vision- Leaders and the public have a broad and long-term perspective on good governance and human development, along with a sense of what is needed for such development. There is also an understanding of the historical, cultural and social complexities in which that perspective is grounded. The Constitution of India provides a clear mandate for democratic decentralisation not only through the Directive Principles of State Policy which exhorts the State to promote Panchayati Raj Institutions but more specifically now through the 73rd and 74th Amendments of the Constitution which seek to create an institutional framework for ushering in grass root democracy through the medium of genuinely self-governing local bodies in both urban and rural areas of the country. However, despite the constitutional mandate, the growth of self-governing local bodies as the third tier of governance in the country has been uneven, halting and slow. 9.2 ????? Origin and Evolution of Local Self-governance in India The concept of local self-governance is not new in our country and there is mention of community assemblies in the Vedic texts. Around 600 B.C. the territory north of the river
NSOU ? GE-GR-11 137 Ganga comprising modern day north Bihar and eastern Uttar Pradesh was under the suzerainty of small republics called Janapadas. In these Janapadas, the affairs of the State were conducted by an assembly consisting of local chieftains. In the post Mauryan times as well, there existed republics of Malavas and the Kshudrakas where decisions were taken by “sabhas”. The Greek Ambassador, Megasthenes, who visited the court of Chandragupta Maurya in 303 B.C. described the City Council which governed Pataliputra – comprising six committees with 30 members. Similar participatory structures also existed in South India. In the Chola Kingdoms, the village council, together with its sub-committees and wards, played an important part in administration, arbitrated disputes and managed social affairs. They were also responsible for revenue collection, assessing individual contribution and negotiating the collective assessment with the King’s representative. They had virtual ownership of village waste land, with right of sale, and they were active in irrigation, road building and related work. Their transactions, recorded on the walls of village temples, show a vigorous community life and are a permanent memorial to the best practices in early Indian polity. B. British Period The present structure of Local Self Government institutions took shape in 1688 when the British established a Municipal Corporation at Madras which was followed by creation of similar bodies at Bombay and Calcutta (1726). A corresponding effective structure for rural areas came up with the enactment of the Bengal Local Self Government Act, 1885 which led to the establishment of district local boards across the entire territory of the then Bengal province. These boards comprised nominated as well as elected members with the District Magistrate as Chairman who was responsible for maintenance of rural roads, rest houses, roadside lands and properties, maintenance and superintendence of public schools, charitable dispensaries and veterinary hospitals. Within a span of five years, a large number of district boards came into existence in other parts of the country, notably Bihar, Orissa, Assam and North West Province. The Minto-Morley Reforms, 1909 and the Montague Chelmsford Reforms, 1919, when Local Self Government became a transferred subject, widened the participation of people in the governing process and, by 1924-25, district boards had a preponderance of elected representatives and a non-official Chairman. This arrangement continued till the country’s Independence in 1947 and thereafter till the late 1950s. During the 19202 s Mahatma Gandhi made a strong plea for introduction of self- government in the villages with a view to improve their economy. He had pointed out

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that independence must begin at the bottom. Every village should be a republic or			

a Panchayat

138 NSOU ? GE-GR-11 having full Bran powers. The greater the power of Panchayats is the better for the people. However, the British Government did not pay mch heed. It was only in 1937 when the Congress Ministry was formed that attention was paid to the establishment of the Gram Panchayats and their reorganization. However, before they could achieve anything substantial in this direction, the British declared India as a Party to war without consulting the popular ministries. This resulted in the resignation of the Congress Ministries. These developments gave a severe blow to the movement for revival of Panchayats. Soon after World War II, the elections to the central and such; provincial legislatures were held and the Congress was returned to the power. Once again, it paid attention to the issue of revival of Panchayats and passed numerous Acts. When India became independent in 1947 perhaps one-third of the villages of India had traditional Panchayats and their functioning was not up to the mark. C. Post-independence Period The debates in the Constituent Assembly indicate that the leaders at that time were hesitant to introduce a wholesale change in the then prevailing administrative system and as a compromise, it was agreed that Panchayati Raj Institutions would find place in the Directive Principles of State Policy (Part IV, Article 40) which, inter alia, provides

that the State shall take steps to organise village panchayats and endow them with such powers and authority as may be necessary to enable them to function as units of self-government. But

there was a general view that local government institutions would be creatures of the State Legislature and hence there was no whittling down of the powers of the State Government. In compliance with the provisions of the Directive Principles of State Policy pertaining to establishment of village panchayats as units of self-government, an ambitious rural sector initiative, the Community Development Programme, was launched in 1952. Its main thrust was on securing socio-economic transformation of village life through people's own democratic and cooperative organisations with the government providing technical services, supply and credit. Under this programme 100 to 150 villages formed a Community Development Block and participation of the whole community was the key element of this experiment which strengthened the foundation of grassroots democracy. In 1953, the National Extension Service was introduced which was an amplified version of the Community Development Programme and aimed at transferring scientific and technical knowledge to agricultural, animal husbandry and rural craft sectors. The underlying theme was extension of innovative pilot projects and while the programme did not have any content of elected democratic institutions since they were run by government functionaries with the help of ad hoc semi- popular bodies like VikasMandal and PrakhandSamiti, yet in the midst of the euphoria

NSOU ? GE-GR-11 139 prevailing immediately after Independence in the country, they, to a great extent, caught the attention of the rural masses. 9.3 ????? Recommendations of the Balwant Rai Mehta Committee In 1956, when the Second Five Year Plan was launched, it recommended that the Village Panchayats should be organically linked with popular organisations at higher levels and in stages the democratic body should take over the entire general administration and development of the district or the sub-division excluding functions such as law and order, administration of justice and selected functions pertaining to revenue administration. To operationalise this initiative, Government appointed a committee under the chairmanship of Shri Balwantrai Mehta in 1957. The Balwantrai Mehta Committee offered two broad directional thrusts. 1. There should be administrative decentralisation for effective implementation of the development programmes and the decentralised administrative system should be placed under the control of local bodies. 2. It recommended that the CD/NES blocks throughout the country should be designed as administrative democratic units with an elected PanchayatSamiti at this level to operate as a fulcrum of developmental activity in the area. This Samiti would need guidance of technical personnel in many matters. The PanchayatSamiti was also to be equipped with sources of income. The recommendations also suggested reservation for SC/ST and women through co- option. In order to ensure coordination, the Committee recommended formation of a ZilaParishad at the district level just as an advisory body and a support structure. It would consist of all the Presidents of the PanchayatSamitis, Members of Legislative Assemblies and Members of Parliament with district level officers of the public health, agriculture, veterinary and education departments as members and the Collector as the chairman. In 1969, the first Administrative Reforms Commission in its report on State Administration recommended that the main executive organ of the Panchayati Raj system should be located at the district level in the form of “ZilaParishad” and not at the Block level as PanchayatSamiti. It was of the view that the ZilaParishad would be in a better position to take a composite view of the resources and needs of the entire district and thus will be able to formulate a plan for the area.
140 NSOU ? GE-GR-11 By the 1960s, Gram Panchayats covered 90% of the rural population in the country. Out of 399 districts in existence, 262 ZilaParishads were also constituted with varying degrees of actual power. Although a number of Panchayat structures were set up in different States at all the three tiers, they had limited powers and resources and the essential idea that all developmental activity should flow only through the Block PanchayatSamitis lost ground. Moreover, important schemes like the SFDA, DPAP and ITDP were not brought within the purview of the elected ZilaParishad even in States like Maharashtra and Gujarat where effective financial decentralisation had taken place. Unfortunately, after the intensive stage of the Community Development programme, there was a visible trend towards centralisation. The net result was that, by the 1970s, these bodies remained in existence without adequate functions and authority. However, by end 1980s, except Meghalaya, Nagaland, Mizoram and the Union Territory of Lakshadweep, all other States and UTs had enacted legislation for the creation of PRIs. In 14 States/ UTs, there was a three-tier system, in 4 States/UTs it was a two-tier structure and in 9 States/ UTs only one tier functioned. 9.4 ????? Recommendations of the Asoka Mehta Committee In 1977, Government formed a committee under the chairmanship of Shri Asoka Mehta to go into the working of Panchayati Raj Institutions and to suggest measures to strengthen them into effective local apparatus for decentralised planning and development of the rural areas. This was considered necessary in view of the Government’s high priority to rural development which included the need to increase agricultural production, create employment and eradicate poverty. The Asoka Mehta Committee was of the view that the democratic process could not stop at the state level. the committee was f following opinions. 1. The concept of Panchayati Raj, like democracy at national and state levels, is both an end as well as a means. It was an inevitable extension of democracy to the grass roots which in turn makes it the base of the democratic pyramid of the country. In the end, Panchayati Raj should emerge as a system of democratic local government discharging developmental, municipal and ultimately regulatory functions. 2. Based on the Maharashtra-Gujarat model which was commended by the first Administrative Reforms Commission and a number of other committees, the Committee chose the district as the first point of decentralisation below the State level.

NSOU ? GE-GR-11 141 3. The next level of self-governing institutions recommended by this Committee was the MandalPanchayat which was to cover a population of around 10,000 to 15,000. It was thought that the cluster of villages falling in the jurisdiction of the Mandalpanchayat would turn into a growth centre. 4. As an ad hoc arrangement, the Committee recommended continuation of the PanchayatSamiti at the Block level, not as a unit of self-governance but as a nominated middle level support body working as an executing arm of the ZilaParishad. Similarly, at the village level it thought of a nominated village level committee consisting of (a) local member elected to MandalPanchayat, (b) local member elected to the ZilaParishad, and (c) a representative of small and marginal farmers. 5. In the total view of the set-up, the ZilaParishad was recommended to take up planning for the district as a whole, to coordinate the programmes and to guide the lower PRI tiers. There was recommendation for transfer of all development functions and related government staff to the control of the ZilaParishad. 6. The recommendations also called for creation of a machinery for taking up the district level planning exercise and for this it recommended stationing professionally qualified teams of experts at the district headquarters. The annual plan thus prepared had to be placed before the ZilaParishad for their comments/views. 7. To assist the ZilaParishad, it recommended creating a senior post known as the Chief Executive Officer who could provide support to the body in formulation and implementation of policies. In order to ensure effective coordination among officers posted at the district, this officer could be senior in rank to the District Collector. Although a number of committees were formed between 1978 and 1986 to look into various aspects of strengthening the local self-governance institutions such as the committees under Shri C.H. Hanumantha Rao, Shri G.V.K. Rao and Shri L.M. Singhvi, with minor variations introduced by these subsequent committees in the 1980s, the recommendations of the Asoka Mehta Committee were generally well received and led many of the States to introduce appropriate amendments in their Panchayati Raj Acts. Karnataka, Maharashtra, Andhra Pradesh, West Bengal and Gujarat adopted the new arrangement, but U.P., Bihar, Orissa, Punjab and Haryana held back. Some of them did not hold elections even to the existing bodies.The Committee which submitted its report in 1978 was also of the view that

142 NSOU ? GE-GR-11 despite the rhetoric, Panchayat empowerment was not of much use unless it received Constitutional standing. Hence, there was need for introducing a Constitutional amendment on this subject. With some variations, these recommendations form the basis of the PRI format in existence in the country today. 9.5 ????? The 64 th and 65 th Constitutional Amendment Bills The next landmark in decentralised governance occurred with the 64th and 65th Constitutional Amendment Bills introduced in July 1989 by the Government of Shri Rajiv Gandhi. The basic provisions of the Bills were: (a) it should be mandatory for all States to set up PRIs/ULBs, (b) the elections to be conducted by the Election Commission, (c) tenure of Panchayats/ULBs to be five years and, if dissolved before time, fresh elections should be held within six months, (d) all seats (except those meant for the representatives of other institutions) to be filled through direct elections, (e) reservation of seats to be made for SC/ST/Women, (f) Local Bodies to be entrusted with more functions e.g. minor irrigation, soil conservation, bio-gas, health, benefits to SC/ST etc. (g) planning and budgeting systems be introduced at the panchayat level, (h) the State Legislature to authorisePanchayats/ ULBs to levy taxes/tolls and fees, (i) a separate commission to review the Local Body finances, and (j) PRI/ULB accounts to be audited by the CAG. The Bill could however not be passed in the RajyaSabha. In 1990, a combined Constitution Amendment Bill, covering both PRIs and ULBs was tabled in Parliament. It was a skeleton legislation which left the details to be crafted by the State Governments in their State enactments; even matters concerning elections were left completely to the discretion of the State Government. With the dissolution of the Government, this Bill too lapsed. 9.6 ????? The 73 rd Constitutional Amendment Bill Finally in 1992, after synthesising important features of the earlier exercises on this subject, Government drafted and introduced the 73rd Amendment Bill in Parliament which were passed in 1993. The 73rd Amendment to the Constitution constitutes a new chapter in the process of democratic decentralisation in the country. In terms of these amendments, the responsibility for taking decisions regarding activities at the grass root level which affect people's lives directly would rest upon the elected members of the people themselves.

NSOU ? GE-GR-11 143 Articles 243, 243A to 243-O were added as parts of newly inserted Part IX of the Constitution. The amendment took into consideration following aspects. 1. Article 243 B of the Constitution envisages that all the States/ UTs, except those with populations not exceeding 20 lakhs, will have to constitute

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a three-tier system of Panchayats i.e. at the village, intermediate and district levels. The

electorates at Gram Panchayat level have been named as the Gram Sabha which elects the representatives to Gram Panchayat by way of direct election. 2. Article 243D provides for reservation of seats at all levels for Scheduled Castes (SCs), Scheduled Tribes (STs) and women. While the reservation for the SCs/ STs is as per their actual proportion in

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population of the concerned area, it is provided that not less than one-third of the total seats in all the tiers will be reserved for women.

The States are empowered to reserve the offices of the Chairpersons at all the three tiers. 3. The Constitution now provides that every PRI shall continue for a period of five years. The States have also been empowered to allow the PRIs in their respective legislative Acts to levy, collect and appropriate several tolls and taxes. 4. With this the PRIs at all the tiers will be able to generate financial resources at local-level and make expenditure in the desired field as per locally-felt needs. The State laws may lay down the procedure to be followed, as well as the limits of such taxes/ levies. The State governments may also assign to the panchayats various taxes and duties collected by it. The State governments are required to appoint a State

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Finance Commission to review the financial position of the PRIs and make recommendations with regard to the

distribution of net proceeds of taxes between the States and the PRIs, assignment of certain taxes exclusively to the PRIs and the grants-in-aid. 5. Another set of important changes made in the Constitution pertain to the elections to the PRIs. To ensure free and fair elections to these institutions, the 73rd Amendment provides for setting up of a State Election Commission in every State and the State Election Commissioner is appointed by the Governor of the State concerned. With a view to ensure the independence of the State Election Commission, it is laid down that the State Election Commissioner can be removed only in the same manner and on the same grounds as the Judge of a High Court.

144 NSOU ? GE-GR-11 6. These institutions are also responsible for implementation of schemes aimed at socio-economic development and exercise powers delegated in respect of 29 developmental items as prescribed in 11th Schedule of the Constitution. These items include: land improvement, irrigation, animal husbandry, fisheries, education, women and child development, etc. 7. As per Articles 243G and 243H, the PRIs are entrusted with the responsibility of preparing micro-plans for economic development, beginning at panchayat level. 8. The PRIs have been made responsible for preparing District, Block and Panchayat level plans for ensuring economic development in their respective areas. The flow of funds for economic development would be based on such plans. With the power to levy several taxes at Panchayat level, these provisions would empower the PRIs financially and make them self-reliant. In totality, the intention of these amendments is to assign a position of command to them in the democratic framework of the country. But there seems to be an area of weakness in the constitutional scheme. Local governance being a State subject under Schedule VII, the scope of implementation of these provisions is, to a large extent, dependent on the intention and strength of the State Panchayati Raj enactment. The challenge is to ensure an architecture for the State law which is in total harmony with the spirit of the 73rd Amendment. 9.7 ????? Panchayats (Extension to the Scheduled Areas) Act, 1996 (PESA) Village level democracy became a real prospect for India in 1992 with the 73rd Amendment to the Constitution, which mandated that resources, responsibility and decision making be passed on from central government to the lowest unit of the governance, the Gram Sabha or the Village Assembly. A three tier structure of local self-governance was envisaged under this amendment. Since the laws do not automatically cover the scheduled areas, Panchayats (Extension to Scheduled Areas) Act, 1996 or PESA is a law enacted by the Government of India to cover the "Scheduled areas", which are not covered in the 73rd Amendment or Panchayati Raj Act of the Indian Constitution. It was enacted on 24th December 1996 to enable Gram Sabhas to self-govern their natural resources. The Act extended the provisions of Panchayats to the tribal areas of nine states that have Fifth
NSOU ? GE-GR-11 145 Schedule Areas. Most of the North eastern states under Sixth Schedule Areas (where autonomous councils exist) are not covered by PESA, as these states have their own Autonomous councils for governance. The nine states with Fifth Schedule areas are: Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh, Jharkhand, Maharashtra, Madhya Pradesh, Orissa and Rajasthan. It is an Act to provide for the extension of the provisions of Part IX of the Constitution relating to the Panchayats to the Scheduled Areas. "Scheduled Areas" means

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the Scheduled Areas as referred to in Clause (1) of Article 244 of the Constitution.			

The Act extended the provisions of Panchayats to the tribal areas of nine states that have Fifth Schedule Areas. Revised Reservation Policy for Women in Panchayati Raj Institutions, 2009 In 2009 the Union Cabinet of the Government of India approved 50% reservation for women in Panchayati Raj Institutions (PRI). The Indian states Andhra Pradesh, Bihar (first state among all to reserve 50% of seats for women), Chhattisgarh, Himachal Pradesh, Jharkhand, Kerala, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Sikkim, Tamil Nadu, Tripura, West Bengal and Uttarakhand have implemented 50% reservation for women in PRIs. The majority of candidates in these Panchayats are women. Currently 100% of elected members in Kodassery Panchayat in Kerala are women. 9.8 ????? The Three Tier System The states of Goa, Jammu and Kashmir, Mizoram, Meghalaya, Nagaland and Sikim have two-tier system of panchayats, one at the village level and the second at the Zila or District level. In Jammu and Kashmir, block is the second level. In all other states Panchayati Raj Institutions have a three-tier system- village as first level, block or janapad as second level and zila or district as the third level. 1. Village Level Village is the basic unit of Panchayati Raj Institutions. The word 'village' by and large synonymous with revenue estate. Through word 'village' use in singular it will also mean 'villages' when read in relevant context. An area recorded as revenue estate in revenue records of a district can only be called village. The unit of local government here is called gram panchayat. In the structure of the Panchayati Raj Institution, the gram panchayat is the lowest unit. The panchayats have two types of functions.

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146 NSOU ? GE-GR-11 A. Mandatory Functions- Sanitation, conservancy and drainage, prevention of public nuisances, drinking water, construction and maintenance of village roads, construction and repair of public buildings, registration of births and deaths, opening and maintenance of cremation and burial grounds, rural electrification, poverty alleviation programme, preparation of annual budget and development plans, construction and maintenance of cattle sheds, ponds etc. social farm forestry, fuel and fodder, slaughter houses, public parks and playgrounds, agriculture, poultry and fisheries etc. B. Discretionary Functions- Agriculture, animal husbandry and dairy development, minor irrigation, small scale industries, housing, electricity and non-conventional energy, rural development programmes, education cultural affairs and heritage, public health etc. In addition, the village panchayats may be assigned additional functions by the state governments and ZilaParishads. 2. Block Level Block or Union is the intermediate level or tehsil level of local self-government in rural India. There are a number of variations in nomenclature for block level panchayat. For example in Andhra Pradesh, it is known as Mandal Praja Parishad, Anchalik Panchayat in Assam, Taluka Panchayat in Gujrat, Mandal Panchayat in Karnataka. In general it is known as Panchayat Samiti in Bihar, Jharkhand, Haryana, Himachal Pradesh, Tripura, West Bengal, Maharashtra, Orissa, Punjab and Rajasthan. The PanchayatSamiti has

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jurisdiction over the entire Block area excluding such portion of the Block area as is included in a Municipality or is under the authority of a Municipal Corporation, a Cantonment Board or a Notified Area Committee constituted under any law for the tone being in force. Usually, a PanchayatSamiti

consists of 20 to 60 villages depending on area and population. The
NSOU ? GE-GR-11 147 average population under a Samiti is about 80,000, but the range is from 35,000 to 1, 00,000. The principal function of the PanchayatSamiti is to co-ordinate the activities of the various panchayats within its jurisdiction. The PanchayatSamiti supervises the work of the Panchayats and scrutinizes their budgets. It also reserves the right to suggest measures for improving the functioning of the Panchayats. The Samiti is charged with the responsibility of preparing and implementing plans for the development of agriculture, Land improvement and Soil Conservation, Minor Irrigation, Water Management and Watershed Development, Poverty Alleviation Programme, Animal Husbandry, Dairying and Poultry, Fisheries, Khadi Village and Cottage Industries, Rural Housing, Drinking Water,

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Social and Farm Forestry, Minor Forest Produce, Fuel and Fodder,

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Roads, Buildings, Bridges, Ferries, Waterways and other means of communication,

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Non-Conventional Energy Sources, Education including Primary and Secondary Schools,

Technical Training and Vocational Education, Adult and non-formal education, Cultural Activities, Markets and Fairs, Health and Family Welfare,
Women and Child Development, Social Welfare including Welfare of the Handicapped and Mentally Retarded,

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Welfare of the weaker sections and in particular of the Scheduled Castes and Backward Classes, Maintenance of

Community Assets, Public Distribution Systems, Rural Electricification, Co-operation, Libraries and

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Such other functions as may be entrusted by the State Government. 3.

District Level Except in the State of Jammu and Kashmir, the District/ ZilaPanchayat constitutes the apex body of the three-tier structure of the Panchayati Raj System in India. The ZilaParishad having jurisdiction

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over the entire district excluding such portions of the district as are included in a municipality or cantonment area or are under the authority of a municipal corporation or a notified area committee constituted under any law for the time being in force. Generally, the

ZilaParishad is an elected body. It consist of representatives of the PanchayatSamiti, all

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members of the State Legislative and the Parliament representing a part or whole of the district,

all district level officers of the Medical, Public Health, Public Works, Engineering, Agriculture, Education and other development departments. The ZilaParishad, for the most part, performs co-coordinating and supervisory functions. It coordinates the activities of the Panchayat Samiti falling within its jurisdiction. In certain states the ZilaParishad also approves the budgets of the PanchayatSamitis. It also renders
148 NSOU ? GE-GR-11 Number of District, Intermediate and Village Panchayats in States of India, September 2019 Name of the State District Intermediate Village Panchayats Panchayats Panchayats Andaman and Nicobar Islands 2 7 70 Andhra Pradesh 13 660 13065 Arunachal Pradesh 25 177 1785 Assam 26 191 2199 Bihar 38 534 8386 Chhattishgarh 27 146 10978 Dadra and Nagar Haveli 1

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N.A. 20 Daman and Diu 2 N.A. 18 Goa 2 N.A. 191 Gujarat 33 248 14292 Haryana 21 126 6199 Himachal Pradesh 12 78 3226 Jammu and Kashmir 22 306 4482 Jharkhand 24 263 4350 Karnataka 30 176 6021 Kerala 14 152 941 Lakshadweep 1 N.A. 10 Madhya Pradesh 51 313 22812 Maharashtra 34 351 27869 Manipur 6 N.A. 161 Odisha 30 314 6798 Puducherry N.A. 10 108 Punjab 22 150 13260 Rajasthan 33 295 9888 Sikkim 4 N.A. 185

Tamil Nadu 31 385 12524 Telengana 32 540 12772 Tripura 8 35 591 Uttarakhand 13 95 7762 Uttar Pradesh 75 822 58766 West Bengal 22 342 3340 Total 654 6716 253069 N.A.- Not Applicable Source: https://lgdirectory.gov.in
NSOU ? GE-GR-11 149 necessary advice to the Government with regard to the implementation of the various developmental programmes. It is also responsible for the maintenance and development of Agriculture, Irrigation ground water resources and Watershed Development, Horticulture, Statistics of various projects

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and programme, Rural electrification including distribution of electricity, Distribution of Essential commodities, Soil Conservation, Marketing, Social Forestry, Animal Husbandry and Dairying, Minor Forest Produce and Fuel and Fodder, Fisheries, Household and Small Scale Industries including food processing, Rural Roads, Health and Hygiene, Rural Housing, Education, Social Welfare and Welfare of Weaker Sections, Poverty Alleviation Programmes, Social Reforms Activities, Verification of weights and measures in shopping establishments, Promotion of thrift and savings through and such programmes

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vested by the State Government with such powers under any other law as the State Government may deem fit.

There is also a provision that

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the ZilaParishad of two or more adjacent districts may jointly undertake and execute any development scheme on such terms and conditions as may be mutually

agreed upon. 9.9 ????? Number of District, Intermediate and Village Panchayats The number of Village Panchayats in the country as on September, 2019 was 2,53,069; of the Intermediate Panchayats 6,716 and of the District Panchayats 654. Critical Analysis Consequent to the 73rd Constitutional Amendment as well as the Supreme Court's rulings which effectively mandate that local authorities are also to be treated as 'Government or State;' the PRIs have acquired substantial legitimacy, are recognised as an instrument of the Government, and have created participatory structures of grass roots democracy for the rural people. Creation of Constitutional bodies like the State Election Commissions and the State Finance Commissions have also given permanency and stability to these institutions. The Panchayati Raj Institutions (PRIs) in India have, over the years, developed certain critical strengths, although they are characterised by several systemic weaknesses and constraints as well. Strengths Each village has its own set of issues, which only the locals can understand. Members of a Panchayat are far more cognizant of the region-specific problems, and thus they are
150 NSOU ? GE-GR-11 capable of taking a more informed decision in favour of the people of their village. Taking into consideration the specified needs of their inhabitants, the panchayats work accordingly. The panchayats undertake works of varied levels starting from creation of necessary establishments such as primary schools, to hygiene-related issues, to water requirements, to seek the central government's help towards generating jobs at the village level as well. They also have a major share of contribution towards mobilisation of local resources, encouraging, large-scale community participation, planning at the lower levels, reduction of corruption as well as improvement in quality oh nations working. Weaknesses and Constraints ? Few states have not yet rested and delegated the powers to the panchayats to the true meaning and spirit of the 73rd constitutional amendment. Even if the functions have been delegated, the required powers to execute the said functions are not with the PRIs. ? There is a general lack of manpower in the PRIs, particularly at the village level. With a limited number of officials, even after the complete devolution of powers, it may become difficult for the PRIs to look after all the works assigned to them by the State government. Unless the PRIs are equipped with adequate staff to discharge their functions ? As required by the panchayat act, the gram sabhas have not been efficient in ensuring and empowering the participation of people at the lower levels to the fullest sense possible. ? Powers given to the State Election Commissions also vary from State to State. No uniformity is ensured in this regard. Also, recommendations of State Finance Commissions (SFCs) are generally not taken seriously. ? The PRIs have a varied menu of potential taxes such as on professions, entertainment, tolls, users charges etc., but remain crippled by lack of elastic revenue sources. Although the 11th and 12th Finance Commissions have provided untied grants to these institutions, their financial capacity remains suspect. ? While women got political representation, the real power was usurped by their husbands, "The SarpanchPati" depriving them of any meaningful gains. Caste and gender-based discrimination are still prevalent and despite earning a political

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NSOU ? GE-GR-11 151 position, women are denied their due respect. Widespread illiteracy and ignorance further inhibit their capacity to perform. ? Illiteracy has been one of the most glaring stumbling blocks in achieving the laid down goals of the new Panchayati Raj system. Conclusion The Panchayati Raj Institutions exist as over-structured but under-empowered organisations, boasting of Constitutional status but suffering from lack of effective devolution of powers and functions from the State Governments.At the same time, the structure of district administration under the control of the Collector/District Magistrate, characterised by a command structure and lack of horizontal coordination at the grass roots level, has become somewhat anachronistic in the modern democratic framework of our polity. One of the greatest shortcomings of any centre-sponsored rural development programme is its inability to 'trickle down' to the true intended beneficiaries or the poorest of the poor, as happened in case of the PRIs. In order to make local administration more responsive, transparent and accountable to citizens, there is need to have a representative government not only in the Union and States but also at the district and village levels with an equitable division of functions among them. However, any such reform agenda is constrained by the lack of cooperation between the legislature and the representatives of local bodies as well as the lack of capacity of the Panchayati Raj Institutions to take on enhanced responsibilities because of absence of trained personnel as well as their financial incapacity. Most necessary are the attitudinal changes.
152 NSOU ? GE-GR-11 Unit 10 ????? Rural Development Policies and Programmes in India Structure 10.0 Introduction 10.1 Need for a Rural Development Policy 10.2 Goals of Rural Development Policy 10.3 Strategies of Rural Development Policies 10.4 Plan Period-wise Rural Development Programmes 10.5 Categories of Rural Development Programmes 10.6 Community Development Programme 10.7 Small Farmers Development Agency and Marginal Farmers and Agricultural Labours Development Agency (SFDA and MFALDA) 10.8
Drought Prone Area Programme (DPAP) 10.9 Minimum Need
Programme (MNP) 10.10

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Integrated Rural Development Programme (IRDP) 10.11 Training of Rural Youth for Self-Employment (TRYSEM) 10.12 Development of Women and Children in Rural Areas (DWCRA) 10.13

Jawahar Rozgar Yojana (JRY) 10.14
Swarnjayanti Gram Swarozgar Yojana (SGSY) 10.15 Rashtriya Swasthya Bima Yojona (RSBY) 10.0 ????? Introduction In the discussion of development the terms 'Policy' and 'Programme' are used frequently. However, the terms are not synonymous. The term 'Policy' may be defined as a definite course of action selected, as by a government, an institution, a group or an

NSOU ? GE-GR-11 153 individual, from among alternatives, which are expected to guide and usually to determine present and future decisions under certain given condition. Thus rural development policy implies the actions taken by the government in pursuit of certain objectives of rural development. A policy has to be translated into a number of programmes before it can be implemented. Thus a policy subsumes some programmes, which are narrower in scope than policies, but more specific with regard to its mission, mode, concerned authority and area of implementation. In India there is a long history of government intervention in the rural part of its economy. In the pre-independence era, the main aim of the British Government in this regard was to promote export of food and raw materials to the Great Britain. Basically there was no state policy to develop the resources of this country for the welfare of its people. Introduction of land tenure system, opening up of road and rail communications, and promotion of export trade in certain agricultural commodities were some of the important measures taken by the British Government, which had some benefits for the rural economic sector. In January 1946, the then Government of India issued a 'Statement of Agriculture and Food Policy in India', mentioning some objectives, and measures, and respective roles of the centre and the provinces. Basically in India there was no unified national policy for rural development until the year 2000, when the first National Agricultural Policy was announced. However, there was a remarkable change in paradigm of rural development in India since the Government of India launched a New Economic Policy in August 1991. The essential elements of the policy were privatisation, deregulation and globalization. The statist model of rural development characterized by the predominant role of the state in initiating, fostering and directing rural development is likely to be abandoned giving way to market-driven and guided model. 10.1 ????? Need for a Rural Development Policy Public policy is definitely a form of social control. Some basic reasons making government intervention in rural sector can be specified in this context. 1. India's commitment to set up a 'socialist pattern of society', 2. Violent fluctuations in agricultural production, prices and income 3. Rural poverty and income inequality, 4. Small, scattered and unorganised rural enterprises and 5. Poor basic infrastructure in rural areas.

154 NSOU ? GE-GR-11 10.2 ????? Goals of Rural Development Policy Rural development policies are designed to improve the conditions under which rural people work and live. The goals of the policies are governed by what people desire, and measures the policies by what people think the government can and ought to do to bring about desired change. From the 'Directive Principles of State Policy' enshrined in the India's Constitution, it is possible to derive two dominant goals of economic policy: first, increasing the national income; and second, improving the distribution of national income among the members of the society. These goals are reflected in India's economic policies that are enunciated in the five year plans. The goal which seek to achieve 'growth with equity' need to be seen in the context of four important dimensions of state policy. These are as follows: 1. The quality of life of citizens, 2. The generation of productive employment, 3. Regional balance, 4. Self-reliance. 10.3 ????? Strategies of Rural Development Policies Review and critical analysis of rural development policies adopted in India reveal four different strategies for development. These are as mentioned below. i. Holistic and Equity-oriented Approach-

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A very comprehensive but integrated view of the basic problems of poverty, unemployment and inequality

characterises this approach. It

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seeks to address the physical, economic, technological, social, motivational, organisational and political bases of the problems. Multiple goals of the strategy are sought to be achieved by building capacity of the community

and making it a participant in the process of development. The Community Development Programme launched during the First Five Year Plan is the example of this approach. Other subsequent policies of similar nature include the Integrated Rural Development Programme, the

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National Rural Employment Programme, theTraining of Rural Youth for Self-employment etc. 1

NSOU ? GE-GR-11 155 ii. Growth-oriented Strategy- Since middle of the Second Five Year Plan a need for new approach was felt, which is required for matching the agricultural production with the increasing demand of the expanding population of the country. In 1957-58, the country experienced its

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first post-independence food crisis. Based upon the recommendation of the Ford Foundation-sponsored Team of American Agricultural Production Specialists, Intensive Agricultural District Programme (IADP)

was launched in 1960-61. In contrast to the equity criterion of the CDP, focus was laid on concentration principle in deploying resource in this programme. The aim was to achieve rapid increase in agricultural production through the e use of complementary inputs and services. Other significant programmes in this category include the Integrated Agricultural Area Programme, the High Yielding Varieties Programme, the Intensive Cattle Development Programme etc. iii. Welfare-oriented Strategy- Being an exception to the two already mentioned strategies, this approach attempts to promote welfare of the rural population, taking rural poor into special consideration. The notion inherent in this approach is that rural people are not competent enough to identify and mitigate their problems. Government specialists can identify their need and meet them with financial and administrative resources available with the government. The Minimum Needs Programme, the Applied Nutrition Programme, the Mid-day Meals Programme, the RashtriyaSwasthyaBimaYojona etc. were programmes launched with this approach. iv. Facilitating and Participatory Strategy-This approach aims to help rural people to help themselves though their own organisations, active participation and support system. Role of the government is to facilitate their self-help effort by making provision for technology and resources. This is a kind of empowerment that helps the rural people identify and resolve their own problems. The Operation Flood launched in 1970 was planned in this line of thought. 10.4 ????? Plan Period-wise Rural Development Programmes Since independence a large number of programmes has been undertaken by the Central and the State governments in order to improve the living standard of the rural poor and 2
156 NSOU ? GE-GR-11 to bring self-sufficiency under various Five Year Plans. A list of some important rural development programmes has been furnished below. List of

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Rural Development Programmes in India (1951-56 to 2012-17) Plan Period Programmes Year of Introduction First Five Year Plan Community Development Programme 1952 (1951-56) National Extension Service 1953 Second Five Year Khadi and Village Industries Programme 1957

Plan(1956-61) Village Housing Project Scheme 1957

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Intensive Agricultural District Programme. 1960 Third Five Year Plan Applied Nutrition Programme 1962 (1961-66) Rural Industries Project 1962 Intensive Agriculture Area Programme 1964 High Yielding Variety Programme 1965 Annual Plan, 1966-67 Well-Construction Programme 1966 Annual Plan, 1967-68 Rural Work Programme 1967 Annual Plan, 1968-69 Tribal Development Block 1968 Rural Manpower Programme 1969 Composite Programme for women and

Pre-School Children 1969 Fourth Five Year Plan Drought Prone Area Programme 1970 (1969-74) Crash

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Scheme for Rural Employment 1971 Small Farmer Development Agency 1971 Tribal Area Development Programme 1972 Pilot Projects for Tribal Development 1972 Pilot Intensive Rural Employment Programme 1972 NSOU ? GE-GR-11 157 Minimum Needs Prognunme 1972 Command Area Development Programme 1974 Fifth Five Year Plan Hill Area Development Programme 1975 (1974-79) Special Livestock Production Programme 1975 Food for Work Programme 1977 Desert Development Programme 1977 Whole Village Development Programme 1979 Training of Rural Youth for Self Employment 1979 Integrated Rural Development Programme 1979 Sixth Five Year Plan National Rural Employment Programme 1980 (1980-85) Prime Minister's New 20-

Points Programme 1980 Rural Landless Employment Guarantee 1983

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Programme Development of Women and Children in 1983 Rural Areas Seventh Five Year Plan

Integrated Rural Energy Planning Programme 1985 (1985-90) Indira AwaasYojana 1985 Special Livestock Breeding Programme 1986 Eighth Five Year Plan JawaharRozgarYoyana 1989 (1980-85) Prime Minister's RozgarYojana 1993 Employment Assurance Scheme 1993 Ninth Five Year Plan Basic Minimum Service 1996 (1997-2002) Jawahar Gram SamridhiYojana 1998 Swarnjayanti Gram SwarozgarYojana 1999 SampoornaGrameenRozgarYojona 2001 Plan Period Programmes Year of Introduction
158 NSOU ? GE-GR-11 Pradhan Mantri Gram SadakYojna 2000 Sarva Shiksha Abhiyan 2002 Swajaldhara (Rural Sanitation and Drinking 2002 Water) Tenth Five Year Plan Mahatma Gandhi National Rural (2002-07) Employment Guarantee Act 2005 National Rural Health Mission 2005 Rajiv Gandhi Grameen Vidyutikaran Yojana 2005 Janani Suraksha Yojana 2005 Eleventh Five Year Aam Aadmi BimaYojna 2007 Plan (2007-12) Rashtriya Swasthya BimaYojona 2007 National Rural Drinking Water Programme 2009 National Rural Livelihood Mission 2011 Twelfth Five Year Plan Roshni: Skill Development Scheme for (2012-17) Tribals 2013 Pradhan Mantri Jan DhanYojana 2014 Deen Dayal Upadhyay Grameen Kaushal 2014 Yojna Swachchh Bharat Mission-Gramin 2014 Sansad Adarsh Gram Yojna 2014 Deendayal Upadhyaya Gram Jyoti Yojana 2015 10.5 ????? Categories of Rural Development Programmes Rural development programmesa dopted by the Government of India during different phases may be broadly categorised into five groups, like - (1) Agricultural Development Plan Period Programmes Year of Introduction
NSOU ? GE-GR-11 159 Programme, (2) Employment Generation Programme, (3) Area Development Programme, (4) Social Development Programme, and (5) Infrastructural Development Programme. (A) Agricultural Development Programme 1. Land Reforms (LR) 2. Bhoodan Movement (BM), 1951 3. Community Development Programme (CDP), 1952 4. National Extension Service (NES), 1952 5. Panchayati Raj (PR), 1959 6. Integrated Agricultural District Programme (IADP), 1960 7. Intensive Agricultural Area Programme (IAAP), 1964 8. High Yielding Variety Programme (HYVP), 1965 9.

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Small Farmers Development Agency (SFDA), 1969 10. Marginal Farmers and Agricultural Laborers Development Agency (MFALDA), 1969. (

B) Employment Generation Programmes 1. Integrated Rural Development Programme (IRDP), 1979 2. Rural Industrie Project (RIP), 1962 3. Crash Programme for Rural Employment (CPRE), 1971 4.
Food for Work
Programme (FWP), 1977 5.

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National Rural Employment Programme(NREP), 1980 6. Rural Landless Employment Guarantee Programme, (RLEGP), 1983 7. JawaharRozgarYojana(JRY), 1989 8. Employment Assurance Scheme (EAS), 1993 9.

Jawahar Gram SamridhiYojana (JGSY), 1999 10.

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Swarnjayanti Gram SwarozgarYojana (SGSY), 1999 11. SampoornaGrameenRozgarYojana (SGRY), 2001 12. Mahatma Gandhi National Rural Employment Guarantee Act, 2005 160

NSOU ? GE-GR-11 (C) Area Development Programme 1. Tribal Area Development Agency (TADA), 1962/ Integrated Tribal Development Programme(ITDP) 2. Drought Prone Area Programme(DAPA), 1970 3. Command Area Development Programme (CADP), 1974 4. Desert Area Development Project (DDP), 1977 5. Integrated Rural Energy Programme(IREP), 1992. (D) Social Development Programme 1. Minimum Need Programme (MNP), 1972 2. Twenty Points Programme and Revised Twenty PointProgramme(TPP), 1975 3. Training for

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Rural Youth for Self-employment (TRYSEM), 1979 4. Development of Women and Children in Rural Area (DWCRA), 1982 5. Accelerated Rural

Water Supply Programme(ARWSP), 1986 6. Million Wells Scheme (MWS), 1989 7. Indira AwaasYojana(IAY), 1989 8. Rajiv Gandhi National Drinking Water Mission (RGNDWM), 1991 9. National Social Assistance Programme (NSAP), 1995 10. Mid-day Meal Scheme (MMS), 1995 11. Credit-cum-Subsidy for Rural Housing Scheme, 1999. 12. SarvaShikshaAbhiyan (SSA), 2002 13. JnaniSurakshaYojona (JSY), 2005 14. National Rural Health Mission (NRHM), 2005 15. Swachh Bharat Mission (SBM), 2014 16. Pradhan Mantri Jan ArogyaYojana (PMJAY), 2018 (E) Infrastructural (Physical) Development Programme 1. Accelerated Rural Water Supply Programme (ARWSP), 1973 2. Rajiv Gandhi National Drinking Water Mission (RGNDWM), 1991
NSOU ? GE-GR-11 161 3. Rajiv Gandhi GrameenVidyutikaranYojana (RGGVY), 2005 4. National Rural Drinking Water Programme (NRDWP), 2009 5. Pradhan Mantri Jan DhanYojana (PMJDY), 2014 6. DeendayalUpadhyaya Gram JyotiYojana (DDUGJY), 2015 7. Pradhan MantriAwaasYojana (Gramin) (PMAY-G), 2016 Selected important rural development programmes from different categories have been discussed in the following section. Other relevant programmes have been discussed under different units of this SLM. 10.6 ????? Community Development Programme The Community Development Programme (CDP) was launched during the First Five Year Plan period on 2nd October 1952. The CDP was consideredto be the process

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by which efforts of the people themselves are combined withthose of governmental authorities to improve

the economic, social and cultural communities to integrate them into the life of the nation and to the responsibility of the Department of Rural Development under the Ministry of Agriculture. Objectives

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The main objective of CDP was to secure the total development of the material and human resources of rural areas and to develop

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local leadership and self-governing institutions. The central idea behind CDP was to raise the local community to higher level of living with active participation and initiatives of the local people.

This objective was targeted to be attended by increasing production of food and other agricultural products rapidly. This was again targeted to be achieved by strengthening programmes of natural resource development, like minor irrigation and soil conservation, by improving supply of farm inputs and by providing agricultural extension services to the farmers. Main Features 1. Through CDP a systematic approach made to reach as much as rural poor as possible. 2. Emphasis was on development activities more particularly in the field of agriculture, animal husbandry, social education, public health, programme for women, children and youth.
162 NSOU ? GE-GR-11 3.

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Overall development of rural community can be brought about only with effective participation of the people. 4.

There must be provision of necessary institutional structure and services including various basic democratic village institutions, and coordination of technical and other services. 5.

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The problems of rural development have to be viewed from a holistic perspective and

the efforts to solve them need to be multidimensional. 10.7 ????? Small Farmers Development Agency and Marginal Farmers and Agricultural labours Development Agency (SFDA and MFALDA) It was felt shortly after the Green revolution that the small and marginal farmers and also the agricultural labourers were not benefited from it. The gap between the rich farmers and small and marginal farmers started widening. Besides there was also increase in regional variations in agricultural development. Thus the All India Rural Credit Review Committee in 1969 in its report recommended for the establishment of a country-wide network of pilot project in the form special programmes, the Small Farmers Development Agency (SFDA) and the Marginal Farmers and Agricultural Labourers Development Agency, (MFALDA). During the Fourth Five Year Plan, the government of India gave more stress on eradication of poverty, under which a whole lot of development programmes of the weaker sections of the society was launched. In 1970-71 SFDA and MFALDA were launched as parts of this mission. Later, SFDA and MFALDA were later on merged with Integrated Rural development Programme. (IRDP). Objectives The basic objectives of these programmes were to promote small/marginal farmers through facilitating extensive use of new agricultural technology and inputs like high yielding variety of seeds and fertilisers, and additional production assets like wells, tube-wells, pump sets, bullocks and farm-implementation. Identification of small features, marginal farmers, agricultural laboures and their problems, formulation and execution of model plans to resolve the different problems and to review the progress of the execution of these activities as well as the effectiveness of the efforts undertaken to benefit the target groups, they were given necessary assistance by existing agencies and financial institutions.

NSOU ? GE-GR-11 163 Main Features 1. Provision of supplementary sources of income like diary and other type of animal husbandry, bullock carts, and small handicrafts were made in which special loans at concessional rates were granted. 2. Further incase of all the productive schemes, 25 per cent of the total amount was sanctioned as subsidy for the small farmers and 33.33 per cent for the marginal farmers and agricultural labourers and the rest as loans. 3. The main emphasis of the SFAD/MFALDP was on the crop husbandry in irrigated and rain fed areas. 4. The programme was duly supported by activities like development of minor irrigation, soil conservation and land development, water harvesting techniques, consolidation of holding coupled with a shaping and construction of watercourses and field channels. 5. Under the programme emphasis was also laid on strengthening the cooperative sector for smooth flow of credit to the identified small and marginal farmers. 6. Provisions were also made for strengthening the market and go down facilities. 10.8 ????? Drought Prone Area Programme (DPAP) Indian agriculture mostly heavily depends upon the monsoon. Inadequate and erratic rainfall often results in drought, which causes scarcity of drinking water and food, more so in the rural areas. Severe drought condition of the mid-sixties decreased agricultural output and increased incidence of poverty in India. Thus government had launched a special programme called he Rural Works Programme (RWP) in 1970-71 with the focus on the execution of rural works and employment generation in an attempt to mitigate the conditions of scarcity in drought-prone areas. As it was realized in course of time that mere RWP would not be able to attain the goals and the programme need to be reoriented on the basis of an area development approach. Thus it was redesignated as the Drought Prone Area Programme (DPAP), which was launched in

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by the Central Government in 1973-74 to tackle the special problems faced by those fragile areas which are constantly affected by severe drought

condition. Under the new strategy of rural development adopted in the Sixth Five Year Plan the DPAP was merged with the Integrated Rural Development Programme
164 NSOU ? GE-GR-11 (IRDP).

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The programme is now under the administrative jurisdiction of the Department of Land Resources

in the Ministry of Rural Development. Objectives The basic objectives of the programme are to reduce the severity of the impact of drought; to stabilise the income of people, particularly weaker sections of the society and to restore the ecological balance. To attain these goals the DPAP includes some important elements, like i)

95%	MATCHING BLOCK 147/223	W	

development and management of water resources, ii) soil and moisture conservation, iii)

afforestation,
iv) restructuring the cropping pattern and pasture development, v) changes in agronomic practices, vi) livestock and dairy development, vii) and development of small farmers, marginal farmers and agricultural labourers. Main Features 1. The central idea
of the DPAP was

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to minimise the adverse effects of drought on production of crops and live-stocks, and productivity of land, water and human resources through integrated development of the natural resources base of the area by adoption of appropriate technologies. 2. Under the DPAP there are provisions to conserve, develop and harness land, water and other natural resources including rainfall for restoration of

57%	MATCHING BLOCK 150/223	SA	Monuj Dutta 1.docx (D33435960)

ecological balance in the long run, and to improve the economic and social condition of the poor and disadvantaged sections

of the society by developing subsidiary occupations. 3. The basic thrust was to ensure that the rural works taken up under the programme were of a permanent in nature, like infrastructural works on which further development could be programmed. 4. At the initial stage, the approach was based on labour-intensive scheme. 5. During the Forth Five Year Plan the DPAP was a central sector scheme with 100 per cent financial assistance from the centre. From the Fifth Five Year Plan onwards, allocation of funds between centre and state was at 50:50 ratio. 10.9 ????? Minimum Need Programme (MNP) The concept of Minimum Needs Programme (MNP) emerged and crystallised out of the experience of

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the previous plans, which showed that that neither growth nor social consumption could be sustained,

much less accelerated, without being mutually supportive.
NSOU ? GE-GR-11 165 The MNP was introduced in the Fifth Five Year Plan in 1972 with objective of providing the rural poor living below the poverty line

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with access to certain items of social consumption, which form an integral part of

the basic needs. Objectives Initially main thrust of the MNP was on provision of eight components during the Fifth Five Year Plan. In the following two plans the list was expanded and during the Seventh Five Year Plan he MNP included twelve components as follows. i.

58%	MATCHING BLOCK 153/223	SA	Chapter - Vi first draft Rural Development Pro ... (D40434799)

Elementary Education ii. Adult Education iii. Rural Health iv. Rural Water Supply v. Rural Roads vi. Rural Housing vii. Rural Electrification viii. Environmental Improvement

of Urban Slums ix. Nutrition x. Rural Domestic Cooking Energy xi. Rural Sanitation xii. Public Distribution System Main Features 1. The MNP is basically a human resources development programme, which concerned all states and union territories. 2. Integration of social consumption along with economic development has been considered necessary to accelerated growth and ensure achievement of plan objectives. 3. The programmeemphasises the urgency for providing social services according to the nationally accepted norms within a stipulated time frame. 4. To optimise benefits all the twelve components of the MNP

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are taken as a package, and related to specific areas and beneficiary groups. 166

NSOU ? GE-GR-11 5.

70%	MATCHING BLOCK 155/223	SA	Ishu_Economics_Chapter 5.docx (D53969364)

Provision of free or subsidised services through public agencies is expected to improve the consumption levels of

the persons living below the rural and thereby improving the productive efficiencies of both the rural and urban workers. 6. The programme envisaged reducing the disparities in the development of social services and infrastructure as prevailing in different regions and states. 10.10 ????? Integrated Rural Development Programme (IRDP) Eradication of rural poverty has been the major goal of India's economic policy since the commencement of planning era. The Integrated Rural Development Programme was conceived during the Fifth Five Year Plan and was launched in 1978-79. This is the most important programme among the self-employment generating programmes. The concept of'integration' has two aspects. Firstly, it implies the emphasis on inter-sectional coordination with elements of inter-sectoral complementarities and internal consistency. It comprises of comprehensive agricultural development linked with rural industries, subsidiary occupations, tertiary sectors opportunities, community services and development organisations. Secondly if refers to anintegrated project approach with the core project as a basic starting point and all then ecessary support to the core project. It has emerged out the emphasisassigned to employment and income redistribution and many other aspects of rural development. Objectives Main objectives of the Integrated Rural Development Programme were the alleviation of poverty through growth and generation of employment opportunities for the poorest of the poor in rural India. The benefitswere to accrue to the identified the target groups comprising of Scheduled Castes (SCs) and Scheduled Tribes (STs), small and marginal farmer, tenants, landless labourers, sharecroppers and rural artisans. The IRDP represents a synthesis of three approaches: the cluster approach toselect villages for implementation, the antyodaya approach to select beneficiaries from the selected villages and the package approach to assist the selected beneficiaries. The first approach ensures that the supporting infrastructure are available in the selected villages at low cost, the second approach ensures that the real poor are selected and third approach ensures that the family benefits fully from the complementarily between various inputsand services.

NSOU ? GE-GR-11 167 Main Features 1. The IRDP is the single largest anti-poverty programme currently under way in all the community development blocks in the country. 2. The IRDP seeks to redistribute assets and employment opportunities in favour of rural poor and thereby reduce income inequality. 3. It

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is a centrally sponsored scheme and is funded on 50:50 basis by the centre and the

state. The IRDP beneficiaries are assisted through viable and bankable projects, which

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are financed partly by subsidy and partly by bank loans. 4. The

IRP is implemented by

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an autonomous agency called the District Rural Development Agency (DRDA).

At national level

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the Ministry of Rural Development is responsible for release of the central share of the funds, policy formulation, overall guidance, direction, coordination and

monitoring. 5. It has also the provision of training for the beneficiaries and functionaries at all level. The beneficiaries are trained how to manage the new assets or projects as how to derive maximum benefits from them. 10.11 ????? Training of Rural Youth for Self-Employment (TRYSEM) As a part of the strategy for promoting self-employment opportunities to eradicate poverty, which was particularly emphasised in the Sixth Five Year Plan, Central government launched the National Scheme for Training of Rural Youth for Self-Employment (TRYSEM) from 15 th August 1979. It is an integral part of the Integrated Rural Development Programme (IRDP) and has concentrated on rural youths between the ages 18 and 35, which obviously cover a large section of rural labour-force. Objectives The objective of the programme was to provide

91%	MATCHING BLOCK 159/223	J

technical and managerial skills to the rural youth below the poverty line

with a view to make them capable of taking of self- employment in the field of agriculture and allied activities, industries and household/ professional trade etc. depending upon the local need, capabilities and skill of the rural youth. Priority is given to rural youth from Scheduled Castes (SCs), Scheduled Tribes (STs) and woman candidates.
168 NSOU ? GE-GR-11 Main Features 1. The model of training included in the scheme are institutional training, individual or collective, local training through master craftsman, artisans and other skilled manpower. 2. The selection of youths is made from rural families with annual income of less than Rs.3500. 3. During the Sixth plan period 1980-85 about 9 lakh youths have received training to improve their skill and about half of them are already self-employed. 10.12 ????? Development

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of Women and Children in Rural Areas (DWCRA) A new scheme known as

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Development of Women and Children in Rural Areas (DWCRA) was introduced in September, 1982

as a part of the
Integrated Rural Development Programme (IRDP). On the basis of the experience gained during the first three years of the Sixth Five Year Plan, it was noticed that benefits of the IRDP failed to trickle down adequately to promote welfare of women and children. Thus the basic idea of the DWCRA was to provide rural poor women with suitable avenues of income generation to their skill and local conditions. Objectives The aim of the scheme was to empower rural women living below the poverty line by way of organizing them to create sustainable income generating activities through self-employment. Moeoer, it focuses on availability of input, providing training, marketing of the products and future scope for such activities. Main Features 1. The DWCRA was the first programme of its kind that specifically focuses on improving the quality of life of rural women. 2. Unlike the other IRDP components, this scheme focuses not only on improvement in income, but also on access to health, education, safe drinking water, sanitation, nutrition, and so on. Thus it focuses on social development also.

NSOU ? GE-GR-11 169 3. The programme emphasized on group activity. It was thought that in long run, women's empowerment depends on creation of a movement that promotes awareness and self-reliance. 4. Under the DWCRA, a group of women are granted assistance to take-up viable economic activities with Rs. 15,000 as one time grant to be used as a revolving fund. This programme is implemented through DRDAs. 10.13 ????? Jawahar Rozgar Yojana (JRY) During 1989-90, two employment guarantee programmesNational

96%	**MATCHING BLOCK 164/223**	**SA**	Ishu_Economics_Chapter 5.docx (D53969364)

Rural Employment Programme (NREP) and Rural Landless Employment Guarantee Programme (RLEGP) were merged into

a single programme known as JawaharRozgarYojana. It was launched in April 1989.

97%	**MATCHING BLOCK 162/223**	**J**	

It was the single largest wage employment programme implemented in all villages of the country through the Panchayati Raj Institutions.

JRY was restructured in 1999 and renamed as the Jawahar Gram SamridhiYojona (JGSY). Objectives The objectives of the programme were to provide additional gainful wage employmentto the unemployed and underemployed persons of the households below the povertyline with special emphasis uponScheduled Castes (SCs) and Scheduled Tribes (STs), to create durable and productive community assets with a view to improve overall quality of rurallife, and to make provision so that at least 30 per cent of the total employment opportunities may beprovided to women beneficiaries. Main Features 1. It is a centrally sponsored programme. The expenditure under the programme is shared by the center and the state on an 80:20 bases. 2. The aim of the scheme is to reach every Panchayat and to provide employment to at least one member in a family living below the poverty line in rural areas for 50 to 100 days a year at a place near his residence. 3. Under

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the scheme, workers can be taken upfor execution during any part of the year, whenever the need for generating supplementary employment is felt, preferably during lean agricultural

seasons.
170 NSOU ? GE-GR-11 4. The scheme emphasised upon creation of rural infrastructure, like

95%	**MATCHING BLOCK 167/223**	**SA**	Monuj Dutta First Chapter.docx (D34217208)

durable assets in form of school buildings, roads and other infrastructure. 5.

The resources for the scheme are allocated to the States/Union territories in accordance with the poverty incidence. 6. Implementation of the JRY was entirely placed upon village panchayats. Through this devolution it was hoped that the benefits of this programme directly reaching the people to be significantlyhigher than in the past. 7. It also aims at placing in the hands of the village Panchayats around the country adequate funds to the run their own rural employment schemes. 8. Entitlement of funds to a Gram Panchayat depends on the per capita allocation of the district worked out onbackwardness criteria as well as population. 10.14 ?????

76%	**MATCHING BLOCK 166/223**	**J**	

Swarnjayanti Gram Swarozgar Yojana (SGSY) The Swarnjayanti Gram SwarozgarYojana is a self-employment for the rural poor launched on 1st April, 1999 by restructuring and combining the Integrated Rural Development Programme (IRDP) and other self-employment allied programmes, likethe Training for

81%	MATCHING BLOCK 168/223	SA	Literature Review.docx (D149220814)

Rural Youth for Self-Employment (TRYSEM), the Development of Women and Children in Rural Area (DWCRA)

etc. SGSY is aninnovative and carefully thought out scheme, which takes into account all thestrengths and weakness of all earlier self-employed programme.

96%	MATCHING BLOCK 169/223	SA	Mithlesh_Rural Development Management.docx (D119259395)

It aims at establishing a large number of micro enterprises in the rural areas.

Persons assisted under this programme are known as Swarozgaris not beneficiaries. Objectives

100%	MATCHING BLOCK 170/223	SA	BDO Chapter I.doc (D19274323)

The basic objective of SGSY is to bring the assisted poor families

above the

64%	MATCHING BLOCK 171/223	SA	BDO Chapter I.doc (D19274323)

poverty line by providing them with income-generating assets through bank credit and government subsidy. Thus formation of the organization of the poor at the grassroot level through a process of social mobilization for poverty reduction is

the core idea of the scheme. The moot approach was to develop women's self-help groups (SHGs) that have to act as financial intermediary and a vehicle for women's empowerment.
NSOU ? GE-GR-11 171 Main Features 1. The

76%	MATCHING BLOCK 172/223	J

SGSY is conceived as a holistic self-employment scheme covering aspects like organisation of the rural poor into self-help groups and their capacity building, planning of activity clusters, infrastructure build up, technology, credit and marketing. 2.

It
aims to establish a large number of microenterprisesin the

78%	MATCHING BLOCK 174/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

rural areas, based on the ability of the poor and potential of the rural area. 3. The

programme has been designed to provide proper support and encouragement to tap the inherent talent and capabilities of the rural poor. 4. The most vulnerable sections are its target group i.e. at least 50 per cent of the Swarozgaris will be Scheduled Castes (SCs) and Scheduled Tribes (STs), and 40 per cent will be women, and 3 per centwill be disabled persons. 5. Gram Sabhas are entrusted with the task of authenticating

100%	MATCHING BLOCK 173/223	J

the list of families below the poverty line identified in the

below poverty line census. 6. The SGSY is a credit-cum-subsidy programme. Thus the greater involvementof banks is envisaged

83%	MATCHING BLOCK 176/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

in the planning and preparation of projects, identification of activity cluster, infrastructure planning as well as capacity building and choice of activity of the SHGs, selection of individual Swarozgaris, pre-credit activities and post-credit monitoring including loan recovery.

It seeks to promote multiple credits. 7. The funds under the SGSY shared between the center and states in ratioof 75:25. 8. It is implemented by the DRDAs through Panchayat Samitis. The non- governmental organisations (NGOs) are expected to facilitate the formation of such groups and community involvement is particularly emphasised. 10.15 ????? Rashtriya Swasthya Bima Yojona (RSBY) Rashtriya Swasthya Bima Yojona was launched in 1 October 2007. The RSBY is a Government sponsored health insurance scheme for the BPL population of India. It provides health insurance for the enrolled BPL families from each district up to a maximum number

172 NSOU ? GE-GR-11 of households based on the definition and the figures provided for each state by the union Planning Commission. Objectives The scheme aims to provide health insurance coverage to the unorganised sector workers belonging to the BPL category and their family members It provides for cashless insurance for hospitalisation in public as well as private hospitals. The total sum insured is Rs. 30,000 per family per annum. Main Features 1. Beneficiaries need to pay only Rs. 30 the registration fee. This amount shall be used for incurring administrative expenses under the scheme. 2. The scheme has a provision of smart cards to be issued to the beneficiaries to enable cashless transaction for healthcare. 3. The majority of the financing, about 75 percent, is provided by the Government of India, while the remainder is paid by the respective state government. Government of India's contribution is 90 percent in case of North-eastern states and Jammu and Kashmir and respective state Governments need to pay only 10% of the premium. 4. State governments engage in a competitive public bidding process and select a public or private insurance company licensed to provide health insurance by the Insurance Regulatory Development Authority (IRDA) or enabled by a Central legislation. 5. State Government must prepare and submit the BPL data in an electronic format specified by Government of India and send these data to Government of India which in turn checks the compatibility of this data with the standard format. 6. The scheme gives special emphasis on bringing private investment in health services in rural sector.

NSOU ? GE-GR-11 173 Unit 11 ????? Rural Infrastructural Development Programmes Structure 11.0 Introduction 11.1 Bharat Nirman 11.2 Rural Electrification 11.2.1 Rajiv Gandhi Grameen Vidyutikaran Yojana 11.2.2 National Rural Electrification Policy, 2006 11.2.3 Deen Dayal Upadhyaya Gram Jyoti Yojana 11.2.4 Pradhan Mantri Sahaj Bijli Har GharYojana 11.3 Pradhan Mantri Gram Sadak Yojna 11.4 Pradhan Mantri Awaas Yojana (Gramin) 11.5 Rural Tele-connectivity 11.6 National Digital Communications Policy, 2018 11.0 ????? Introduction The role of infrastructure is of paramount importance in development process of any kind, as its shortage often becomes the major limiting factor for economic progress. This has become even more significant under the globalised market regime, where increased productivity, wider connectivity, greater efficiency and competitiveness, to a large extent, determine the viability of any economy. All these again have direct bearing upon environment, health, poverty, equity and standard of living of a country's population. Rural infrastructure is particularly crucial for agriculture, agro-industries and overall rural development of rural areas in India. As per the 2011 census, rural areas account for 69 percent of India's total population. Therefore, improved connectivity and accessibility to rural areas will provide a vital impetus to the country's economic growth. Development of rural infrastructure in general and rural transport infrastructure in particular is very crucial in India. Given the low per capita income of rural households, and hence their low affordability, there is a

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174 NSOU ? GE-GR-11 clear need for government intervention in taking suitable initiative for improving access to infrastructure services, with a view to eventually moving towards achieving the objectives of universal coverage. This implies gradually improving physical proximity for all to the sources of infrastructure services. Thus, through universal access, the residents of every village should be able to access a common telephone. Each village should be able to connect to wired network/electricity grid, have access to a road and be close to a drinking water source. Thus electrification, transport, housing and connectivity may be considered as the most vital components of rural infrastructure. Government of India has taken initiatives for development of these areas and has introduced various plans and programmes in this regard. 11.1 ????? Bharat Nirman Government of India launched this time bound plan in 2005 for implementation during four years period of 2005-2009. Six components of rural infrastructure included in the Bharat NirmanProgramme are: 1. Roads, 2. Telephone connections, 3. Water supply, 4. Irrigation, 5. Housing, 6. Electrification. Objectives The Bharat Nirman is a business plan for development of rural infrastructure which was implemented by the Government of India. The primary objective is to provide and improve six basic amenities to the rural India. Main Features Roads ? In order to increase rural connectivity, rural roads programme Pradhan Mantri Gram SadakYojana (PMGSY) was launched in December 2000.

NSOU ? GE-GR-11 175 ? As part of the programme, GOI intends that by the end of financial year 2008- 09, every village of over 1000 population, or over 500 in hilly and tribal areas has an all-weather road. ? To achieve the targets of Bharat Nirman, 146,185 km of road length is proposed to be constructed by 2009. ? This will benefit 66,802 unconnected eligible habitations in the country. ? Systematic upgradation

75%	MATCHING BLOCK 178/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

of the existing rural road networks is also an integral component of the scheme.

Telephone Connections ? It aims in increasing the rural telecommunication facilities by 40%. ? It also aims to supply broadband and Bharat Nirman Seva Kendras in 2.5 lac Panchayats. ? Under the Bharat Nirman Programme 66,822 revenue villages not having telephone connectivity are to be provided with Village Public Telephone (VPT) facility. ? Out of these, 14183 remotely located villages are to be provided VPTs through digital satellite phone terminals, while the remaining are to be provided any other technology. Water supply ? Providing rural areas with safe drinking water facilities was one of the key objectives of the plan. ? During Bharat Nirman Period, 55,067 uncovered and 3.31 lakh slipped-back habitations are to be covered with provisions of drinking water facilities. ? 2.17 lakh quality affected habitations are to be addressed for water quality problem. Irrigation ? The target of creation of additional irrigation potential of one crore hectare in 4 years is planned to be met largely through expeditious completion of identified ongoing major and medium irrigation projects. ? Irrigation potential of 42 lakh hectares is planned to be created by expeditiously completing such ongoing major and medium projects.

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176 NSOU ? GE-GR-11 Housing ? The main objective of the housing component is to provide housing facilities to the rural areas of India. This is being implemented in parallel with Indira AwaasYojana (IAY) scheme. ? IAY scheme was launched as an independent and major housing scheme from January 1, 1996 to provide assistance for construction up gradation of dwelling units to the BPL rural households. ? Bharat Nirman programme has set a target to construct 60 lakh houses by 2009 at the rate of 15 lakh houses each year. Electrification ? The rural electrification targets are set to be achieved under Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY). ? RGGVY has been introduced by Ministry of Power in April, 2005. ? The twin objectives of electrification of 1,25,000 villages and electrifying the 2.3 crore BPL households are proposed to be achieved under the Bharat Nirman Programme. 11.2 ????? Rural Electrification Electricity is an essential requirement for all facets of our life and it has been recognized as a basic human need. It is the key to accelerating economic growth, generation of employment, elimination of poverty and human development specially in rural areas. Rural Electrification (RE) is viewed as the key for accelerating rural development. Provision of electricity is essential to cater for requirements of agriculture and other important activities including small and medium industries, khadi and village industries, cold chains, health care, education and information technology. Both the central government and state governments jointly endeavour to achieve this objective at the earliest. Consumers, particularly those who are ready to pay a tariff which reflects efficient costs have the right to get uninterrupted twenty four hours supply of quality power. Determined efforts should be made to ensure that the task of rural electrification for securing electricity access to all households and also ensuring that electricity reaches poor and marginal sections of the society at reasonable rates is completed within the next five years.
NSOU ? GE-GR-11 177 11.2.1 Rajiv Gandhi Grameen Vidyutikaran Yojana The

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Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) was launched in April 2005 by merging all ongoing schemes. The

Government is implementing Decentralised Distributed Generation (DDG) under the Rajiv Gandhi GrameenVidyutikaranYojana (RGGVY) for electrification of villages where grid connectivity is either not feasible or not cost effective. In XII Plan period, DDG has also been extended to the grid connected area where supply of electricity is less than 6 hours a day. Decentralized Distributed Generation (DDG) can be from conventional or renewable sources such as Biomass, Biofuels, Biogas, Mini hydro, Solar etc. Under

95%	MATCHING BLOCK 177/223	W

the programme, 90% grant is provided by Govt. of India and 10% as loan by Rural Electrification Corporation (REC) to the State Governments. Rural Electrification Corporation (REC) is the nodal agency for the programme.

As many as 96% of un-electrified villages have been electrified across the country as on May 2014 and intensive electrification of 80% villages has been completed while free electricity connections have been provided to 77% BPL households under the programmethe RGGVY. Objectives The scheme had a target of electrifying all villages and habitations as per new definition, providing access to electricity to all rural households, providing electricity connection to Below Poverty Line (BPL) families free of charge. Users can contact Gram Panchayat for further details related to the scheme. Main Features 1. Decentralized Distributed Generation (DDG) Systems are based on conventional and non-conventional energy sources where grid supply is not feasible or cost- effective. 2. Under the RGGVY, electricity distribution infrastructure is envisaged to establish Rural Electricity Distribution Backbone (REDB) with at least a 33/11KV sub- station, Village Electrification Infrastructure (VEI) with at least a Distribution Transformer in a village or hamlet, and standalone grids with generation where grid supply is not feasible. 3. This infrastructure would cater to the requirements of agriculture and other activities in rural areas including irrigation pump sets, small and medium industries, khadi and village industries, cold chains, healthcare and education and IT. This

178 NSOU ? GE-GR-11 would facilitate overall rural development, employment generation and poverty alleviation. 4. Subsidy towards capital expenditure to the tune of 90% will be provided, through Rural Electrification Corporation Limited (REC), which is a nodal agency for implementation of the scheme. Electrification of un-electrified Below Poverty Line (BPL) households will be financed with 100% capital subsidy at the rate Rs.1500/- per connection in all rural habitations. 5. The Management of Rural Distribution is mandated through franchisees. The services of Central Public Sector Undertakings (CPSU) are available to the States for assisting them in the execution of Rural Electrification projects. 11.2.2 National Rural Electrification Policy, 2006 The National Rural Electrification Policy was notified in compliance with Sections 4 & 5 of the Electricity Act, 2003 by the Central Government. Goals include provision of

91%	MATCHING BLOCK 179/223	SA	Mithlesh_Rural Development Management.docx (D119259395)

access to electricity to all households by the year 2009, quality and reliable power supply at reasonable rates,

and minimum lifeline consumption of 1 unit/household/day as a merit good by year 2012. Earlier in compliance with section 3 of the Electricity Act 2003 the Central Government notified the National Electricity Policy. The National Electricity Policy aims at laying guidelines for accelerated development of the power sector, providing supply of electricity to all areas and protecting interests of consumers and other stakeholders keeping in view availability of energy resources, technology available to exploit these resources, economics of generation using different resources, and energy security issues. Objectives The Policy aims at provision of access to electricity to all households by year 2009, supply of

88%	MATCHING BLOCK 180/223	SA	Mithlesh_Rural Development Management.docx (D119259395)

quality and reliable power at reasonable rates, ensuring minimum lifeline consumption of 1 unit per household per day as

a merit good by year 2012. Main Features 1. For villages/habitations where grid connectivity would not be feasible or not cost effective, off-grid solutions based on stand-alone systems may be taken up for supply of electricity. Where these also are not feasible and if only alternative is to use isolated lighting technologies like solar photovoltaic, these may be adopted. However, such remote villages may not be designated as electrified.

NSOU ? GE-GR-11 179 2. State government should, within 6 months, prepare and notify a rural electrification plan which should map and detail the electrification delivery mechanism. The plan may be linked to and integrated with district development plans. The plan should also be intimated to the appropriate commission. 3. Gram panchayat shall issue the first certificate at the time of the village becoming eligible for declaration as electrified. Subsequently, the Gram Panchayat shall certify and confirm the electrified status of the village as on 31st March each year. 4. The state government should set up a committee at the district level within 3 months, under the chairmanship of chairperson of the ZillaPanchayat and with representations from district level agencies, consumer associations, and important stakeholders with adequate representation of women. 5. The district committee would coordinate and review the extension of electrification in the district and consumer satisfaction, etc. 6. Panchayat Raj institutions would have a supervisory / advisory role. 7. Institutional arrangements for backup services and technical support to systems based on non-conventional sources of energy will have to be created by the state government. 11.2.3 Deen Dayal Upadhyaya Gram Jyoti Yojana The Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) was launched in 2015 by the Government of India for rural electrification. The erstwhile Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) scheme for village electrification and providing electricity distribution infrastructure in the rural areas has been subsumed in the DDUGJY scheme as its rural electrification component. Rural Electrification Corporation is the Nodal Agency for implementation of DDUGJY. It will furnish monthly progress reports on the implementation of the scheme indicating both financial and physical progress to Ministry of Power and Central Electricity Authority. Under DDUGJY-RE, Ministry of Power has sanctioned 921 projects to electrify 1,21,225 un-electrified villages, intensive electrification of 5,92,979 partially electrified villages and provide free electricity connections to 397.45 lakh BPL rural households. As on 30th June 2015, works in 1,10,146 un-electrified villages and intensive electrification of 3,20,185 partially

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electrified villages have been completed and 220.63 lakh free electricity connections have been released

to BPL households.
180 NSOU ? GE-GR-11 Objectives This scheme focuses on feeder separation (rural households & agricultural) and strengthening of sub-transmission & distribution infrastructure including metering at all levels in rural areas. This will help in providing round the clock power to rural households and adequate power to agricultural consumers. The major components of the scheme are feeder separation; strengthening of sub-transmission and distribution network; Metering at all levels (input points, feeders and distribution transformers); Micro grid and off grid distribution network & Rural electrification- already sanctioned projects under the RGGVY to be completed. Main Features 1. The scheme would help to Increase in agriculture yield, development of rural entrepreneurship, improvement in Health, Education, Banking (ATM) services, improvement in accessibility to radio, telephone, television, internet and mobile etc. 2. It will increase accessibility of electricity to schools, panchayats, hospitals and police stations etc. and will ensure betterment in social security due to availability of electricity. 3. The scheme takes into consideration metering to reduce the losses. 4. The village-wise works sanctioned under theDDUGJY has been mapped to scrutinise the progress of work carried out under the project in each village. 5. Projects under this Scheme will be completed within a period of 24 months from the date of issue of Letter of Awards by the utility. 6. All North Eastern States including Sikkim, Jammu & Kashmir, Himachal Pradesh and Uttrakhand are included in special category States. 7. The Ministry of Power has launched a new app, GARV-II app to provide real- time data of all six lakh villages of the country. The app is envisaged to ensure transparency in the implementation of rural electrification programme. The new app will also enable the citizens to participate in the developmental works and can give their feedback and inputs related to the rural electrification programme. The participation of citizens will enable public scrutiny of the rural electrification programmes.
NSOU ? GE-GR-11 181 11.2.4 Pradhan Mantri Sahaj Bijli Har GharYojana The Pradhan MantriSahajBijliHarGharYojana or the Saubhagya Scheme is an Indian government project to provide electricity to all households. The project was announced in September 25th September 2017. The aim was to complete the electrification process by December 2018. Under Saubhagya

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free electricity connections to all households (both APL and poor families) in rural

areas and poor families in urban areas will be provided. There are around 4 Crore un-electrified households in the country and they are targeted for providing electricity connections by December 2018. Rural Electrification Corporation (REC) has been designated as its nodal agency for the Saubhagya scheme. . The total outlay of the project is Rs. 16, 320 crore while the Gross Budgetary Support (GBS) is Rs. 12,320 crore. 91% of rural Indian households have received electricity access till June 2019. Objectives The basic objective is to provide last mile connectivity and electricity connections to all un-electrified households in rural areas and to provide Solar Photovoltaic (SPV) based standalone system for un-electrified households located in remote and inaccessible villages/ habitations, where grid extension is not feasible or cost-effective Main Features 1. All DISCOMs including Private Sector DISCOMs, State Power Departments and RE Cooperative Societies shall be eligible for financial assistance under the scheme in line with the DDUGJY. 2. The prospective beneficiary households for free electricity connections under the scheme would be identified using SECC 2011 data. However, un-electrified households not covered under SECC data would also be provided electricity connections under the scheme on payment of Rs. 500 which shall be recovered by DISCOMs in 10 installments through electricity bill. 3. The electricity connections to un-electrified households include provision of service line cable, energy meter including pre-paid/smart meter, single point wiring. LED lamps and associated accessories in line with technical specifications and construction standard. 4. In case of un-electrified households located in remote and inaccessible areas, power packs of 200 to 300 Wp (with battery bank) with a maximum of 5 LED

182 NSOU ? GE-GR-11 lights, 1 DC Fan, 1 DC power plug etc. may be provided along with the provision of Repair and Maintenance (R&M) for 5 years. 5. The details of consumers viz, Name and Aadhar number/ Mobile number/ Bank account/ Driving License/Voter ID etc., as available would be collected by the DISCOMs. 6. The defaulters whose connections have been disconnected should not be given benefit of the scheme. However, the utilities may consider settlement of old dues and reconnection as per norms. Rural Transport

100%	MATCHING BLOCK 183/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

Rural Road Connectivity is not only a key component of rural development by promoting access to economic and social services and thereby generating increased agricultural incomes and productive employment opportunities in India, it is also as a result, a key ingredient in ensuring sustainable poverty reduction. 11.3 ?????

Pradhan Mantri Gram SadakYojna The Pradhan Mantri Gram SadakYojana (PMGSY) is a centrally sponsored scheme, which was introduced in 25 December 2000. It

100%	MATCHING BLOCK 184/223	SA	Commerce Conference 202. Rural Development Adr ... (D16863539)

is a nationwide plan in India to provide good all-weather road connectivity to unconnected villages

of more than 500 persons in the rural areas and 250 persons in the hilly and desert areas. The PMGSY is under the authority of the Ministry of Rural Development. Scheme has started to change the lifestyle of many villagers with new roads and upgrades, such as in Manipur. The Phase II of the PMGSY was approved during May, 2013. While the ongoing the PMGSY Phase-I continued, under the PMGSY Phase II the roads already built for village connectivity was to be upgraded to enhance rural infrastructure. Of 178,000 (1.7 lakh) habitations with a population of above 500 in the plains and above 250 in the hilly areas planned to be connected by all-weather roads, 82% were already connected by December 2017 and work-in-progress on the remaining 47,000 habitations was on-track for completion by March 2019. The average speed of road construction under the PMGSY was 98.5 kilometers per day from 2004 to 2014, it rose to 130 km per day in fy2016-17. Objectives

79%	MATCHING BLOCK 185/223	SA	parveen walia thesis.pdf (D40589667)

The primary objectives of the PMGSY Phase-I is to provide connectivity by \way of an all-weather road (with necessary culverts and cross-drainage structures, which is operable NSOU ? GE-GR-11 183 throughout the year) to eligible unconnected habitations in the rural areas with a population of 500 persons and above in plain areas. In respect of the hill states,

desert areas, tribal areas and the selected tribal and backward districts
the objective would be to connect
eligible

81%	MATCHING BLOCK 191/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

unconnected habitations with a population of 250 persons and above. The PMGSY will permit upgradation of existing roads in those districts where all the eligible habitations of the designated population size have been provided all-weather road connectivity.

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Under the scheme, 1,35,436 habitations were targeted for providing road connectivity and 3.68 lakh km. for upgradation of existing rural roads (including 40 % renewal of rural roads to be funded by the States) in order to ensure full farm to market connectivity. The Phase II of PMGSY was approved during May, 2013. While the ongoing PMGSY - I continued, under PMGSY phase II, the roads already built for village connectivity was to be upgraded to enhance rural infrastructure. For the 12th Five Year Plan period a target of 50,000 Km length under PMGSY-II. 75 per cent of the cost of the upgradation was by the Centre and 25 per cent by the state. For hill states, desert areas, Schedule V areas and Naxal-affected districts, 90 per cent of cost was borne by the Centre. The Phase III was approved by the Cabinet during July 2019. It involves

85%	MATCHING BLOCK 196/223	SA	CHAP-1.pdf (D110896322)

consolidation of Through Routes and Major Rural Links connecting habitations to Gramin Agricultural Markets (GrAMs), Higher Secondary Schools and Hospitals. Under the

PMGSY-III Scheme, it is proposed to consolidate 1,25,000 Km road length in the States. The duration of the scheme is 2019-20 to 2024-25. The funds would be shared in the ratio of 60:40 between the Centre and State for all States except for 8 North Eastern and 3 Himalayan States (Jammu & Kashmir, Himachal Pradesh &Uttarakhand) for which it is 90:10. Main Features 1.

95%	MATCHING BLOCK 186/223	J

The unit of this programme is a habitation and not a revenue village or a panchayat. A habitation is a cluster of population, living in an area, the location of which does not change over time. 2.

The eligible

83%	MATCHING BLOCK 187/223	J

Unconnected Habitations are to be connected to nearby Habitations already connected by an All-weather road or to another existing All-weather road so that services (educational, health, marketing facilities etc.), which are not available in the unconnected Habitation, become available to the residents. 3.

100%	MATCHING BLOCK 188/223	J

It should be ensured that each road work that is taken up under the PMGSY is part of the Core Network.

91%	MATCHING BLOCK 189/223	J

A Core Network comprises of Through Routes and Link Routes. Through routes are the ones which collect traffic from several link roads or a long chain of Habitations and lead it to Marketing centres either 184 NSOU ? GE-GR-11 directly or through the higher category roads i.e., the District Roads or the State or National Highway. 4.

69%	MATCHING BLOCK 197/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

The primary focus of the PMGSY is to provide All-weather road connectivity to the eligible unconnected Habitations.

An All-weather road is one which is negotiable in all seasons of the year. This implies that the road-bed is drained effectively (by adequate cross-drainage structures such as culverts, minor bridges and causeways), but this does not necessarily imply that it should be paved or surfaced or black-topped. Interruptions to traffic as per permitted frequency and duration may be allowed. 5.

100%	MATCHING BLOCK 190/223	J

Provision of connectivity to unconnected Habitations would be termed as New Connectivity.

Since the purpose of the PMGSY inter alia is to provide farm to market access, new connectivity may involve 'new construction' where the link to the habitation is missing and additionally, if required, 'Upgradation' where an intermediate link in its present condition cannot function as an all-weather road. 6.

92%	MATCHING BLOCK 192/223	J

The PMGSY shall cover only the rural areas. Urban roads are excluded from the purview of this Programme. Even in the rural areas, the PMGSY covers only the Rural Roads i.e., Roads that were formerly classified as 'Other District Roads' (

ODR) and 'Village Roads' (VR). 7. Proper planning is imperative to achieve the objectives of the Programme in a systematic and cost effective manner. The District Rural Roads Plan would indicate the entire existing road network system in the District and also clearly identify the proposed roads for providing connectivity to Unconnected Habitations, in an economic and efficient manner in terms of cost and utility. 8. In order to implement this, an Online Management, Monitoring and Accounting System or OMMAS GIS system was developed to identify targets and monitor progress. The system manages and monitors all the phases of road development right from its proposal mode to road completion. 9. The PMGSY is managed by the National Rural Roads Development Agency (NRRDA), headed by a Director-General. 10. The Pradhan Mantri Gram SadakYojana (PMGSY) program has been attempting to increase the green cover near the roads. This is through the planting of tree saplings, including the planting of fruit bearing tree saplings.
NSOU ? GE-GR-11 185 Rural Housing

95%	MATCHING BLOCK 193/223	J

Housing is one of basic requirements for human survival. For a

shelterless person, possession of

100%	MATCHING BLOCK 194/223	J

a house brings about a profound social change in his existence, endowing him with an identity, thus integrating him with his immediate social milieu.

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Public housing programme in the country started with the rehabilitation of refugees immediately after independence and since then, it has been a major focus area of the Government as an instrument of poverty alleviation. Rural housing programme, as an independent programme, started with Indira AwaasYojana (IAY). 11.4 ????? Pradhan Mantri Awaas Yojana (GRAMIN) The Pradhan MantriAwaasYojana (Gramin) (PMAY-G) is a social welfare flagship programme, launched by the Ministry of Rural Development, to provide housing for the rural poor on 1st April 2016. Earlier the Indira AwaasYojana was launched in 1985 as one of the major flagship programmes of the Government of India. The broad purpose of the scheme was to provide financial assistance to some of the weakest sections of society for them to upgrade or construct a house of respectable quality for their personal living.To address the gaps in the rural housing program and in view of the Government's commitment to providing "Housing for All" by 2022, the 'Indira AwaasYojana' (IAY) was restructured as the 'Pradhan MantriGraminAwaasYojana'.Total number of houses sanctioned for completion in 2018-19 was 2219934. The same figure for 2016-2020 period is 12489117. Objectives Started in 1985 as part of the Rural Landless Employment Guarantee Programme, the Indira AwaasYojana (IAY) was subsumed in the Jawahar Rozgar Yojana in 1989 and has been operating as an independent scheme since 1 January 1996. The basic aim was to provide financial assistance for construction/ upgradation of dwelling units to the below poverty line (BPL) rural households belonging to the scheduled castes (SC), scheduled tribes (ST) and freed bonded labourers categories. In 1993-94 this scheme was extended to
Non-SC/ST categories also.

66% MATCHING BLOCK 195/223 J

From 1995–96 the scheme has been further extended to widows or next-of-kin of defence personnel killed in action, ex-servicemen and retired members of the paramilitary forces

who wish to live in rural areas as long as they meet basic eligibility criteria. Presently, the PMAY-G

71% MATCHING BLOCK 198/223 SA Monuj Dutta First Chapter.docx (D34217208)

aims at providing a pucca house, with basic amenities, to all houseless householder and those households living in kutcha and dilapidated 186 NSOU ? GE-GR-11 house, by 2022.The immediate the objective is to

cover 1.00 crore household living in kutcha house/dilapidated house in three years from 2016-17 to 2018- 19. Main Features 1. The minimum size of the house has been increased to 25 sq.mt. (from20sq.mt.) with a hygienic cooking space. The unit assistance has been increased from Rs. 70,000 to Rs. 1.20 lakh in plain and from Rs75,000 to Rs 1.30 lakh in hilly states, difficult areas and Integrated Action Plan (IAP) districts. 2. The assistance for construction of toilet shall be leveraged though convergence with theSwacch Bharat Mission (Gramin), Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) or any other dedicated the source of funding. Convergence for piped drinking water, electricity connection, LPG gas connection etc. different Government programmers are also to be attempted. 3.

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The cost of unit assistance is to be shared between Central and State Government in the ratio 60:40 in plain areas and 90:10 for North Eastern and the Himalayan States. 4.

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Provision of 90-95 unskilled labour wage under theMNREGA for construction of houses over and above the unit assistance has been made, 5. To ensure that assistance is targeted at those who are genuinely deprived and that the selection is objective and verifiable, thePMAY-G instead of selecting a the beneficiary from among the BPL households selects beneficiary using housing deprivation parameters in the Socio-economic and Caste Census (SECC) 2011data which is to be verified by the Gram Sabhas. 6. Towards better quality of construction, setting up of a Nation Technical Support Agency (NTSA) at the national level is envisaged. 7. One of the major constraints in quality house construction is the lack of the sufficient number of skilled masons. To address this, a pan-India training and certification programme of Masons has been launched in the States/UTs. 8. Focus will be on construction of quality houses using local materials and appropriate designs. 9. In the PMAY-G, programme implementation and monitoring is to be carried out through an end to end e-Governance model, using AwaasSoft and Awaas App.

NSOU ? GE-GR-11 187 All payments would be directly made to the beneficiary's bank/post office accounts linked to Aadhar with consent and also registered in AwaasSoftMIS. 10. The programme implementation is to be monitored not only electronically, but also through community participation (social audit), Member of Parliament (DISHA Committee), Central and State Government officials, National Level Monitors etc. 11.5 ????? Rural Tele-connectivity The telecom services have been recognized the world-over as an important tool for socio economic development for a nation and hence telecom infrastructure is treated as a crucial factor to realize the socio-economic objectives in India. Accordingly, the Department of Telecom has been formulating developmental policies for the accelerated growth of the telecommunication services. The vision is to provide secure, reliable affordable and high quality converged telecommunication services anytime, anywhere for an accelerated inclusive socio-economic development. Special emphais has given on following aspects. 1. To develop a robust and secure state-of-the-art telecommunication network providing seamless coverage with special focus on rural and remote areas for bridging the digital divide and thereby facilitate socio-economic development, 2. To create an inclusive knowledge society through proliferation of affordable and high quality broadband services across the nation, 3. Reposition the mobile device as an instrument of socio-economic empowerment of citizens; make India a global hub for telecom equipment manufacturing, 4. To promote development of new standards to meet national requirements; 5. To attract investment, bothdomestic and foreign and promote creation of jobs. Total telephone subscriber in rural India was 501.81 million in 2017, which was 41.99 per cent of total users. Rural tele-density has been lagging, although wireless connectivity is growing at a fast pace and India is home to over a billion such connections. In 2017 tele- density was only 56.98 persons per 100 inhabitants, though the target was to reach the level of 70 persons per 100 inhabitants by 2017 and to 100 per cent by 2020. Similarly, broadband connectivity to villages has been lagging, with delay in laying of an optical fibre

188 NSOU ? GE-GR-11 network (OFN) up to gram panchayats. Internet subscribers in rural India was 15.49 persons per 100 inhabitants in 2017. 11.6 ????? National Digital Communications Policy, 2018 As the present world has entered the era of modern technological advancements in the Telecom Sector, a need was being felt to introduce a 'customer focused' and 'application driven' policy for the Indian Telecom Sector, which can form the main pillar of Digital India by addressing emerging opportunities for expanding not only the availability of telecom services but also telecom based services.Accordingly, the new National Digital Communications Policy, 2018 has been formulated, in place of the existing National Telecom Policy, 2012, to cater to the modern needs of the digital communications sector of India. The vision is to fulfil the information and communication needs of citizens and enterprises through the establishment of a ubiquitous, resilient, secure, accessible and affordable Digital Communications Infrastructure and Services; and in the process, support India's transition to a digitally empowered economy and society. Objectives The key objectives of the policy are to provide broadband facility for all, creating four million additional jobs in the Digital Communications Sector, enhancing the contribution of the Digital Communications sector to 8% of India's GDP from 6% in 2017, enhancing India's contribution to Global Value Chains; and ensuring Digital Sovereignty.These objectives are to be achieved by 2022. Main Features 1. Creating Robust Digital Communications Infrastructure as a tool for socio-economic development, while ensuring service quality and environmental sustainability. 2. Enabling Next Generation Technologies and Services through Investments, Innovation and IPR generation To harness the power of emerging digital technologies, including 5G, AI, IoT, Cloud and Big Data to enable provision of future ready products and services; and to catalyse the fourth industrial revolution (Industry 4.0) by promoting Investments, Innovation and IPR. 3. Ensuring Sovereignty, Safety and Security of Digital Communications To secure the interests of citizens and safeguard the digital sovereignty of India with a focus

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NSOU ? GE-GR-11 189 on ensuring individual autonomy and choice, data ownership, privacy and security; while recognizing data as a crucial economic resource. 4. The policy aims to ? Provide universal broadband connectivity at 50 Mbps to every citizen; ? Provide 1 Gbps connectivity to all Gram Panchayats by 2020 and 10 Gbps by 2022; ? Ensure connectivity to all uncovered areas; ? Attract investments of USD 100 billion in the Digital Communications Sector; ? Train one million manpower for building New Age Skill; ? Expand IoT ecosystem to 5 billion connected devices; ? Establish a comprehensive data protection regime for digital communications that safeguards the privacy, autonomy and choice of individuals; ? Facilitate India's effective participation in the global digital economy; ? Enforce accountability through appropriate institutional mechanisms to assure citizens of safe and ? Secure digital communications infrastructure and services.

190 NSOU ? GE-GR-11 Unit 12 ????? Rural Development Programmes for Women and Children Structure 12.1 Rural Development Programmes for Women and Children 12.2 Janani Suraksha Yojana 12.3 National Nutrition Mission 12.4 Drinking Water and Sanitation Programmes 12.5 Accelerated Rural Water Supply Programme 12.6 Rajiv Gandhi National Drinking Water Mission 12.7 National Rural Drinking Water Programme 12.8 Swachh Bharat Mission 12.9 National Rural Health Mission 12.10 Sarva Shiksha Abhiyan 12.11 Questions 12.12 Suggested Readings 12.1 ????? Rural Development Programmes for Women and Children Anycountry cannot prosper if the basic needs of a large section of women and children are not met sufficiently with adequate standards. However, far too many women, children worldwide still have little or no access to essential, good-quality health services and education, clean air and water, adequate sanitation and good nutrition. Many more people suffer illness and disability and fail to reach their full potential, resulting in enormous loss and costs for countries both today and for future generations. The problem is definitely more crucial for the developing countries. Hence it is extremelycrucial for any government to strengthen the position of thesesections in society and to ensure their empowerment. There is a continuous need to focus on safeguarding women and children in humanitarian and fragile settings and upholding their human rights to the highest attainable standard of health, even in the most difficult circumstances.

NSOU ? GE-GR-11 191 Keeping this objective in mind, The Department of Women and Child Development was set up in the year 1985 as a part of the Ministry of Human Resource Development to give the much needed impetus to the holistic development of women and children. The Ministry of Women and Child Development, Government of India, came into existence as a separate Ministry with effect from 30th January, 2006 with the nodal responsibility to advance the rights and concerns of women and children, who together constitute 68% of the country's population, as per 2011 Census. The vision of the ministry is empowered women living with dignity and contributing as equal partners in development in an environment free from violence and discrimination, and well-nurtured children with full opportunities for growth and development in a safe and protective environment. Basic missions of the ministry are mentioned below. 1. To promote social and economic empowerment of women through cross- cutting policies and programmes, mainstreaming gender concerns, creating awareness about their rights and facilitating institutional and legislative support for enabling them realize their human rights and develop to their full potential. 2. To ensure development, care and protection of children through cross-cutting policies and programmes,spreading awareness about their rights and facilitating access to learning, nutrition,institutional and legislative support for enabling them to grow and develop to their full potential. The Government of India has taken several initiatives to develop the woman and child section of its population, some of which are stated below. 12.2 ????? Janani Suraksha Yojana Janani Suraksha Yojana (JSY) is a safe motherhood intervention scheme implemented by the Government of India under the National Rural Health Mission (NRHM). It was launched on 12 April 2005. In order to reduce the maternal and infant mortality, Reproductive and Child Health Programme is being implemented to promote institutional deliveries so that skilled attendance at birth is available and women and new born can be saved from pregnancy related deaths. Several initiatives have been launched by the Ministry of Health and Family Welfare (MoHFW) including Janani Suraksha Yojana (JSY), a key intervention that has resulted in phenomenal growth in institutional deliveries. It aims to promote institutional delivery among poor pregnant women and to reduce neo-

192 NSOU ? GE-GR-11 natal mortality and maternal mortality. It is operated under the Ministry of Health and Family Welfare as part of the National Rural Health Mission. The JSY is a 100 % centrally sponsored scheme and it integrates cash assistance with delivery and post- delivery care. Objectives The JananiSurakshaYojana was implemented to ensure that pregnant women who are Below the Poverty Line (BPL) access health facilities for childbirth. It provides cash benefit to eligible pregnant women if they choose to deliver in a health facility, irrespective of their age and the number of children they have.Special dispensation is provided to states that have low institutional delivery rates. These states are eight EAG States, including Uttar Pradesh, Uttarakhand, Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Rajasthan, Odisha, along with Assam and Jammu and Kashmir. These are referred to as Low Performing States (LPS) under the scheme. Other states and union territories are called High Performing States (HPS) owing to their higher rates of institutional delivery. Main Features 1. In LPS, all pregnant women delivering in government health facilities are eligible for a cash benefit. Women who choose to deliver in accredited private institutions are eligible only if they are Below the Poverty Line or belong to a Scheduled Caste or Scheduled Tribe. 2. In HPS, only pregnant women who are Below the Poverty Line or belong to a Scheduled Caste or Scheduled Tribe are eligible for cash benefits, irrespective of whether they choose to deliver in a government health facility or an accredited private institution. 3. Women who are Below the Poverty Line and choose to deliver at home are entitled to a cash assistance of '500 per delivery. 4. Accredited Social Health Activists (ASHA) are also incentivised under the Scheme for promoting institutional deliveries among pregnant women. 5. Tracking of each p is emphasised. Each beneficiary registered under this Yojana should have a JSY card along with a MCH card. ASHA/AWW (Anganwadi worker)/ any other identified link worker under the overall supervision of the NSOU ? GE-GR-11 193 ANM and the MO, PHC should mandatorily prepare a micro-birth plan. This will effectively help in monitoring antenatal check-up, and the post-delivery care. 12.3 ????? National Nutrition Mission National Nutrition Mission (NNM) or POSHAN Abhiyaan is a flagship programme of the Ministry of Women and Child Development (MWCD), Government of India, commencing from 2017-18. This programme ensures convergence with various programmes i.e., Anganwadi Services, Pradhan Mantri Matru Vandana Yojana (PMMVY), Scheme for Adolescent Girls (SAG) of MWCD JananiSurakshaYojana (JSY), National Health Mission (NHM), Swachh-Bharat Mission, Public Distribution System (PDS), Department Food and Public Distribution, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and Ministry of Drinking Water and Sanitation. Government is implementing several schemes and programmes under the Umbrella Integrated Child Development Services Scheme as direct targeted interventions to address the problem of malnutrition in the country. All these schemes address one or other aspects related to nutrition and have the potential to improve nutritional outcomes in the country. This scheme will be funded by Government Budgetary Support (50%) and 50% by IBRD or other MDB. Government budgetary support would be 60:40 between Centre and States/ UTs, 90:10 for NER and Himalayan States and 100% for UTs without legislature. Under the POSHAN Abhiyaan all districts of the 36 States/ Union Territories (UTs) have been covered in a phased manner. More than 10 crore people will be benefitted by this programme. Upto June 2019 Approximately 10.55 lakh field functionaries which include Anganwadi Workers, Lady Supervisors, Child Development Project Officers, District Project Officers and State Project Monitoring Unit Officers have been trained on various Modules of Increment Learning Approach and ICDS-CAS to strengthen implementation and operational preparedness under this Abhiyaan.During Financial Year 2017-18 and 2018-19, a sum of Rs.61.92 Crore has been spent under the head 'Information, Education and Communication (IEC), Advocacy and Jan Andolan' under the POSHAN Abhiyaan. Objectives Malnutrition is not a direct cause of death but contributes to mortality and morbidity by reducing resistance to infections. There are a number of causes of death of children such as prematurity, low birth weight, pneumonia, diarrhoeal diseases, non-communicable diseases,

194 NSOU ? GE-GR-11 birth asphyxia and birth trauma, injuries, congenital anomalies, acute bacterial sepsis and severe infections, etc. Thus the goal of NNM is to achieve improvement in nutritional status of children from 0-6 years, adolescent girls, pregnant women and lactating mothers in a time bound manner during the next three years beginning in 2017-18. The mission will create synergy, ensure better monitoring, issue alerts for timely action, and encourage States/ UTs to perform, guide and supervise the line Ministries and States/UT s to achieve the targeted goals. Major Features 1. The NNM is a comprehensive approach towards raising nutrition level in the country on a war footing. 2. The NNM targets to reduce stunting, under-nutrition, anemia (among young children, women and adolescent girls) and reduce low birth weight by 2%, 2%, 3% and 2% per annum respectively. However, the mission would strive to achieve reduction in Stunting from 38.4% to 25% by 2022. 3. It will comprise mapping of various schemes contributing towards addressing malnutrition, including a very robust convergence mechanism, ICT based Real Time Monitoring system, 4. It aims at incentivizing States/ UTs for meeting the targets, 5. The mission attempts on incentivizing Anganwadi Workers (AWWs) for using IT based tools and eliminating registers used by AWWs, 6. It focuses on introducing measurement of height of children at the Anganwadi Centres (AWCs), 7. NNM stresses on social udits, setting-up Nutrition Resource Centres, involving masses through Jan Andolan for their participation on nutrition through various activities etc. 8. Implementation strategy would be based on intense monitoring and Convergence Action Plan right upto the grass root level. 12.4 ????? Drinking Water and Sanitation Programmes Drinking water and sanitation facilities are very important and crucial for achieving the goal for achieving the goal of "HEALTH FOR ALL". Safe drinking water supply and basic NSOU ? GE-GR-11 195 sanitation are so intrinsically linked to human and ecosystem health that they, along with proper hygiene form the most essential components of a safe and healthy life. The Union Government of India appointed the Environmental Hygiene Committee (1948-49), which recommended a comprehensive plan for providing safe water supply and sanitation to the population. Thereafter the National Water Supply and Sanitation Programme was launched in 1954. The United Nations declared 1981-1990 as the "International Drinking Water Supply and Sanitation Decade". The following targets were fixed by the Indian Government for the decade: ? 100% Urban and Rural Water Supply ? 50% Urban Sanitation ? 25% Rural Sanitation 12.5 ????? Accelerated Rural Water Supply Programme

92% **MATCHING BLOCK 199/223** W

The Accelerated Rural Water Supply Programme (ARWSP) was introduced in 1972- 73 by the Government of India to assist the States and Union Territories (UTs) to accelerate the pace of coverage of drinking water supply.

The entire programme was given a Mission approach with the launch of

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the Technology Mission on Drinking Water and Related Water Management

in 1986. Salient features of the revised policy for implementation of Accelerated Rural Water Supply Programme during the Ninth Plan period are as follows: i. Normative criteria should be replaced with a need-based approach regarding allocation criteria of funds under ARWSP to the states. ii. Decentralization of powers to the states for implementation of sub-mission programmes. iii. Institutionalizing community-based demand-driven rural water supply pro-gramme with cost-sharing instruments by communities, gradually replacing the current supply-driven, centrally maintained non-people participating ru-ral water supply programme. iv. Institutionalising water quality monitoring and surveillance systems was given priority. Special emphasis is being given to areas affected with quality problems due to excess fluoride, arsenic, iron and other pollutants.

196 NSOU ? GE-GR-11 12.6 ????? Rajiv Gandhi National Drinking Water Mission In 1986, the National Drinking Water Mission (NDWM) was launched in order to provide scientific and cost effective content to the Centrally Sponsored Accelerated Rural Water Supply Programme (1972-73). The NDWM was renamed as the Rajiv Gandhi National Drinking Water Mission (RGNDWM) in 1991. Rural water supplies being a state subject, the state governments have been implementing the rural water supply programme under the Minimum Needs Programme (MNP). The central government through RGNDWM supplements the efforts of the state governments by providing assistance under the Accelerated Rural Water Supply Programme. 12.7 ????? National Rural Drinking Water Programme The centrally sponsored scheme, National Rural Drinking Water Programme (NRDWP) was launched in 1 April, 2009. It aims to provide safe and adequate water to every rural person on a sustainable basis. The Department of Drinking Water and Sanitation provides technical and financial assistance to the States to provide safe and adequate drinking water to rural India. The Programme is being implemented in all States and two Union Territories (Andaman and Nicobar Islands and Puducherry). The Programme has been restructured in November 2017 to make it more competitive, outcome based and result oriented. This is in line with United Nations Sustainable Development Goal (SDG) Target 6, i.e. 'By 2030, achieve universal and equitable access to safe and affordable drinking water for all'. Till now there are 13,99,345 fully covered habitations, which is 81.08 per cent of total and 2,68,779 partially covered habitations. Objectives The aim and objective of NRDWP is to provide every rural person with adequate safe water for drinking, cooking and other basic domestic needs on a sustainable basis, with a minimum water quality standard, which should be conveniently accessible at all times and in all situations. Achieving this aim and objective is a continuous process. The Department is committed to providing household piped water supply to all rural households by 2024 with a focus on small scale, community managed schemes groundwater schemes wherever possible, with emphasis on source sustainability through groundwater recharge and wastewater reuse.

NSOU ? GE-GR-11 197 Main Features 1. States are being asked to plan for coverage of habitations with piped water supply through stand posts or household connections. This shall reduce the drudgery and time taken in the collection of water. It shall also facilitate in tackling the problem of drinking water quality in the habitations affected with water issues. 2. The State Governments, in consultation with the Central Ministry, prepare Annual Action Plans (AAP) each year, to implement rural water supply schemes to cover partially covered and quality affected habitations and for other activities. 3. To ensure sustainability of functioning of rural water supply schemes, the States have to adopt improved Operation and Maintenance (OandM) methods for their better working and to control leakages. 4. To incentivise States to involve the Panchayati Raj Institutions (PRI) in the planning, operation and management for drinking water supply schemes, a Management Devolution Index has been formulated to measure the extent of devolution of powers made by States to the PRIs with respect to Funds, Functions and Functionaries in regard to drinking water supply. 5. The Ministry has set up a robust web-based monitoring mechanism at the central level to monitor the implementation of water supply schemes under the NRDWP in the States. 6. To facilitate water quality testing, a separate Water Quality Monitoring and Surveillance Component with 3% of NRDWP allocation has been created to strengthen water quality testing practices in States. 7. The NRDWP has special provisions to ensure coverage of the Scheduled Caste and Scheduled Tribe population with potable water supply. 22% and 10% of the funds are earmarked for the use in SC and ST dominated areas respectively. 8. Rural Water Supply and Sanitation Project-Low Income States (RWSSP-LIS) costing Rs. 6174 Crore is being implemented since June 2014 with the support of World Bank to improve piped water supply in Assam, Bihar, Jharkhand and Uttar Pradesh. The Project is planned to be completed by March 2020 and expected to benefit 75 lakh population and 16,933 habitations.

198 NSOU ? GE-GR-11 9. National Water Quality Sub-Mission had been launched on 22nd March, 2017 to provide safe drinking water to about 28,000 arsenic / fluoride affected habitations over a span of 4 years. 10. Swajal, a community demand driven, decentralized, single village, preferably solar powered, mini PWS programme for aspirational districts identified by NITI Aayog has been launched. The States may use Flexi Funds of NRDWP releases. 11. A National Centre for Drinking Water, Sanitation and Quality (formerly known as International Centre for Drinking Water Quality) registered under Societies Registration Act. 1860 is set up at Kolkata as an autonomous Institution under the Ministry. The scope of work of the Centre was initially limited to undertake activities under drinking water quality sector. 12.8 ????? Swachh Bharat Mission To accelerate the efforts to achieve universal sanitation coverage in a time bound manner in mission mode,

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the government of India launched the Swachh Bharat Mission (SBM) on 2nd October, 2014,

with the goal of achieving an open defecation free (ODF) India by 2nd October 2019, as a fitting tribute to Mahatma Gandhi on his 150th birth anniversary. The Department of Drinking Water and Sanitation manages the rural component of the mission – Swachh Bharat Mission Grameen (SBM-G), and is the coordinating department for the overall SBM. Going forward, the SBM will focus on moving from ODF to ODF Plus, through a focus on ODF sustainability and Solid Liquid Waste Management under four major verticals: Grey water management, plastic waste management, bio-degradable solid waste management and faecal sludge management. Since the launch of the SBM, India's rural sanitation coverage has increased from 39% in 2014 to over 99% as of June 2019. Total number of toilet built since 2nd Oct 2014 under SBM-G is 997.53 lakh. There has been 61.28 % increase in households with toilet since 2nd Oct 2014. There are 5,90,098 self-declared ODF villages. Objectives The basic idea is to

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bring about an improvement in the general quality of life in the rural areas, by promoting cleanliness, hygiene and eliminating open defecation

and to accelerate
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100%	MATCHING BLOCK 204/223	SA	Abhishek Mitra.pdf (D135026886)

sanitation coverage in rural areas to achieve the vision of Swachh Bharat by 2nd October 2019.

The mission aims to motivate communities to adopt sustainable sanitation practices and facilities through awareness creation and health education and to

100%	MATCHING BLOCK 205/223	SA	Abhishek Mitra.pdf (D135026886)

encourage cost effective and appropriate technologies for ecologically safe and sustainable sanitation.

To develop, wherever required, community managed sanitation systems focus is on scientific solid and

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liquid waste management systems for overall cleanliness in the rural areas.

To create significant positive impact on gender and promote social inclusion emphasis is given on improving sanitation especially in marginalized communities Main Features 1. Augmenting the institutional capacity of districts for undertaking intensive behavioural change activities at the grassroot level by emphasising awareness generation, triggering mindsets leading to community behaviour change and demand generation for sanitary facilities in houses, schools, Anganwadis, places of community congregation, and for Solid and Liquid Waste Management activities. 2. Incentivising the performance of state-level institutions to implement behavioural change activities in communities. 3. Strengthening the capacities of implementing agencies to roll out the programme in a time-bound manner and to measure collective outcomes 4. To cater the need for a dedicated, trained and properly incentivized sanitation workforce at the gram panchayat level, an army of 'foot soldiers' or 'Swachhagrahis', earlier known as 'SwachhataDoots' is developed and engaged through existing arrangements like Panchayati Raj Institutions, co-operatives, ASHAs, Anganwadi workers, Women Groups, Community Based Organisations, Self-help Groups, water linemen/pump operators etc. 5. To ensure appropriate participation of the beneficiary/communities, financially or otherwise in the setting up of the toilets to promote ownership and sustained use, both at the household and community levels. An illustrative list of technology options, with cost implications is provided to meet the user preferences and location-specific needs.
200 NSOU ? GE-GR-11 6. To engage a robust monitoring machinery by using community-led system, like social audit. community-based monitoring and vigilance committees. 7. As sanitation is a State subject, and States are the key entities in implementation of the programme, the mechanism for ODF verification are best evolved by the States themselves. The role of the Centre is to cross-share processes adopted by different States and evolve a mechanism to validate a small percentage of GPs/villages declared ODF by the States and further facilitate and guide the States where there is large difference in evaluation of Centre/State. 12.9? ?? ?? ?? ?? ?

96%	MATCHING BLOCK 208/223	SA	Mithlesh_Rural Development Management.docx (D119259395)

National Rural Health Mission The National Rural Health Mission (NRHM) was launched on 12

th April 2005,
to provide accessible, affordable and quality health care to the rural population, especially the vulnerable groups. Under the NRHM, the Empowered Action Group (EAG) States, including Bihar, Jharkhand, Uttar Pradesh, Uttarakhand Madhya Pradesh, Chhattisgarh, Odisha and Rajasthan, as well as north-eastern states, Jammu and Kashmir and Himachal Pradesh have been given special focus. As per the 12th Plan document of the Planning Commission, the flagship programme of NRHM will be strengthened under the umbrella of National Health Mission. The focus on covering rural areas and rural population will continue along with up scaling of NRHM to include non-communicable diseases. The mission aims to raise public spending on the health sector to 2-3% of the Gross Domestic Product (GDP), by undertaking architectural correction of the health system and promote policies that strengthen public health management and service delivery in the country. At the National level, the NHM has a Mission Steering Group (MSG) headed by the Union Minister for Health and Family Welfare and an Empowered Programme Committee (EPC) headed by the Union Secretary for Health and FW. The EPC will implement the Mission under the overall guidance of the MSG. At the State level, the Mission would function under the overall guidance of the State Health Mission headed by the Chief Minister of the State. The functions under the Mission would be carried out through the State Health and Family Welfare Society. The National Health Mission (NHM) was launched by the government of India in 2013 subsuming the National Rural Health Mission and National Urban Health Mission. It was further extended in March 2018, to continue until March 2020.
NSOU ? GE-GR-11 201 Objectives The NRHM seeks to provide equitable

63%	MATCHING BLOCK 207/223	SA	Mithlesh_Rural Development Management.docx (D119259395)

health care to the rural population, especially the vulnerable groups. The thrust of the mission is on establishing a fully functional, community owned, decentralised health delivery system with inter-sectoral convergence at all levels,

human resources management, community involvement, rigorous monitoring and evaluation against standards, innovations and flexible financing and also interventions for improving the health indicators

100%	MATCHING BLOCK 209/223	SA	Mithlesh_Rural Development Management.docx (D119259395)
to ensure simultaneous action on a wide range of determinants of health			

such as

100%	MATCHING BLOCK 215/223	SA	Mithlesh_Rural Development Management.docx (D119259395)
water, sanitation, education, nutrition, social and gender equality. The NRHM			

focuses on Reproductive, Maternal, Newborn, Child Health and Adolescent Services. The emphasis here is on strategies for improving maternal and child health through a continuum of care and the life cycle approach. It recognises the inextricable linkages between adolescent health, family planning, maternal health and child survival. Moreover, the linking of community and facility-based care and strengthening referrals between various levels of health care system to create a continuous care pathway is also to be focussed. Main Features 1. To

91%	MATCHING BLOCK 210/223	W
train and enhance capacity of Panchayat Raj Institutions (PRIs) to own, control and manage public health services. 2.		

To

100%	MATCHING BLOCK 211/223	W
promote access to improved healthcare at household level through the female health activist,		

i.e. Accredited Social Health Activists (ASHA). ASHA is the first port of call for any health related demands of deprived sections of the population, especially women and children, who find it difficult to access health services in rural areas. 3. Health Plan for each village through Village Health Committee of the Panchayat along with
preparation and implementation of an

64%	MATCHING BLOCK 222/223	SA	Ishu_Economics_Chapter 5.docx (D53969364)
inter-sectoral District Health Plan prepared by the District Health Mission, including drinking water, sanitation and hygiene			

and nutrition.

100%	MATCHING BLOCK 212/223	W
Integrating vertical Health and Family Welfare Programmes at National, State, Block, and District levels. 4.		

Strengthening existing PHCs and CHCs, and provision of 30- 50 beded hospitals. 5. The RogiKalyanSamiti (Patient Welfare Committee)/ Hospital Management Society, which is a management structure that acts as a group of trustees for the
202 NSOU ? GE-GR-11 hospitals to manage the affairs of the hospital. Financial assistance is provided to these Committees through untied fund to undertake activities for patient welfare. 6.

100%	MATCHING BLOCK 213/223	W

Strengthening capacities for data collection, assessment and review for evidence based planning, monitoring and supervision. 7.

100%	MATCHING BLOCK 214/223	W

Developing capacities for preventive health care at all levels for promoting healthy life styles, reduction in consumption of tobacco and alcohol etc. 8.

100%	MATCHING BLOCK 216/223	W

Promotion of public-private partnerships for achieving public health goals

and also promoting non-profit sector particularly in under-served areas. 9.

92%	MATCHING BLOCK 217/223	W

Regulation of private sector including the informal rural practitioners to ensure availability of quality service to citizens at reasonable cost

and revitalising local health traditions including AYUSH services. 10. Provided health care contractors to under-served areas, and an emphasis upon training to expand the skill of doctors and capacity building of nursing staff and auxiliary workers such as Auxiliary Nurse Midwives (ANMs). 11. Reorienting medical education to support rural health issues including regulation of Medical care and Medical Ethics. 12.

100%	MATCHING BLOCK 218/223	W

Effective and viable risk pooling and social health insurance to provide health security to the poor by ensuring

accessible, affordable, accountable and good quality hospital care. 12.10 ????? Sarva Shiksha Abhiyan The SarvaShikshaAbhiyan (SSA) is a flagship programme of the Government of India aimed at the universalisation of elementary education "in a time bound manner", asmandated by the 86

63%	MATCHING BLOCK 219/223	W

th Amendment to the Constitution of India making free and compulsory education to children between the ages of 6 and 14 a fundamental right.

As an intervention programme, it started on 2002, though SSA has been operational since 2000-2001. However, its origin goes back to 1993-1994, when the District Primary Education Programme (DPEP) was launched, with an aim of achieving the objective of universal primary education. The Central share was funded by a number of external agencies, including the World Bank, Department for International Development (DFID) and UNICEF. In 2018-19 total number of educational institutes was 10426, which include an enrolment of 517115 girls and 1316060 boys.

NSOU ? GE-GR-11 203 Objectives The SSA aims to provide for a variety of interventions for universal access and retention, bridging of gender and social category gaps in elementary education and improving the quality of learning. The SSA interventions include inter alia, opening of new schools and alternate schooling facilities, construction of schools and additional classrooms, toilets and drinking water, provisioning for teachers, regular teacher in service training and academic resource support, free textbooks and uniforms, and support for improving learning achievement levels/ outcome. As the Right to Education Act (RTE) came into force on 1 April 2010, changes have been incorporated into the SSA approach, strategies and norms. The changes encompass the vision and approach to elementary education, guided by the following principles: Holistic view of education, as interpreted in the National Curriculum Framework 2005, with implications for a systemic revamp of the entire content and process of education with significant implications for curriculum, teacher education, educational planning and management. Equity, to mean not only equal opportunity, but also creation of conditions in which the disadvantaged sections of the society, children of SC, ST, Muslim minority, landless agricultural workers and children with special needs, etc., can avail of the opportunity. 'Padhe Bharat Badhe Bharat', launched in 2014 by the Ministry of Human Resource Development, is a nationwide sub-programme of Sarva Shiksha Abhiyan. Children who fail to read in early education lag behind in other subjects. The programme is designed to improve comprehensive early reading, writing and early mathematics programme for children in Classes I and II. The programme will not only provide print rich environment, timely distribution of books but will also include new teacher mentoring and appraisal system. In 2018, Sarva Shiksha Abhiyan along with Rashtriya Madhyamik Shiksha Abhiyan was launched to form Samagra Shiksha Abhiyan. Major Features 1. The SarvaShikshaAbhiyan is a programme for Universal Elementary Education. 2. This

92%	MATCHING BLOCK 220/223	W

programme is also an attempt to provide an opportunity for improving human capabilities to all children through provision of community-owned quality education in a mission mode. 3.

100%	MATCHING BLOCK 221/223	W

It is a response to the demand for quality basic education all over the country. 204

NSOU ? GE-GR-11 4. The SSA attempts to provide quality elementary education including life skills with a special focus on the education of girls and children with special needs as well as computer education. 5. Centrality of teacher, to motivate them to innovate and create a culture in the classroom, and beyond the classroom, might produce an inclusive environment for children, especially for girls from oppressed and marginalised backgrounds. 6. Moral compulsion is imposed through the RTE Act on parents, teachers, educational administrators and other stakeholders, rather than shifting emphasis on punitive processes. 7. Convergent and integrated system of educational management is pre-requisite for implementation of the RTE law. All states must move in that direction as speedily as feasible. Key Words : Target group, Approaches to Rural Development, SGSY, MGNREGA, Jan Dhan Yojana, Rural Services, Elementary Education, Health Care, Micro credit, PURA, Rural Governance, Panchayati Raj Institution, Rural Development Policies, Rural Development Programmes, Rural Infrastructure, Infrastructural Development Programmes, Rural Electrification, Rural Transport, Rural Housing, Rural Connectivity, Janani Suraksha Yojona, National Nutrition Mission, Drinking Water and Sanitation Programme, NRHM, Sarva Sikha Mission. 12.11 ????? Questions Long Questions 1. Give an idea on different approaches adopted in post-independence India of rural development with special reference to the Target Group Approach. 2. Explain major objectives and features of the

100%	MATCHING BLOCK 223/223	SA	Impact of Rural Development Programmes on Soci ... (D23330902)

Swarnjayanti Gram SwarozgarYojana (SGSY)/ Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). 3.

Discuss briefly the origin and characteristics of the PURA Scheme in India.

NSOU ? GE-GR-11 205 4. Critically discuss the Panchayati Raj System in India. 5. Make a brief discussion on the basic strategies behind rural development policies and programmes in India. Classify rural development policies and programmes in India. 6. Discuss briefly origin and basic characteristics of any two employment generating programme/ social development programme adopted for rural areas in India. 7. Discuss some major initiatives taken by the Government of India to develop the physical infrastructure of the rural areas. 8. What are the major policies adopted for the development of woman and child health condition in rural India? 9. Make a detailed discussion on the recent policies aimed to promote elementary education in Rural India. Short Questions 1. Give an idea on the aims and objectives of the Jan DhanYojona. 2. What are the typical features of provision of services in rural areas? 3. Discuss the basic characteristics of the IRDP. 4. Mention the significance of the DWCRA scheme with respect to woman and child development? 5. Give an idea on the origin and significance of the Swachh Bharat Mission/ the SarvaShikshaAbhiyan. 6. Explain the three tier model of rural governance as adopted in India. Make a short note on the micro credit facilities available in rural India. 12.12 ????? Suggested Readings ? R. E. Dickinson; (1964) City and Region-A Geographical Interpretation; Published by – Routledge & Kegan Paul Ltd; London. ? R. P. Mishra; (1992); Regional Planning – Concepts, Techniques, Policies and Case Studies; Concept Publishing Company, New Delhi.
206 NSOU ? GE-GR-11 ? John Glasson; An Introduction to Regional Planning – concepts, Theory and Practice; Hutchinson, London etc. ? Jayasri Ray Chaudhuri; an Introduction to Development and Regional Planning – With Special Reference to India; Orient Longman. ? R. C. Chandna; Regional Planning and Development; Kalyani Publishers; Ludhiana etc. ? V. Nath; Edited by – S. K. Agarwal; Regional Development – Planning in India; Concept Publishing Company; New Delhi. M. Chand and V. K. Puri; Regional Planning in India; allied Publishers Pvt. Ltd. ? R. L. Singh; India – A Regional Geography. ? C. R. Pathak – spatial structures and processes of development in India; Regional Science Association, India. ? B. J. L. Berry and F. F. Horton (1970); Geographic Perspectives on Urban systems; Prentice Hall, New Jersy. ? L. S. Bhat (1972); Regional Planning in India; Statistical Publishing Society. ? H. J. De Blij (1971); Geography ; Regions and Concepts; John Wiley and Sons. ? M. Chand and V. K. Puri (1983); Regional Planning in India; Allied Publishers; New Delhi. ? P. J. Claval (1998); An Introduction to Regional Geography; Blackwell Publishers; Oxford and Massachusetts. ? J. Friedman and W. Alonso (1965); Regional Policy – Reading in Theory and Applications; MIT Press, Massachusetts. ? C. G. Gore (1984); Regions in Questions: Development; Essays on the Theory, Politics and Practice of Development Intervention, Metropolis – Verlag, Marburg. ? P. Hall (1992); Urban; and Regional Planning; Routledge; London. ? S. K. Kulshetra (2012) Urban and Regional Planning in India: A Handbook for Professional Practioners; Sage Publications, New Delhi. ? A. Kundu (1992); Urban Development Urban Research in India, Khanna Publishers; New Delhi.
NSOU ? GE-GR-11 207 ? R. P. Mishra, K. V. Sundaram, V. L. S. Prakash Rao (1974); Regional Development Planning in India; Vikas Publication, New Delhi. ? R. Peet (1999); Theories of Development; The Guilford Press, New York. ? UNDP 2001-04; Human Development Report; Oxford University Press. ? World Bank 2001-05; World Bank Development Report; Oxford University Press; New Delhi. _________
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Submitted text	As student entered the text in the submitted document.
Matching text	As the text appears in the source.

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1/223	SUBMITTED TEXT	18 WORDS	100% MATCHING TEXT	18 WORDS

one of the developing countries, it is apparent that there is a divide between urban and rural areas.

one of the developing countries, it is apparent that there is a divide between urban and rural areas.

W http://www.essay.uk.com/free-essays/international-relations-politics/urban-rural-interdependence.php

2/223	SUBMITTED TEXT	12 WORDS	100% MATCHING TEXT	12 WORDS

There exists an economic, social and environmental interdependence between urban and rural areas.

there exists an economic, social and environmental interdependence between urban and rural areas

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3/223	SUBMITTED TEXT	18 WORDS	87% MATCHING TEXT	18 WORDS

Adequate infrastructure such as transportation, communication, energy and basic services is the backbone of the rural-urban development linkage approach.

adequate infrastructure such as transportation, communication, energy and basic services is the backbone of the government's urban-rural development linkage approach.

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4/223	SUBMITTED TEXT	16 WORDS	91% MATCHING TEXT	16 WORDS

Spatial" links refer to the movement of people, goods, money, and information between urban and rural areas. "

spatial links to the movement of people, goods, money, and information between urban and rural areas

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5/223	SUBMITTED TEXT	31 WORDS	100% MATCHING TEXT	31 WORDS

Changes in land use around urban centers, from farmland to residential or industrial use; (2) Greater diversification of income sources in rural and urban areas, often involving people migrating or commuting between

changes in land use around urban centers, from farmland to residential or industrial use; greater diversification of income sources in rural and urban areas, often involving people migrating or commuting between

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6/223	SUBMITTED TEXT	15 WORDS	100% MATCHING TEXT	15 WORDS

the countryside and urban centers; and (3) Changes in the direction and composition of internal migration.

the countryside and urban centers; and changes in the direction and composition of internal migration

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7/223	SUBMITTED TEXT 48 WORDS	100% MATCHING TEXT 48 WORDS
	It is now widely recognized that there exists an economic, social and environmental interdependence between urban and rural areas and a need for balanced and mutually supportive approach to development of the two areas. The discrete consideration of rural development as completely distinct from urban development is no longer valid.	It is now widely recognized that there exists an economic, social and environmental interdependence between urban and rural areas and a need for balanced and mutually supportive approach to development of the two areas. The discrete consideration of rural development as completely distinct from urban development is no longer valid.

W http://www.essay.uk.com/free-essays/international-relations-politics/urban-rural-interdependence.php

8/223	SUBMITTED TEXT 112 WORDS	95% MATCHING TEXT 112 WORDS
	Since 1991, significantly greater access to information technology, better roads, improved education and changing economic realities has increased the movement of people, goods and services, waste and pollution and blurring the boundaries between urban and rural areas. The government has laid down policies that draw on urban-rural interdependencies. Such interdependence however still have a relatively limited impact on development practices. There liesa gap between development policy and tangible policy outcomes. Rural-urban developmental policies haven’t produced as expected instead, regional economies, the goods and services required by the new economic activities stimulated by these policies come from private businesses. Many policies that attempt to draw on urban-rural linkages are often unsuccessful because they fail to reflect the true circumstances of the people	Since 1994, significantly greater access to information technology, better roads, improved education and changing economic realities are increasing the movement of people, goods and services, waste and pollution and blurring the boundaries between urban and rural areas. (Kanbur & Venables, 2005). The government has laid down policies that draw on urban-rural interdependencies. Such interdependence however still have a relatively limited impact on development practices. There still a gap between development policy and tangible policy outcomes. Rural-urban developmental policies haven’t produced as expected instead, regional economies, the goods and services required by the new economic activities stimulated by these policies come from private businesses. Many policies that attempt to draw on urban-rural linkages are often unsuccessful because they fail to reflect the true circumstances of the people

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9/223	SUBMITTED TEXT 123 WORDS	98% MATCHING TEXT 123 WORDS
	Rural-urban interdependence relates to the joint or interactive relationship between urban and rural areas. The mutually beneficial correlativeness of urban and rural areas. Traditionally, rural and urban issues and planning have been typically seen as and dealt with separately. However, in recent years as urbanization and inequality increase, more sophisticated analyses of the linkages and interdependencies between rural and urban areas have emerged. The flows of people, goods, services, information and money typically provide strong and dynamic linkages between rural and urban areas. In many places these interdependencies have deepened since the market liberalization of the 1980s due to increased price risk, rising input prices relative to output prices, detrimental HIV/AIDS effects on labor and other asset availability, environmental deterioration and continuing farm sub-division at inheritance (Low, et al., 1999). Rural-urban interdependence	Rural-urban interdependence relates to the joint or interactive relationship between urban and rural areas. The mutually beneficial correlativeness of urban and rural areas. Traditionally, rural and urban issues and planning have been typically seen as and dealt with separately. However, in recent years as urbanization and inequality increase, more sophisticated analyses of the linkages and interdependencies between rural and urban areas have emerged. The flows of people, goods, services, information and money typically provide strong and dynamic linkages between rural and urban areas. In many places these interdependencies have deepened since the market liberalization of the 1980s due to increased price risk, rising input prices relative to output prices, detrimental HIV/AIDS effects on labor and other asset availability, environmental deterioration and continuing farm sub-division at inheritance (Low, et al., 1999). Urban-rural interdependence

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10/223	SUBMITTED TEXT	182 WORDS	99%	MATCHING TEXT	182 WORDS

important for poverty alleviation and sustainable rural development and urbanization. Strong linkages can improve the living conditions and employment opportunities of both rural and urban population. Domestic trade and the adequacy and efficiency of infrastructure are the backbone of mutually beneficial rural-urban relationships and of the success of the relationship between urban and rural areas (Bekker, 2000). Issues such as changes in land use around urban centers, from farmland to residential or industrial use; greater diversification of income sources in rural and urban areas, often involving people migrating or commuting between the countryside and urban centers; and changes in the direction and composition of internal migration are likely to emerge in the near future. The relationships or inter-linkages between urban and rural areas are not all positive or beneficial to both ends of the spectrum. Cities and their metropolitan extensions absorb productive agricultural land, exploit water resources, pollute the rural environment and act as sinks for urban waste. On the other hand, cities rarely expand and build up efficiently. There often remains extensive rural areas within cities and their metropolitan boundaries, giving rise to the phenomenon of urban villages with urban farming occupation and prevalence (Tacoli, 1998).

important for poverty alleviation and sustainable rural development and urbanization. Strong linkages can improve the living conditions and employment opportunities of both rural and urban populations. Domestic trade and the adequacy and efficiency of infrastructure are the backbone of mutually beneficial rural-urban relationships and of the success of the relationship between urban and rural areas (Bekker, 2000). Issues such as changes in land use around urban centers, from farmland to residential or industrial use; greater diversification of income sources in rural and urban areas, often involving people migrating or commuting between the countryside and urban centers; and changes in the direction and composition of internal migration are likely to emerge in the near future. The relationships or inter-linkages between urban and rural areas are not all positive or beneficial to both ends of the spectrum. Cities and their metropolitan extensions absorb productive agricultural land, exploit water resources, pollute the rural environment and act as sinks for urban waste. On the other hand, cities rarely expand and build up efficiently. There often remains extensive rural areas within cities and their metropolitan boundaries, giving rise to the phenomenon of urban villages with urban farming occupation and prevalence (Tacoli, 1998). 2.

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11/223	SUBMITTED TEXT	241 WORDS	96%	MATCHING TEXT	241 WORDS
Strategies and interventions by government to foster urban-rural interdependence are in the form of policies and they include the following: a) A rural-urban linkage development approach The government has engaged a number of strategies for upgrading urban-rural interdependence in the country. Provision of adequate infrastructure such as transportation, communication, energy and basic services is the backbone of the government's urban- rural development linkage approach. There is a positive relationship between adequacy of transportation infrastructure, ease of mobility and access to employment and enhancement of income. Adequate investments in infrastructure, particularly transportation infrastructure, also improve rural productivity and allow access to markets, jobs and public service by both men and women (Gete, et al. 2007). The high densities have obvious consequences in terms of the choice of transportation modes, living conditions, congestion and pollution. b) Local Economic Development Approach Local economic development offers local government, the private and not-for-profit sectors, and local communities the opportunity to work together to improve the local economy. LED has encompassed a range of disciplines including physical planning, economics 14 NSOU ? GE-GR-11 and marketing. It has also incorporated many local government and private sector functions, including environmental planning, business development, infrastructure provision, real estate development and finance. All these disciplines must work together to improve the local economy. The discrete consideration of rural development as completely distinct from urban development is no longer valid. Considering the positive impacts of this, it becomes clear that urban-rural interdependence will be greatly boasted as local produce will need improved transport infrastructure to be in place in order to access urban markets.				Strategies and interventions by government to foster urban-rural interdependence are in the form of policies and they include the following: a) A rural-urban linkage development approach The South African government has engaged a number of strategies for upgrading urban-rural interdependence in the country. Provision of adequate infrastructure such as transportation, communication, energy and basic services is the backbone of the government's urban-rural development linkage approach. There is a positive relationship between adequacy of transportation infrastructure, ease of mobility and access to employment and enhancement of income. Adequate investments in infrastructure, particularly transportation infrastructure, also improve rural productivity and allow access to markets, jobs and public service by both men and women (Gete, et al. 2007). The high densities have obvious consequences in terms of the choice of transportation modes, living conditions, congestion and pollution. b) Local Economic Development (LED) Local economic development offers local government, the private and not-for-profit sectors, and local communities the opportunity to work together to improve the local economy. LED has encompassed a range of disciplines including physical planning, economics and marketing. It has also incorporated many local government and private sector functions, including environmental planning, business development, infrastructure provision, real estate development and finance. All these disciplines must work together to improve the local economy. The discrete consideration of rural development as completely distinct from urban development is no longer valid. Considering the positive impacts of LED, it becomes clear that urban-rural interdependence will be greatly boasted as local produce will need improved transport infrastructure to be in place in order to access urban markets.	

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12/223	SUBMITTED TEXT	21 WORDS	100%	MATCHING TEXT	21 WORDS

This linkage will allow comprehending these areas as interdependent phenomena rather than as random disparities (Gete, et al. 2007). c) The National Infrastructure

This linkage will allow comprehending these areas as interdependent phenomena rather than as random disparities (Gete, et al. 2007). c) The National Infrastructure

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13/223	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

improve access to a number of facilities, including healthcare facilities, schools, roads etc. This

improve access to a number of facilities, including healthcare facilities, schools, roads etc. This

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14/223	SUBMITTED TEXT	20 WORDS	75%	MATCHING TEXT	20 WORDS

between urban and country areas by construction of ports, roads, railways, hospitals, schools and dams also contributes to faster economic growth. d)

between urban and country areas will be significantly improved. Construction of ports, roads, railways, hospitals, schools and dams will also contribute to faster economic growth (NIP, 2012). d)

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15/223	SUBMITTED TEXT	66 WORDS	91%	MATCHING TEXT	66 WORDS

The Integrated urban space and public transportation programme aims at coordinating planning and implementation of public transportation, human settlement, economic and social infrastructure and location decisions into sustainable urban settlements connected by densified transport corridors. Such government projects enhance greatly the interdependence of urban and rural areas. Other potential solutions to initiate Urban-Rural interdependence : i) Spatial Reconstruction and Integration Spatial Reconstruction and integration is a local development priority aiming at eradicating the

The Integrated urban space and public transportation programme which is aimed at coordinating planning and implementation of public transportation, human settlement, economic and social infrastructure and location decisions into sustainable urban settlements connected by densified transport corridors. Such government projects enhances greatly the interdependence of urban and rural areas (NIP, 2012). 4. Other potential solutions to foster urban-rural interdependence i) Spatial Reconstruction and Integration Spatial Reconstruction and integration is a local development priority aiming at eradicating the

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16/223	SUBMITTED TEXT	100 WORDS	98%	MATCHING TEXT	100 WORDS

spatial system that was created by past spatial policies where areas of severe poverty, limited economic opportunities, inferior forms of land tenure and limited social and engineering infrastructure, were far removed from employment opportunities and economic growth areas. Spatial integration must focus on improved rail and road linkage (transportation corridors and connectors) between concentrations of greatest need for development and areas of greatest economic potential (economic nodes), the provision of housing in localities within reasonable walking distance to public transport, this is to enhance accessibility to employment opportunities, social facilities and greater variety of goods and services. This may enhance urban-rural interdependence through enhanced regional accessibility (Okpala, 2003)

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W http://www.essay.uk.com/free-essays/international-relations-politics/urban-rural-interdependence.php

17/223	SUBMITTED TEXT	76 WORDS	100%	MATCHING TEXT	76 WORDS

ii) Strategic Development Concept In order to overcome the spatial distortions of apartheid, future settlements, economic development opportunities and infrastructure investments should be channeled to activity corridors and nodes that link with major growth centers or that have a potential to become major growth centers. The strategic development concept is based on nodes, corridors and precincts, which aim is to reconstruct and integrate the urban and rural landscape on regional scale into a more rational, cost effective and manageable structure (Diyamett, 2001)

ii) Strategic Development Concept In order to overcome the spatial distortions of apartheid, future settlements, economic development opportunities and infrastructure investments should be channeled to activity corridors and nodes that link with major growth centers or that have a potential to become major growth centers. The strategic development concept is based on nodes, corridors and precincts, which aim is to reconstruct and integrate the urban and rural landscape on regional scale into a more rational, cost effective and manageable structure (Diyamett, 2001).

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18/223	SUBMITTED TEXT	86 WORDS	98%	MATCHING TEXT	86 WORDS

iii) Rural Transportation Strategy Improved regional access via road, rail and air transportation is important to unlock the tourism potential, to ensure functional urban and rural integration and to enhance inter- and intra-municipal accessibility. Transportation strategies need to address issues such as the provision of integrated modal interchanges supported by infrastructure, shelters, amenities, footpaths and security facilities in all activity nodes, the provision of affordable basic access to transportation, reducing long walking and travelling distances, an Integrated Transport Plan to identify important linkages that need constant maintenance and upgrade (NIP, 2012). iv) Capacity building

iii) Rural Transportation Strategy Improved regional access via road, rail and air transportation is important to unlock the tourism potential, to ensure functional urban and rural integration and to enhance inter- and intra-municipal accessibility. Transportation strategies need to address issues such as the provision of integrated modal interchanges supported by infrastructure, inter alia ranks, shelters, amenities, footpaths and security facilities in all activity nodes, the provision of affordable basic access to transportation, reducing long walking and travelling distances, an Integrated Transport Plan to identify important linkages that need constant maintenance and upgrade (NIP, 2012). iv) Capacity building/

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19/223	SUBMITTED TEXT	80 WORDS	97%	MATCHING TEXT	80 WORDS

Rural areas are located far away from services and job opportunities. Rural areas depend on urban areas for secondary schools, post and telephone, credit, agricultural expansion services, farm equipment, hospitals and government services. People in rural areas travel long distances to access services and job opportunities and this on itself have financial implications. As incomes from agriculture decrease, rural households are forced to develop new and more complex livelihood strategies that include both agricultural and non-agricultural income, including remittances from seasonal and permanent migrants (Simkins, 1983).

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20/223	SUBMITTED TEXT	41 WORDS	91%	MATCHING TEXT	41 WORDS

Efficiency of Policy Presented with a fast growing and dynamic economy, the government should ensure that all citizens benefit from economic growth. Implementing successful rural development and land reform in the country is however challenging and controversial. 1.3 ? ?? ?? ?? ?? ?

Efficiency of Policy Presented with a fast growing and dynamic economy, the South African government wants to ensure that all citizens benefit from economic growth. Implementing successful rural development and land reform in the country is however challenging and controversial.

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21/223	SUBMITTED TEXT	197 WORDS	97%	MATCHING TEXT	197 WORDS

Bekker, S. (2000). Internal migration and infrastructural provision: challenges to inter- provincial planning in South Africa. Symposium on Challenges for Integrated Rural Development. Cape Town: University of Cape Town Press. 16 NSOU ? GE-GR-11 Diyamett, B., Diyamett, M., James, J., Kibadu, A., Lerise, F., Mabala, R., Mbutolwe, E., Mushi, N., (2001). Exploring rural-urban interactions in Tanzania: a critical review of the methods and tools used Rural-Urban Interactions and Livelihoods. Gete, Z., P. Trutmann, P. & Aster, D. (2007). Fostering New Development Pathways: Harnessing Rural-urban Linkages. Kanbur, R., and Venables, A.J. (2005) Introduction: Spatial inequality and development; Journal of Economic Geography, 5(1). Lohnert, B. and Steinbrink, M., (2005) Rural and urban livelihoods: A translocal perspective in a South African context, South African Geographical Journal, 87 (2), pp. 95- 103. Low, B., Costanza R., Ostrom E, Wilson J., and Simon, C.P., (1999) Human'ecosystem interactions: a dynamic integrated model, Ecological Economics, 31, pp.227- 242. Okpala, D.C. (2003) Promoting the Positive Rural-Urban Linkages Approach to Sustainable Development and Employment Creation: The Role of UN-HABITAT. Simkins, C. (1983). Four essays on the past, present and possible future of the distribution of the black population of South Africa. Cape Town: Saldru. South Africa National Government: National Infrastructure Plan (NIP), 2012. Tacoli, C. (1998). Rural-urban interactions: a guide to the literature. Environment and Urbanisation, 10(1):

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22/223	SUBMITTED TEXT	37 WORDS	79%	MATCHING TEXT	37 WORDS

Of the 121 crore Indians, 83.3 crore live in rural areas while 37.7 crore stay in urban areas, as per the 2011 Census. The absolute increase in population is more in urban areas than in rural areas. The

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

23/223	SUBMITTED TEXT	20 WORDS	100%	MATCHING TEXT	20 WORDS

meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable development

meets the needs of the present without compromising the ability of future generations to meet their own needs'. Sustainable development

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

24/223	SUBMITTED TEXT	146 WORDS	97%	MATCHING TEXT	146 WORDS

Rural development is a national necessity and has considerable importance in India because of the following reasons: 1. To develop rural area as whole in terms of culture, society, economy, technology and health. 2. To develop living standered of rural mass. 3. To develop rural youths, children and women. 4. To develop and empower human resource of rural area in terms of their psychology, skill, knowledge, attitude and other abilities. 5. To develop infrastructure facility of rural area. 6. To provide minimum facility to rural mass in terms of drinking water, education, transport, electricity and communication. 7. To develop rural institutions like panchayat, cooperatives, post, banking and credit. 8. To provide financial assistances to develop the artisans in the rural areas, farmers and agrarian unskilled labour, small and big rural entrepreneurs to improve their economy. 9. To develop rural industries through the development of handicrafts, small scaled industries, village industries, rural crafts, cottage industries and other related economic operations in the rural sector.

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

25/223	SUBMITTED TEXT	62 WORDS	97%	MATCHING TEXT	62 WORDS

To develop agriculture, animal husbandry and other agricultural related areas. 11. To restore uncultivated land, provide irrigation facilities and motivate farmers to adopt improved seed, fertilizers, package of practices of crop cultivation and soil conservation methods. 12. To develop entertainment and recreational facility for rural mass. 13. To develop leadership quality of rural area. 14. To improve rural marketing facility 15. To minimise gap between the urban and rural

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26/223	SUBMITTED TEXT	9 WORDS	100%	MATCHING TEXT	9 WORDS

of rural industries with emphasis on village and cottage industries.

of rural industries with emphasis on village and cottage industries

W https://www.worldwidejournals.com/paripex/recent_issues_pdf/2013/May/rural-development-programmes ...

27/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

so as to enable them to improve their standard of living.

so as to enable them to improve their standard of living.

W https://www.worldwidejournals.com/paripex/recent_issues_pdf/2013/May/rural-development-programmes ...

28/223	SUBMITTED TEXT	13 WORDS	80%	MATCHING TEXT	13 WORDS

maximum possible employment opportunities in rural areas, especially for the weaker sections of

maximum possible employment opportuni- ties in the rural areas especially for the weaker sections of

W https://www.worldwidejournals.com/paripex/recent_issues_pdf/2013/May/rural-development-programmes ...

29/223	SUBMITTED TEXT	152 WORDS	95%	MATCHING TEXT	152 WORDS

Rural Development 5.5 Questions 5.6 Suggested Readings 5.1 ????? Meaning and Concept Although policy makers and the development community have widely used the phrase “rural development”, what constitutes rural development seems to have changed significantlyovertimes. The concept of rural development has changed significantly during the last three decades. Until the 1970s, rural development was synonymous with agricultural development and hence focused on increasing agricultural production. This focus seems to have been driven primarily by the interest of industrialization to extract surpluses from the agriculture sector to reinforce industrialization. The establishment of the Millennium Development Goals has significantly reinforced the concerns about non-income poverty. With the parading shifts in economic development from “growth” to broadly defined “development”, the concept of rural development has begun to be used in a broader sense. In more recent years increased concerns on the environmental’ aspects of economic growth have also influenced the changes. Today’s concept of rural development is fundamentally different from that used about three or four decades ago. The concept

rural development in India. Meaning and Concept: Although policy makers and the development community have widely used the phrase “rural development”, what constitutes rural development seems to have changed significantly overtimes. The concept of rural development has changed significantly during the last three decades. Until the 1970s, rural development was synonymous with agricultural development and hence focused on increasing agricultural production. This focus seems to have been driven primarily by the interest of industrialization to extract surpluses from the agriculture sector to reinforce industrialization. The establishment of the Millennium Development Goals has significantly reinforced the concerns about non-income poverty. With the parading shifts in economic development from “growth” to broadly defined “development”, the concept of rural development has begun to be used in a broader sense. In more recent years increased concerns on the environmental’ aspects of economic growth have also influenced the changes. Today’s concept of rural development is fundamentally different from that used about three or four decades ago. The concept

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30/223	SUBMITTED TEXT	29 WORDS	100%	MATCHING TEXT	29 WORDS
The notion of rural development has been conceived in diverse ways by researchers, ranging from thinking of it as a set of goals and programmes to a well-knit strategy,			The notion of rural development has been conceived in diverse ways by researchers, ranging from thinking of it as a set of goals and programmes to a well-knit strategy,		

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31/223	SUBMITTED TEXT	25 WORDS	100%	MATCHING TEXT	25 WORDS
approach or even an ideology. There is a widely shared view that its essence should be poverty alleviation and distributive Justice oriented economic transformation. 5.2 ?????			approach or even an ideology. There is a widely shared view that its essence should be poverty alleviation and distributive Justice oriented economic transformation.		

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Submitted text:

now encompasses "concerns that go well beyond improvements in growth, income and output. The concern includes an assessment of changes in the quality of life, broadly defined to include improvement in health and nutrition, education, environmentally safe living conditions and reduction in gender and Income inequalities. Today, there seems to be a universal consensus that the ultimate objective of rural development is to improve the quality of life of rural people. This makes it essential to go beyond the income-related 62 NSOU ? GE-GR-11 factors such as prices, production, and productivity to a range of non- income factors that influence quality of life and hence inclusiveness of rural development." Inclusive rural development is more specific concept than the concept of rural development. In broader terms, inclusive rural development is about improving the quality of life of all members of rural society. More specifically, inclusive rural development covers three different but interrelated dimensions. 1. Economic dimension 2. Social dimension 3. Political dimension Economic dimension encompasses providing both capacity and opportunities for the poor and low-income households in particular who may benefit from the economic growth. Socialdimension supports social development of poor and low- Income households, promotes gender equality and women's empowerment and provides social safety nets for vulnerable groups. Political dimension improves the opportunities for the poor and low-Income people in rural areas to effectively and equally participate within the political processes at the village level. ECONOMIC INCLUSIVE RURAL DEVELOPMENT

Matching text:

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33/223	SUBMITTED TEXT	63 WORDS	73%	MATCHING TEXT	63 WORDS

The term rural development connotes overall development of rural areas with a view to improve the quality of life of the rural poor. In this sense, it is a comprehensive and multi-dimensional concept, encompassing the development of agriculture and allied activities, village and cottage industries including crafts, socio-economic infrastructure, community services and facilities, and above all, the human resource development in rural areas. As a phenomenon, rural development

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34/223	SUBMITTED TEXT	49 WORDS	67%	MATCHING TEXT	49 WORDS

result of transactions between various physical, technological, economic, socio-cultural and institutional factors. As a strategy, it is designed to improve the economic and social wellbeing of the specific group of people- 'the rural poor'. As a discipline, it is multi-disciplinary in nature, representing an intersection of agricultural, social, behavioural, engineering and management sciences.

SA Abhishek Mitra.pdf (D135026886)

35/223	SUBMITTED TEXT	47 WORDS	93%	MATCHING TEXT	47 WORDS

Submitted text	Matching text
rural development as a strategy designed to improve the economic and social life of a specific group of people - The rural poor. Rural development involves extending the benefits of development to the poorest among those who seek livelihood in the rural areas. The group includes small-scale farmers, tenants and	rural development as "a strategy designed to improve the economic and social life of a specific group of people- the rural poor. involves extending the benefits of development to the poorest among those who seek a livelihood in the rural areas. The group includes small-scale farmers, tenants and

W https://medium.com/@mikemaketho/rural-development-programs-have-been-around-since-the-1950s-but-t ...

36/223	SUBMITTED TEXT	23 WORDS	58%	MATCHING TEXT	23 WORDS

include a mix of activities including projects to raise agricultural output, create new employment, improve health and education, expand communications and improve housing". 6.2 ?????

include a mix of activities including projects or programs to increase agricultural productivity and production, provide employment, improve health, education and infrastructure, expand communications and improve housing.

W https://medium.com/@mikemaketho/rural-development-programs-have-been-around-since-the-1950s-but-t ...

37/223	SUBMITTED TEXT	20 WORDS	88%	MATCHING TEXT	20 WORDS

Training and Education Programme', 'Well construction Programme', 'Rural works programme' (RWP), 'Tribal Development Block', 'Rural Manpower Programme', 'Composite Programme for Women and

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

38/223	SUBMITTED TEXT	17 WORDS	91%	MATCHING TEXT	17 WORDS

Small Farmers Development Agency (SFDA), Marginal Farmers and Agricultural Labourers Development Agency (MFAL), Drought Prone Area Programme (DPAP),

SA Mithlesh_Rural Development Management.docx (D119259395)

39/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

Development of Women and Children in Rural Areas (DWCRA) etc.,

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

40/223	SUBMITTED TEXT	12 WORDS	83%	MATCHING TEXT	12 WORDS

Growth Oriented Strategy This is based on the philosophy that rural people,

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

41/223	SUBMITTED TEXT	22 WORDS	61%	MATCHING TEXT	22 WORDS

paradigm formed the basis of the predominant agricultural development strategy of the 1960s, when programmes like the Intensive Agriculture District Programme (IADP),

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

42/223	SUBMITTED TEXT	87 WORDS	79%	MATCHING TEXT	87 WORDS

Strategy combines all the positive features of the earlier strategies, and is designed to simultaneously achieve the goals of growth, welfare, equity, and community participation. This paradigm takes a very comprehensive but integrated view of the basic problems of poverty, unemployment and inequality, and seeks to address 86 NSOU ? GE-GR-11 the physical, economic, technological, social, motivational, organizational and political bases of these problems. The multiple goals of this strategy are sought to be achieved by building the capacity of the community to involve itself in development in partnership with the government. The

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

43/223	SUBMITTED TEXT	24 WORDS	98%	MATCHING TEXT	24 WORDS

Pradhan Mantri Gram Sadak Yojana The Pradhan Mantri Gram Sadak Yojana (PMGSY) is a nationwide plan in India to provide good all-weather road connectivity to

SA Commerce Conference 202. Rural Development Adream project.docx (D16863539)

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44/223	SUBMITTED TEXT	140 WORDS	100%	MATCHING TEXT	140 WORDS

Rural Road Connectivity is not only a key component of Rural Development by promoting access to economic and social services and thereby generating increased agricultural incomes and productive employment opportunities in India, it is also as a result, a key ingredient in ensuring sustainable poverty reduction. Notwithstanding the efforts made, over the years, at the State and Central levels, through different Programmes, many Habitations in the country are still not connected by All-weather roads. It is well known that even where connectivity has been provided, the roads constructed are of such quality (due to poor construction or maintenance) that they cannot always be categorised as All- weather roads. With a view to redressing the situation, Government had launched the Pradhan Mantri Gram Sadak Yojana on 25th December, 2000 to provide all-weather access to eligible unconnected habitations. The Pradhan Mantri Gram Sadak Yojana (PMGSY) is a 100% Centrally Sponsored Scheme. ' 6.4.1.

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45/223	SUBMITTED TEXT	108 WORDS	100%	MATCHING TEXT	108 WORDS

The primary objective of the PMGSY is to provide Connectivity, by way of an All- weather Road (with necessary culverts and cross-drainage structures, which is operable throughout the year), to the eligible unconnected Habitations in the rural areas with a population of 500 persons and above in Plain areas. In respect of the Hill States (North- East, Sikkim, Himachal Pradesh, Jammu & Kashmir and Uttarakhand), the Desert Areas (as identified in the Desert Development Programme), the Tribal (Schedule V) areas and Selected Tribal and Backward Districts (as identified by the Ministry of Home Affairs and Planning Commission) the objective would be to connect eligible unconnected Habitations with a population of 250 persons and above. 94

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46/223	SUBMITTED TEXT	24 WORDS	92%	MATCHING TEXT	24 WORDS

habitations of the designated population size have been provided all-weather road connectivity. However, it must be noted that upgradation is not central to the Programme.

habitations of the designated population size have been provided all- weather road connectivity. However, it must be noted that up- gradation is not central to the programme

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47/223	SUBMITTED TEXT	165 WORDS	98%	MATCHING TEXT	165 WORDS

The spirit and the objective of the Pradhan Mantri Gram Sadak Yojana (PMGSY) is to provide good all-weather road connectivity to the eligible unconnected habitations. A habitation which was earlier provided all-weather connectivity would not be eligible even if the present condition of the road is bad. The unit for this Programme is a habitation and not a Revenue Village or a Panchayat. A Habitation is a cluster of population, living in an area, the location of which does not change over time. Desam, Dhanis, Tolas, Majras, Hamlets etc. are commonly used terminology to describe the Habitations. An Unconnected Habitation is one with a population of designated size located at a distance of at least 500 metre or more (1.5 km of path distance in case of Hills) from an All-weather road or a connected Habitation. In the blocks bordering international boundary in the hill States (as identified by the Ministry of Home Affairs), however, all habitations within a path distance of 10 km may be treated as a cluster for this purpose.

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48/223	SUBMITTED TEXT	37 WORDS	100%	MATCHING TEXT	37 WORDS

The PMGSY shall cover only the rural areas. Urban roads are excluded from the purview of this Programme. Even in the rural areas, PMGSY covers only the Rural Roads i.e., Roads that were formerly classified as 'Other District Roads' (

The PMGSY shall cover only the rural areas. Urban roads are excluded from the purview of this programme. Even in the rural areas, PMGSY covers only the rural roads i.e., roads that were formerly classified as 'Other District Roads'

J 731faa5e-53e1-41b2-8464-6d67afe08c83

Ouriginal by Turnitin

49/223	SUBMITTED TEXT	65 WORDS	91%	MATCHING TEXT	65 WORDS

Other District Roads (ODR) are roads serving rural areas of production and providing them with outlet to market centres, taluka (tehsil) headquarters, Block headquarters or other main roads. Village Roads (VR) are roads connecting villages / Habitation or groups of Habitations with each other and to the nearest road of a higher category. Major District Roads, State Highways and National Highways cannot be covered under the PMGSY, even if

Other District Roads are roads serving rural areas of production and providing them with outlet to market centres, taluka headquarters, Block headquarters or other main roads. Village roads are roads connecting villages/habitation or groups of habitation with each other and to the nearest road of a higher category. Major District Roads, State Highways and National Highways cannot be covered under the PMGSY, even if

J 731faa5e-53e1-41b2-8464-6d67afe08c83

50/223	SUBMITTED TEXT	35 WORDS	100%	MATCHING TEXT	35 WORDS

In the blocks bordering international boundary in the hill States (as identified by the Ministry of Home Affairs), however, all habitations within a path distance of 10 km may be treated as a cluster for this purpose.

SA parveen walia thesis.pdf (D40589667)

51/223	SUBMITTED TEXT	20 WORDS	100%	MATCHING TEXT	20 WORDS

The Rural Roads Plan and the Core Network would constitute the basis for all planning exercises under the PMGSY. 4.2 The

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

52/223	SUBMITTED TEXT	17 WORDS	65%	MATCHING TEXT	17 WORDS

Singh Katar, “Rural Development Principles, Practice and Management” Sage Publications, New Delhi,(1998), pp.21-22 2. Report of “The

SA Abhishek Mitra.pdf (D135026886)

53/223	SUBMITTED TEXT	18 WORDS	79%	MATCHING TEXT	18 WORDS

India, New Delhi, (1972). 4. Deb.K, ‘Rural Development in India since Independence”, Sterling Publishers Pvt. Ltd; New Delhi, (1986). 5.

SA parveen walia thesis.pdf (D40589667)

54/223	SUBMITTED TEXT	21 WORDS	56%	MATCHING TEXT	21 WORDS

Development of rural areas has been at the core of the planning process in the country. The term ‘rural development’ is a

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

55/223	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

areas with a view to improve the quality of life of rural people.

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

56/223	SUBMITTED TEXT	26 WORDS	83%	MATCHING TEXT	26 WORDS

The basic objectives of rural development programme have been alleviation of poverty and unemployment through creating basic social and economic infrastructure, training to rural unemployed youth and

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

57/223	SUBMITTED TEXT	11 WORDS	90%	MATCHING TEXT	11 WORDS

to discourage seasonal and permanent migration to urban areas. Rural development

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

Ouriginal by Turnitin

58/223	SUBMITTED TEXT	11 WORDS	83%	MATCHING TEXT	11 WORDS

rural infrastructure, income of rural households and service systems pertaining to education,

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

59/223	SUBMITTED TEXT	12 WORDS	95%	MATCHING TEXT	12 WORDS

Submitted text	Matching text
Swarnjayanti Gram Swarozgar Yojana The Swarnjayanti Gram Swarozgar Yojana (SGSY) is a	Swarnjayanti Gram Swarozgar Yojana (SGSY): The Swarnjayanti Gram Swarozgar Yojana (SGSY) is a

J 731faa5e-53e1-41b2-8464-6d67afe08c83

60/223	SUBMITTED TEXT	22 WORDS	76%	MATCHING TEXT	22 WORDS

the Training Rural Youth for Self-employment (1979), the Development of Women and Children in Rural Areas (1982) and the Jawahar Rozgar Yojana (1989)

SA Literature Review.docx (D149220814)

61/223	SUBMITTED TEXT	25 WORDS	85%	MATCHING TEXT	25 WORDS

Integrated Rural Development Programme (IRDP) and its allied programmes, namely Training of Rural Youth for Self Employment (TRYSEM), Development of Women and Children in Rural Areas (DWCRA),

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

62/223	SUBMITTED TEXT	28 WORDS	100%	MATCHING TEXT	28 WORDS

SGSY is being implemented by the District Rural Development Agencies (DRDAs), with the active involvement of Panchayati Raj Institutions (PRIs), the Banks, the Line Departments and the Non-government Organizations (NGOs).

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

Ouriginal by Turnitin

63/223	SUBMITTED TEXT	29 WORDS	78%	MATCHING TEXT	29 WORDS

The basic objective of the SGSY is to bring the assisted poor families (Swarozgaris) above the Poverty Line by ensuring appreciable increase in income over a period of time. This

SA CHAP-1.pdf (D110896322)

64/223	SUBMITTED TEXT	22 WORDS	90%	MATCHING TEXT	22 WORDS

by providing them income-generating assets through a mix of bank credit and governmental subsidy. It covers all aspects of self-employment of rural poor,

SA Abhishek Mitra.pdf (D135026886)

65/223	SUBMITTED TEXT	29 WORDS	91%	MATCHING TEXT	29 WORDS

The SGSY emphasises assistance to the Swarozgaris for those activities which have been identified and selected as key activities in terms of their economic viability in the area. Each block

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

66/223	SUBMITTED TEXT	28 WORDS	100%	MATCHING TEXT	28 WORDS

on 4-5 key activities based on local resources, occupational skills of the people and availability of markets so that the Swarozgaris can draw sustainable incomes from their investments. The

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

67/223	SUBMITTED TEXT	18 WORDS	77%	MATCHING TEXT	18 WORDS

at establishing a large number of micro enterprises in rural areas based on the ability of the poor

SA CHAP-1.pdf (D110896322)

68/223	SUBMITTED TEXT	29 WORDS	71%	MATCHING TEXT	29 WORDS

training of beneficiaries in group dynamics and skill development for taking up micro enterprises. 7. Marketing support with emphasis on market research, upgradation/ diversification of products, packaging, creation of market facilities,

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

69/223	SUBMITTED TEXT	21 WORDS	93%	MATCHING TEXT	21 WORDS

to ensure a time-bound programme for bringing a specific number of Below Poverty Line (BPL) families above the poverty line through self-employment

SA BDO Chapter I.doc (D19274323)

70/223	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

Submitted text	Matching text
Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) The National Rural Employment Guarantee Act, 2005 (	Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA): The National Rural Employment Guarantee Act (

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

71/223	SUBMITTED TEXT	13 WORDS	96%	MATCHING TEXT	13 WORDS

Submitted text	Matching text
In order to provide direct supplementary wage-employment to rural poor through public works	In order to provide direct supplementary wage employment to the rural poor through public works,

J 731faa5e-53e1-41b2-8464-6d67afe08c83

72/223	SUBMITTED TEXT	17 WORDS	86%	MATCHING TEXT	17 WORDS

Funds under SGSY are shared between the Centre and the States in the ratio of 75:25. The

SA Reyaz Ahmad Pandit, final complete thesis.pdf (D31212673)

73/223	SUBMITTED TEXT	21 WORDS	93%	MATCHING TEXT	21 WORDS
social safety net for the vulnerable groups by providing a fall-back employment source, when other employment alternatives are scarce or inadequate. It			social safety net for the vulnerable by providing a fall back employment source, when other employment alternatives are scarce or inadequate. It		

J 731faa5e-53e1-41b2-8464-6d67afe08c83

74/223	SUBMITTED TEXT	18 WORDS	83%	MATCHING TEXT	18 WORDS
new ways of doing business, as a model of governance reform anchored on the principles of transparency and			new way of doing business and a model of governance reform anchored on the principles of transparency and		

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

75/223	SUBMITTED TEXT	10 WORDS	90%	MATCHING TEXT	10 WORDS
Programmes like National Rural Employment Programme, Rural Landless Employment Guarantee Programme,					

SA Reyaz Ahmad Pandit, final complete thesis.pdf (D31212673)

76/223	SUBMITTED TEXT	45 WORDS	98%	MATCHING TEXT	45 WORDS
It is an act to provide for the enhancement of livelihood security of households in rural areas of the country by providing at least one hundred days of guaranteed wage employment in every financial year to every household whose adult members volunteer to do unskilled manual work.					

SA Monuj Dutta First Chapter.docx (D34217208)

77/223	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS
from basic wage security and recharging rural economy to a transformative empowerment process of democracy.					

SA Mithlesh_Rural Development Management.docx (D119259395)

Ouriginal by Turnitin

78/223	SUBMITTED TEXT	34 WORDS	97%	MATCHING TEXT	34 WORDS

Adult members of a rural household, willing to do unskilled manual work, may apply for registration in writing or orally to the local Gram Panchayat. The Gram Panchayat after due verification will issue a Job Card. 2.

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

79/223	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

protecting the environment, empowering rural women, reducing rural-urban migration and fostering social equity, among others. 3.

SA parveen walia thesis.pdf (D40589667)

80/223	SUBMITTED TEXT	13 WORDS	84%	MATCHING TEXT	13 WORDS

Submitted text	Matching text
Work site facilities such as crèche, drinking water, shade have to be provided.	Work site facilities such as creche, drinking water and shade have to be provided.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

81/223	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

Submitted text	Matching text
projects for a village will be recommended by the gram sabha and approved by the	projects for a village will be recommended by the Gram Sabha and approved by the

J 731faa5e-53e1-41b2-8464-6d67afe08c83

82/223	SUBMITTED TEXT	124 WORDS	90%	MATCHING TEXT	124 WORDS

Employment will be given within 15 days of application for work, if it is not then daily unemployment allowance as per the Act, has to be paid liability of payment of unemployment allowance is of the States. 4. Work should ordinarily be provided within 5 km radius of the village. In case work is provided beyond 5 km, extra wages of 10% are payable to meet additional transportation and living expenses 5. Wages are to be paid according to the Minimum Wages Act 1948 for agricultural labourers in the State, unless the Centre notifies a wage rate which will not be less than Rs. 60/ per day. Equal wages will be provided to both men and women. 6. At least one-third beneficiaries shall be women who have registered and requested work under the scheme. 7.

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

83/223	SUBMITTED TEXT	52 WORDS	90%	MATCHING TEXT	52 WORDS

A 60:40 wage and material ratio has to be maintained. No contractors and machinery is allowed. 11. The Central Government bears the 100 percent wage cost of unskilled manual labour and 75 percent of the material cost including the wages of skilled and semi-skilled workers 12. Social Audit has to be done by the Gram Sabha. 13.

A 60:40 wage and material ratio has to be maintained. No contractors and machinery is allowed. 235 o The Central Government bears the 100 per cent wage cost of unskilled manual labour and 75 per of the material cost including the wages of skilled and semi skilled workers. Social Audit has to be done by the Gram Sabha. 48

J 731faa5e-53e1-41b2-8464-6d67afe08c83

84/223	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

Grievance redressal mechanisms have to be put in place for ensuring a responsive implementation process 14.

Grievance redressal mechanisms have to be put in place for ensuring a responsive implementation process. 233

J 731faa5e-53e1-41b2-8464-6d67afe08c83

85/223	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

Permissible works predominantly include water and soil conservation, afforestation and land development

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

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86/223	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

All accounts and records relating to the scheme should be available for public scrutiny. 7.6 ?????

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

87/223	SUBMITTED TEXT	61 WORDS	97%	MATCHING TEXT	61 WORDS

Submitted text	Matching text
India. India is a country of villages and about 50% of the villages have very poor socio-economic conditions. Since the dawn of independence, concerted efforts have been made to ameliorate the living standard of rural masses. So, rural development is an integrated concept of growth and poverty elimination has been of paramount concern in all the consequent five year plans. Rural Development (RD) programmes comprise	INDIA India is a country of villages and about 50% of the villages have very poor socio-economic conditions. Since the dawn of independence, concerted efforts have been made to ameliorate the living standard of rural masses. So, rural development as an integrated concept of growth and poverty elimination has been of paramount concern in all the consequent five year plans. Rural Development (RD) programmes comprise

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

88/223	SUBMITTED TEXT	71 WORDS	100%	MATCHING TEXT	71 WORDS

Submitted text	Matching text
following: ? Provision of basic infrastructure facilities in the rural areas e.g. schools, health facilities, roads, drinking water, electrification etc. ? Improving agricultural productivity in the rural areas. ? Provision of social services like health and education for socio-economic development. ? Implementing schemes for the promotion of rural industry increasing agriculture productivity, providing rural employment etc. ? Assistance to individual families and Self Help Groups (SHG) living below poverty line by providing productive resources through credit and subsidy. 8.2 ?????	following: • Provision of basic infrastructure facilities in the rural areas e.g. schools, health facilities, roads, drinking water, electrification etc. • Improving agricultural productivity in the rural areas. • Provision of social services like health and education for socio-economic development. • Implementing schemes for the promotion of rural industry increasing agriculture productivity, providing rural employment etc. • Assistance to individual families and Self Help Groups (SHG) living below poverty line by providing productive resources through credit and subsidy.

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

89/223	SUBMITTED TEXT	13 WORDS	88%	MATCHING TEXT	13 WORDS

Sarva Shiksha Abhiyan (SSA) is a flagship programme of the Government of India

SA Reyaz Ahmad Pandit, final complete thesis.pdf (D31212673)

90/223	SUBMITTED TEXT	25 WORDS	92%	MATCHING TEXT	25 WORDS
programme is also an attempt to provide an opportunity for improving human capabilities to all children through provision of community-owned quality education in a mission mode. 3.			programme is also an 24 Rural Development in India attempt to provide an opportunity for improving human capabilities to all children, through provision of community-owned quality education in a mission mode.		

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

91/223	SUBMITTED TEXT	18 WORDS	100%	MATCHING TEXT	18 WORDS
It is a response to the demand for quality basic education all over the country. 4. The SSA			It is a response to the demand for quality basic education all over the country. The SSA		

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

92/223	SUBMITTED TEXT	25 WORDS	63%	MATCHING TEXT	25 WORDS
th Amendment to the Constitution of India making free and compulsory education to children between the ages of 6 and 14 a fundamental right.			th amendment to the Constitution of India making free and compulsory Education to the Children of 6-14 years age group, a Fundamental Right. •		

W https://tarunguptaiitian.wordpress.com/ias/187-2/

93/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS
the National Programme of Nutritional Support to Primary Education (NP-NSPE)					

SA Ishu_Economics_Chapter 5.docx (D53969364)

94/223	SUBMITTED TEXT	23 WORDS	67%	MATCHING TEXT	23 WORDS
The importance of health in economic and social development and improving the quality of life has been recognised by the Government of India.			the importance of Health in the process of economic and social development and improving the quality of life of our citizens, the Government of India		

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

95/223	SUBMITTED TEXT	17 WORDS	82%	MATCHING TEXT	17 WORDS
free and compulsory education to all children from the age of six to 14 years.					

SA Mithlesh_Rural Development Management.docx (D119259395)

96/223	SUBMITTED TEXT	19 WORDS	92%	MATCHING TEXT	19 WORDS

segments of nutrition, sanitation, hygiene and safe drinking water. It also aims at bringing the Indian systems of medicine

segments of nutrition, sanitation, hygiene and safe drinking water. It also aims at mainstreaming the Indian systems of medicine

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

97/223	SUBMITTED TEXT	13 WORDS	96%	MATCHING TEXT	13 WORDS

National Rural Health Mission The National Rural Health Mission (NRHM) was launched on 12

SA Mithlesh_Rural Development Management.docx (D119259395)

98/223	SUBMITTED TEXT	31 WORDS	63%	MATCHING TEXT	31 WORDS

health care to the rural population, especially the vulnerable groups. The thrust of the mission is on establishing a fully functional, community owned, decentralised health delivery system with inter-sectoral convergence at all levels,

SA Mithlesh_Rural Development Management.docx (D119259395)

99/223	SUBMITTED TEXT	17 WORDS	91%	MATCHING TEXT	17 WORDS

train and enhance capacity of Panchayat Raj Institutions (PRIs) to own, control and manage public health services. 2.

Train and enhance capacity of Panchayati raj institutions (PRIs) to own, control and manage public health services. 2.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

100/223	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

promote access to improved healthcare at household level through the female health activist,

Promote access to improved healthcare at household level through the female health activist (

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

Ouriginal by Turnitin

101/223	SUBMITTED TEXT 9 WORDS	100% MATCHING TEXT 9 WORDS
	preparation and implementation of an inter-sectoral District Health Plan	Preparation and Implementation of an inter-sectoral district health plan. 5.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

102/223	SUBMITTED TEXT 14 WORDS	100% MATCHING TEXT 14 WORDS
	Integrating vertical Health and Family Welfare Programmes at National, State, Block, and District levels. 4.	Integrating vertical health and family welfare programmes at national, state, block and district levels.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

103/223	SUBMITTED TEXT 14 WORDS	100% MATCHING TEXT 14 WORDS
	capacities for data collection, assessment and review for evidence based planning, monitoring and supervision. 7.	capacities for data collection, assessment and review for evidence based planning, monitoring and supervision. 8.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

104/223	SUBMITTED TEXT 12 WORDS	100% MATCHING TEXT 12 WORDS
	to ensure simultaneous action on a wide range of determinants of health	

SA Mithlesh_Rural Development Management.docx (D119259395)

105/223	SUBMITTED TEXT 21 WORDS	100% MATCHING TEXT 21 WORDS
	capacities for preventive health care at all levels for promoting healthy life styles, reduction in consumption of tobacco and alcohol etc.	capacities for preventive health care at all levels for promoting healthy life styles, reduction in consumption of tobacco and alcohol etc.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

106/223	SUBMITTED TEXT 20 WORDS	92% MATCHING TEXT 20 WORDS
	Regulation of private sector including the informal rural practitioners to ensure availability of quality service to citizens at reasonable cost	Regulation of private sector including the informal rural practitioners to insure availability of quality service to citizens at reasonable cost. 2.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

Ouriginal by Turnitin

107/223	SUBMITTED TEXT	18 WORDS	100%	MATCHING TEXT	18 WORDS

Effective and viable risk pooling and social health insurance to provide health security to the poor by ensuring

Effective and viable risk pooling and social health insurance to provide health security to the poor by ensuring

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

108/223	SUBMITTED TEXT	13 WORDS	88%	MATCHING TEXT	13 WORDS

areas around a potential growth centre in a Gram Panchayat (or cluster of

SA Commerce Conference 202. Rural Development Adream project.docx (D16863539)

109/223	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

areas around a potential growth centre in a Gram Panchayat (or

SA Commerce Conference 202. Rural Development Adream project.docx (D16863539)

110/223	SUBMITTED TEXT	14 WORDS	85%	MATCHING TEXT	14 WORDS

that independence must begin at the bottom. Every village should be a republic or

SA parveen walia thesis.pdf (D40589667)

111/223	SUBMITTED TEXT	30 WORDS	95%	MATCHING TEXT	30 WORDS

that the State shall take steps to organise village panchayats and endow them with such powers and authority as may be necessary to enable them to function as units of self-government. But

SA Abhishek Mitra.pdf (D135026886)

112/223	SUBMITTED TEXT	13 WORDS	66%	MATCHING TEXT	13 WORDS

a three-tier system of Panchayats i.e. at the village, intermediate and district levels. The

SA parveen walia thesis.pdf (D40589667)

113/223	SUBMITTED TEXT	25 WORDS	42%	MATCHING TEXT	25 WORDS

population of the concerned area, it is provided that not less than one-third of the total seats in all the tiers will be reserved for women.

SA Abhishek Mitra.pdf (D135026886)

114/223	SUBMITTED TEXT	17 WORDS	70%	MATCHING TEXT	17 WORDS

Finance Commission to review the financial position of the PRIs and make recommendations with regard to the

SA Abhishek Mitra.pdf (D135026886)

115/223	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

the Scheduled Areas as referred to in Clause (1) of Article 244 of the Constitution.

SA Abhishek Mitra.pdf (D135026886)

116/223	SUBMITTED TEXT	45 WORDS	95%	MATCHING TEXT	45 WORDS

jurisdiction over the entire Block area excluding such portion of the Block area as is included in a Municipality or is under the authority of a Municipal Corporation, a Cantonment Board or a Notified Area Committee constituted under any law for the tone being in force. Usually, a PanchayatSamiti

SA parveen walia thesis.pdf (D40589667)

117/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

Social and Farm Forestry, Minor Forest Produce, Fuel and Fodder,

SA parveen walia thesis.pdf (D40589667)

Ouriginal
by Turnitin

118/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

Roads, Buildings, Bridges, Ferries, Waterways and other means of communication,

SA parveen walia thesis.pdf (D40589667)

119/223	SUBMITTED TEXT	9 WORDS	100%	MATCHING TEXT	9 WORDS

Non-Conventional Energy Sources, Education including Primary and Secondary Schools,

SA parveen walia thesis.pdf (D40589667)

120/223	SUBMITTED TEXT	17 WORDS	91%	MATCHING TEXT	17 WORDS

Welfare of the weaker sections and in particular of the Scheduled Castes and Backward Classes, Maintenance of

SA parveen walia thesis.pdf (D40589667)

121/223	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

Such other functions as may be entrusted by the State Government. 3.

SA parveen walia thesis.pdf (D40589667)

122/223	SUBMITTED TEXT	43 WORDS	96%	MATCHING TEXT	43 WORDS

over the entire district excluding such portions of the district as are included in a municipality or cantonment area or are under the authority of a municipal corporation or a notified area committee constituted under any law for the time being in force. Generally, the

SA parveen walia thesis.pdf (D40589667)

123/223	SUBMITTED TEXT	16 WORDS	71%	MATCHING TEXT	16 WORDS

members of the State Legislative and the Parliament representing a part or whole of the district,

SA parveen walia thesis.pdf (D40589667)

Ouriginal by Turnitin

124/223	SUBMITTED TEXT	62 WORDS	28%	MATCHING TEXT	62 WORDS

N.A. 20 Daman and Diu 2 N.A. 18 Goa 2 N.A. 191 Gujarat 33 248 14292 Haryana 21 126 6199 Himachal Pradesh 12 78 3226 Jammu and Kashmir 22 306 4482 Jharkhand 24 263 4350 Karnataka 30 176 6021 Kerala 14 152 941 Lakshadweep 1 N.A. 10 Madhya Pradesh 51 313 22812 Maharashtra 34 351 27869 Manipur 6 N.A. 161 Odisha 30 314 6798 Puducherry N.A. 10 108 Punjab 22 150 13260 Rajasthan 33 295 9888 Sikkim 4 N.A. 185

N.A 411 191 N.A 14 N.A 10 GUJARAT 33 33 270 250 248 19034 14359 N.A 165 1 11 HARYANA 22 22 143 143 142 7602 6220 N.A 89 1 12 HIMACHAL PRADESH 12 12 193 99 81 21253 3615 N.A 61 7 13 JAMMU AND KASHMIR 20 20 208 287 285 6856 4291 N.A 78 2 14 JHARKHAND 24 24 264 264 264 32726 4345 N.A 55 1 15 KARNATAKA 31 31 236 234 233 30715 5958 N.A 312 1 16 KERALA 14 14 78 152 152 1666 941 N.A 93 1 17 LADAKH 2 2 13 31 31 250 193 N.A 2 N.A 18 LAKSHADWEEP 1 1 10 10 N.A 27 10

W https://lgdirectory.gov.in/

125/223	SUBMITTED TEXT	14 WORDS	89%	MATCHING TEXT	14 WORDS

and programme, Rural electrification including distribution of electricity, Distribution of Essential commodities, Soil Conservation,

SA parveen walia thesis.pdf (D40589667)

126/223	SUBMITTED TEXT	19 WORDS	100%	MATCHING TEXT	19 WORDS

vested by the State Government with such powers under any other law as the State Government may deem fit.

SA parveen walia thesis.pdf (D40589667)

127/223	SUBMITTED TEXT	24 WORDS	100%	MATCHING TEXT	24 WORDS

the ZilaParishad of two or more adjacent districts may jointly undertake and execute any development scheme on such terms and conditions as may be mutually

SA parveen walia thesis.pdf (D40589667)

128/223	SUBMITTED TEXT	22 WORDS	100%	MATCHING TEXT	22 WORDS

Integrated Rural Development Programme (IRDP) 10.11 Training of Rural Youth for Self-Employment (TRYSEM) 10.12 Development of Women and Children in Rural Areas (DWCRA) 10.13

SA parveen walia thesis.pdf (D40589667)

129/223	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

A very comprehensive but integrated view of the basic
problems of poverty, unemployment and inequality

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

130/223	SUBMITTED TEXT	30 WORDS	67%	MATCHING TEXT	30 WORDS

seeks to address the physical, economic, technological,
social, motivational, organisational and political bases of
the problems. Multiple goals of the strategy are sought to
be achieved by building capacity of the community

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

131/223	SUBMITTED TEXT	11 WORDS	83%	MATCHING TEXT	11 WORDS

National Rural Employment Programme, theTraining of
Rural Youth for Self-employment etc. 1

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

132/223	SUBMITTED TEXT	21 WORDS	40%	MATCHING TEXT	21 WORDS

first post-independence food crisis. Based upon the
recommendation of the Ford Foundation-sponsored
Team of American Agricultural Production Specialists,
Intensive Agricultural District Programme (IADP)

SA Mithlesh_Rural Development Management.docx (D119259395)

133/223	SUBMITTED TEXT	31 WORDS	81%	MATCHING TEXT	31 WORDS

Rural Development Programmes in India (1951-56 to
2012-17) Plan Period Programmes Year of Introduction
First Five Year Plan Community Development Programme
1952 (1951-56) National Extension Service 1953 Second
Five Year Khadi and Village Industries Programme 1957

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

Ouriginal by Turnitin

134/223	SUBMITTED TEXT	48 WORDS	66%	MATCHING TEXT	48 WORDS

Intensive Agricultural District Programme. 1960 Third Five Year Plan Applied Nutrition Programme 1962 (1961-66) Rural Industries Project 1962 Intensive Agriculture Area Programme 1964 High Yielding Variety Programme 1965 Annual Plan, 1966-67 Well-Construction Programme 1966 Annual Plan, 1967-68 Rural Work Programme 1967 Annual Plan, 1968-69 Tribal Development Block 1968 Rural Manpower Programme 1969 Composite Programme for women and

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

135/223	SUBMITTED TEXT	14 WORDS	88%	MATCHING TEXT	14 WORDS

Submitted text	Matching text
Small Farmers Development Agency (SFDA), 1969 10. Marginal Farmers and Agricultural Laborers Development Agency (MFALDA), 1969. (	Small Farmers Development Agency (SFDA) / Marginal Farmers and Agricultural Laborers Development Agencies (MFALDA) 17

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

136/223	SUBMITTED TEXT	81 WORDS	82%	MATCHING TEXT	81 WORDS

Scheme for Rural Employment 1971 Small Farmer Development Agency 1971 Tribal Area Development Programme 1972 Pilot Projects for Tribal Development 1972 Pilot Intensive Rural Employment Programme 1972 NSOU ? GE-GR-11 157 Minimum Needs Prognunme 1972 Command Area Development Programme 1974 Fifth Five Year Plan Hill Area Development Programme 1975 (1974-79) Special Livestock Production Programme 1975 Food for Work Programme 1977 Desert Development Programme 1977 Whole Village Development Programme 1979 Training of Rural Youth for Self Employment 1979 Integrated Rural Development Programme 1979 Sixth Five Year Plan National Rural Employment Programme 1980 (1980-85) Prime Minister’s New 20-

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

Ouriginal by Turnitin

137/223	SUBMITTED TEXT	12 WORDS	96%	MATCHING TEXT	12 WORDS

Programme Development of Women and Children in
1983 Rural Areas Seventh Five Year Plan

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

138/223	SUBMITTED TEXT	20 WORDS	85%	MATCHING TEXT	20 WORDS

National Rural Employment Programme(NREP), 1980 6. Rural Landless Employment Guarantee Programme, (RLEGP), 1983 7. JawaharRozgarYojana(JRY), 1989 8. Employment Assurance Scheme (EAS), 1993 9.

SA Literature Review.docx (D149220814)

139/223	SUBMITTED TEXT	18 WORDS	76%	MATCHING TEXT	18 WORDS

Swarnjayanti Gram SwarozgarYojana (SGSY), 1999 11. SampoornaGrameenRozgarYojana (SGRY), 2001 12. Mahatma Gandhi National Rural Employment Guarantee Act, 2005 160

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

140/223	SUBMITTED TEXT	19 WORDS	82%	MATCHING TEXT	19 WORDS

Rural Youth for Self-employment (TRYSEM), 1979 4. Development of Women and Children in Rural Area (DWCRA), 1982 5. Accelerated Rural

SA Literature Review.docx (D149220814)

141/223	SUBMITTED TEXT	29 WORDS	69%	MATCHING TEXT	29 WORDS
local leadership and self-governing institutions. The central idea behind CDP was to raise the local community to higher level of living with active participation and initiatives of the local people.				local leadership and self-governing institution. 7 The central idea was to raise the rural community to higher levels of living with the active participation and initiative of the people. People'	

J 731faa5e-53e1-41b2-8464-6d67afe08c83

142/223	SUBMITTED TEXT	14 WORDS	66%	MATCHING TEXT	14 WORDS

by which efforts of the people themselves are combined withthose of governmental authorities to improve

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

143/223	SUBMITTED TEXT	23 WORDS	93%	MATCHING TEXT	23 WORDS

The main objective of CDP was to secure the total development of the material and human resources of rural areas and to develop

SA Mithlesh_Rural Development Management.docx (D119259395)

144/223	SUBMITTED TEXT	16 WORDS	87%	MATCHING TEXT	16 WORDS

Overall development of rural community can be brought about only with effective participation of the people. 4.

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

145/223	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

The problems of rural development have to be viewed from a holistic perspective and

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

146/223	SUBMITTED TEXT	22 WORDS	100%	MATCHING TEXT	22 WORDS

by the Central Government in 1973-74 to tackle the special problems faced by those fragile areas which are constantly affected by severe drought

SA parveen walia thesis.pdf (D40589667)

147/223	SUBMITTED TEXT	12 WORDS	95%	MATCHING TEXT	12 WORDS

Submitted text	Matching text
development and management of water resources, ii) soil and moisture conservation, iii)	Development and management of water resources, (ii) Soil and moisture conservation measures, (iii)

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

148/223	SUBMITTED TEXT	14 WORDS	88%	MATCHING TEXT	14 WORDS

The programme is now under the administrative jurisdiction of the Department of Land Resources

SA Monuj Dutta 1.docx (D33435960)

149/223	SUBMITTED TEXT	20 WORDS	86%	MATCHING TEXT	20 WORDS

to minimise the adverse effects of drought on production of crops and live-stocks, and productivity of land, water and human resources

SA Monuj Dutta 1.docx (D33435960)

150/223	SUBMITTED TEXT	19 WORDS	57%	MATCHING TEXT	19 WORDS

ecological balance in the long run, and to improve the economic and social condition of the poor and disadvantaged sections

SA Monuj Dutta 1.docx (D33435960)

151/223	SUBMITTED TEXT	15 WORDS	70%	MATCHING TEXT	15 WORDS

the previous plans, which showed that that neither growth nor social consumption could be sustained,

SA Ishu_Economics_Chapter 5.docx (D53969364)

152/223	SUBMITTED TEXT	14 WORDS	78%	MATCHING TEXT	14 WORDS

with access to certain items of social consumption, which form an integral part of

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

153/223	SUBMITTED TEXT	18 WORDS	58%	MATCHING TEXT	18 WORDS

Elementary Education ii. Adult Education iii. Rural Health iv. Rural Water Supply v. Rural Roads vi. Rural Housing vii. Rural Electrification viii. Environmental Improvement

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

Ouriginal by Turnitin

154/223	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

are taken as a package, and related to specific areas and beneficiary groups. 166

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

155/223	SUBMITTED TEXT	17 WORDS	70%	MATCHING TEXT	17 WORDS

Provision of free or subsidised services through public agencies is expected to improve the consumption levels of

SA Ishu_Economics_Chapter 5.docx (D53969364)

156/223	SUBMITTED TEXT	16 WORDS	70%	MATCHING TEXT	16 WORDS

is a centrally sponsored scheme and is funded on 50:50 basis by the centre and the

SA Reyaz Ahmad Pandit, final complete thesis.pdf (D31212673)

157/223	SUBMITTED TEXT	12 WORDS	95%	MATCHING TEXT	12 WORDS

are financed partly by subsidy and partly by bank loans. 4. The

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

158/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

an autonomous agency called the District Rural Development Agency (DRDA).

SA Ishu_Economics_Chapter 5.docx (D53969364)

159/223	SUBMITTED TEXT	13 WORDS	91%	MATCHING TEXT	13 WORDS

Submitted text	Matching text
technical and managerial skills to the rural youth below the poverty line	technical and managerial skills to the rural youth from families below the poverty line

J 731faa5e-53e1-41b2-8464-6d67afe08c83

160/223	SUBMITTED TEXT	22 WORDS	47%	MATCHING TEXT	22 WORDS

the Ministry of Rural Development is responsible for release of the central share of the funds, policy formulation, overall guidance, direction, coordination and

SA Chapter - Vi first draft Rural Development Programme and Implication (Repaired).doc (D40434799)

161/223	SUBMITTED TEXT	12 WORDS	80%	MATCHING TEXT	12 WORDS

of Women and Children in Rural Areas (DWCRA) A new scheme known as

SA COMMERCE,Amod Joshi Ph.D Thesis PDF.pdf (D111731998)

162/223	SUBMITTED TEXT	20 WORDS	97%	MATCHING TEXT	20 WORDS

Submitted text	Matching text
It was the single largest wage employment programme implemented in all villages of the country through the Panchayati Raj Institutions.	It was the single largest wage employment programme implemented in all the villages of the country through the Panchayati Raj Institutions.

J 731faa5e-53e1-41b2-8464-6d67afe08c83

163/223	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

Submitted text	Matching text
Development of Women and Children in Rural Areas (DWCRA) was introduced in September, 1982	Development of Women and Children in Rural Areas (DWCRA) was introduced in September, 1982

W https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.489.4719&rep=rep1&type=pdf

164/223	SUBMITTED TEXT	13 WORDS	96%	MATCHING TEXT	13 WORDS

Rural Employment Programme (NREP) and Rural Landless Employment Guarantee Programme (RLEGP) were merged into

SA Ishu_Economics_Chapter 5.docx (D53969364)

Ouriginal by Turnitin

165/223	SUBMITTED TEXT	26 WORDS	68%	MATCHING TEXT	26 WORDS

the scheme, workers can be taken upfor execution during any part of the year, whenever the need for generating supplementary employment is felt, preferably during lean agricultural

SA Reyaz Ahmad Pandit, final complete thesis.pdf (D31212673)

166/223	SUBMITTED TEXT	12 WORDS	76%	MATCHING TEXT	12 WORDS

Swarnjayanti Gram Swarozgar Yojana (SGSY) The Swarnjayanti Gram SwarozgarYojana is a self-employment

Swarnjayanti Gram Swarozgar Yojana (SGSY): The Swarnjayanti Gram Swarozgar Yojana (SGSY) is a holistic self-employment

J 731faa5e-53e1-41b2-8464-6d67afe08c83

167/223	SUBMITTED TEXT	11 WORDS	95%	MATCHING TEXT	11 WORDS

durable assets in form of school buildings, roads and other infrastructure. 5.

SA Monuj Dutta First Chapter.docx (D34217208)

168/223	SUBMITTED TEXT	15 WORDS	81%	MATCHING TEXT	15 WORDS

Rural Youth for Self-Employment (TRYSEM), the Development of Women and Children in Rural Area (DWCRA)

SA Literature Review.docx (D149220814)

169/223	SUBMITTED TEXT	14 WORDS	96%	MATCHING TEXT	14 WORDS

It aims at establishing a large number of micro enterprises in the rural areas.

SA Mithlesh_Rural Development Management.docx (D119259395)

170/223	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

The basic objective of SGSY is to bring the assisted poor families

SA BDO Chapter I.doc (D19274323)

171/223	SUBMITTED TEXT	34 WORDS	64%	MATCHING TEXT	34 WORDS

poverty line by providing them with income-generating assets through bank credit and government subsidy. Thus formation of the organization of the poor at the grassroot level through a process of social mobilization for poverty reduction is

SA BDO Chapter I.doc (D19274323)

172/223	SUBMITTED TEXT	32 WORDS	76%	MATCHING TEXT	32 WORDS

Submitted text	Matching text
SGSY is conceived as a holistic self-employment scheme covering aspects like organisation of the rural poor into self-help groups and their capacity building, planning of activity clusters, infrastructure build up, technology, credit and marketing. 2.	SGSY is conceived as a holistic programme of micro-enterprises covering all aspects of self-employment, viz., organisation the rural poor into self-help groups and their capacity building, planning of activity clusters, infrastructure build up, technology, credit and marketing.

J 90058f20-b786-4049-b167-db20e673515c

173/223	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

Submitted text	Matching text
the list of families below the poverty line identified in the	the list of families below the poverty line identified in the

J 90058f20-b786-4049-b167-db20e673515c

174/223	SUBMITTED TEXT	16 WORDS	78%	MATCHING TEXT	16 WORDS

rural areas, based on the ability of the poor and potential of the rural area. 3. The

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

175/223	SUBMITTED TEXT	17 WORDS	78%	MATCHING TEXT	17 WORDS

Submitted text	Matching text
Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) was launched in April 2005 by merging all ongoing schemes. The	Rajiv Gandhi Grameen Vidyutikar n Yojana (RGGVY) was aunched in April 2005 by merging all ongoing schemes. Under the

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

176/223	SUBMITTED TEXT	35 WORDS	83%	MATCHING TEXT	35 WORDS

in the planning and preparation of projects, identification of activity cluster, infrastructure planning as well as capacity building and choice of activity of the SHGs, selection of individual Swarozgaris, pre-credit activities and post-credit monitoring including loan recovery.

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

177/223	SUBMITTED TEXT	33 WORDS	95%	MATCHING TEXT	33 WORDS

Submitted text	Matching text
the programme, 90% grant is provided by Govt. of India and 10% as loan by Rural Electrification Corporation (REC) to the State Governments. Rural Electrification Corporation (REC) is the nodal agency for the programme.	the programme, 90 grant is provided by Govt. of India and 10% as loan by Rural Electrification orporation (REC) to the State Governments. Rural Electrification Corporation (REC) is the nodal agency for the programme.

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

178/223	SUBMITTED TEXT	13 WORDS	75%	MATCHING TEXT	13 WORDS

of the existing rural road networks is also an integral component of the scheme.

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

179/223	SUBMITTED TEXT	18 WORDS	91%	MATCHING TEXT	18 WORDS

access to electricity to all households by the year 2009, quality and reliable power supply at reasonable rates,

SA Mithlesh_Rural Development Management.docx (D119259395)

180/223	SUBMITTED TEXT	19 WORDS	88%	MATCHING TEXT	19 WORDS

quality and reliable power at reasonable rates, ensuring minimum lifeline consumption of 1 unit per household per day as

SA Mithlesh_Rural Development Management.docx (D119259395)

181/223	SUBMITTED TEXT	14 WORDS	76%	MATCHING TEXT	14 WORDS

electrified villages have been completed and 220.63 lakh free electricity connections have been released

SA Monuj Dutta 1.docx (D33435960)

182/223	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

free electricity connections to all households (both APL and poor families) in rural

SA Mithlesh_Rural Development Management.docx (D119259395)

183/223	SUBMITTED TEXT	45 WORDS	100%	MATCHING TEXT	45 WORDS

Rural Road Connectivity is not only a key component of rural development by promoting access to economic and social services and thereby generating increased agricultural incomes and productive employment opportunities in India, it is also as a result, a key ingredient in ensuring sustainable poverty reduction. 11.3 ?????

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

184/223	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

is a nationwide plan in India to provide good all-weather road connectivity to unconnected villages

SA Commerce Conference 202. Rural Development Adream project.docx (D16863539)

185/223	SUBMITTED TEXT	56 WORDS	79%	MATCHING TEXT	56 WORDS

The primary objectives of the PMGSY Phase-I is to provide connectivity by \way of an all-weather road (with necessary culverts and cross-drainage structures, which is operable NSOU ? GE-GR-11 183 throughout the year) to eligible unconnected habitations in the rural areas with a population of 500 persons and above in plain areas. In respect of the hill states,

SA parveen walia thesis.pdf (D40589667)

Ouriginal by Turnitin

186/223	SUBMITTED TEXT 35 WORDS	95% MATCHING TEXT 35 WORDS
	The unit of this programme is a habitation and not a revenue village or a panchayat. A habitation is a cluster of population, living in an area, the location of which does not change over time. 2.	The unit for this programme is a habitation and not a revenue village or a Panchayat. A habitation is a cluster of population, living in an area, the location of which does not change over time.
	J 731faa5e-53e1-41b2-8464-6d67afe08c83	

187/223	SUBMITTED TEXT 40 WORDS	83% MATCHING TEXT 40 WORDS
	Unconnected Habitations are to be connected to nearby Habitations already connected by an All-weather road or to another existing All-weather road so that services (educational, health, marketing facilities etc.), which are not available in the unconnected Habitation, become available to the residents. 3.	unconnected habitations are to be connected to nearby habitations already connected by an all-weather road or to another existing all-weather road so that services, which are not available in the unconnected habitation, become available to the residents.
	J 731faa5e-53e1-41b2-8464-6d67afe08c83	

188/223	SUBMITTED TEXT 21 WORDS	100% MATCHING TEXT 21 WORDS
	It should be ensured that each road work that is taken up under the PMGSY is part of the Core Network.	It should be ensured that each road work that is taken up under the PMGSY is part of the 'Core Network'.
	J 731faa5e-53e1-41b2-8464-6d67afe08c83	

189/223	SUBMITTED TEXT 53 WORDS	91% MATCHING TEXT 53 WORDS
	A Core Network comprises of Through Routes and Link Routes. Through routes are the ones which collect traffic from several link roads or a long chain of Habitations and lead it to Marketing centres either 184 NSOU ? GE-GR-11 directly or through the higher category roads i.e., the District Roads or the State or National Highway. 4.	A core network comprises of 'through routes' and 'link routes'. Through routes are the ones which collect traffic from several link 213 roads or a long chain of habitations and lead it to marketing centres either directly or through the higher category roads i.e., the District Roads or the State or National Highway.
	J 731faa5e-53e1-41b2-8464-6d67afe08c83	

190/223	SUBMITTED TEXT 12 WORDS	100% MATCHING TEXT 12 WORDS
	Provision of connectivity to unconnected Habitations would be termed as New Connectivity.	Provision of connectivity to unconnected habitations would be termed as new connectivity.
	J 731faa5e-53e1-41b2-8464-6d67afe08c83	

Ouriginal by Turnitin

191/223	SUBMITTED TEXT	36 WORDS	81%	MATCHING TEXT	36 WORDS

unconnected habitations with a population of 250 persons and above. The PMGSY will permit upgradation of existing roads in those districts where all the eligible habitations of the designated population size have been provided all-weather road connectivity.

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

192/223	SUBMITTED TEXT	38 WORDS	92%	MATCHING TEXT	38 WORDS
The PMGSY shall cover only the rural areas. Urban roads are excluded from the purview of this Programme. Even in the rural areas, the PMGSY covers only the Rural Roads i.e., Roads that were formerly classified as 'Other District Roads' (			The PMGSY shall cover only the rural areas. Urban roads are excluded from the purview of this programme. Even in the rural areas, PMGSY covers only the rural roads i.e., roads that were formerly classified as 'Other District Roads'		

J 731faa5e-53e1-41b2-8464-6d67afe08c83

193/223	SUBMITTED TEXT	12 WORDS	95%	MATCHING TEXT	12 WORDS
Housing is one of basic requirements for human survival. For a			Housing is one of the basic requirements for human survival. For a		

J 731faa5e-53e1-41b2-8464-6d67afe08c83

194/223	SUBMITTED TEXT	24 WORDS	100%	MATCHING TEXT	24 WORDS
a house brings about a profound social change in his existence, endowing him with an identity, thus integrating him with his immediate social milieu.			a house brings about a profound social change in his existence, endowing him with an identity, thus integrating him with his immediate social milieu.		

J 731faa5e-53e1-41b2-8464-6d67afe08c83

195/223	SUBMITTED TEXT	25 WORDS	66%	MATCHING TEXT	25 WORDS
From 1995–96 the scheme has been further extended to widows or next-of-kin of defence personnel killed in action, ex-servicemen and retired members of the paramilitary forces			From 1995-96, the IAY benefits been extended to widows or next-of kin of defence personnel killed in war. Benefits have also been extended Ex-servicemen and retired members of the paramilitary forces		

J 90058f20-b786-4049-b167-db20e673515c

Ouriginal by Turnitin

196/223	SUBMITTED TEXT	21 WORDS	85%	MATCHING TEXT	21 WORDS

consolidation of Through Routes and Major Rural Links connecting habitations to Gramin Agricultural Markets (GrAMs), Higher Secondary Schools and Hospitals. Under the

SA CHAP-1.pdf (D110896322)

197/223	SUBMITTED TEXT	17 WORDS	69%	MATCHING TEXT	17 WORDS

The primary focus of the PMGSY is to provide All-weather road connectivity to the eligible unconnected Habitations.

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

198/223	SUBMITTED TEXT	32 WORDS	71%	MATCHING TEXT	32 WORDS

aims at providing a pucca house, with basic amenities, to all houseless householder and those households living in kutcha and dilapidated 186 NSOU ? GE-GR-11 house, by 2022.The immediate the objective is to

SA Monuj Dutta First Chapter.docx (D34217208)

199/223	SUBMITTED TEXT	34 WORDS	92%	MATCHING TEXT	34 WORDS
The Accelerated Rural Water Supply Programme (ARWSP) was introduced in 1972- 73 by the Government of India to assist the States and Union Territories (UTs) to accelerate the pace of coverage of drinking water supply.				The Accelerated Rural Water Supply Programme (ARWSP) It was introduced in 1972-73 by the Government of India (GOI), to assist the States and Union Territories to accelerate the pace of coverage of drinking water supply.	

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

200/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS
the Technology Mission on Drinking Water and Related Water Management				The Technology Mission on drinking water and related water management	

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

201/223	SUBMITTED TEXT	29 WORDS	100%	MATCHING TEXT	29 WORDS

The cost of unit assistance is to be shared between Central and State Government in the ratio 60:40 in plain areas and 90:10 for North Eastern and the Himalayan States. 4.

SA Monuj Dutta 1.docx (D33435960)

202/223	SUBMITTED TEXT	14 WORDS	88%	MATCHING TEXT	14 WORDS

the government of India launched the Swachh Bharat Mission (SBM) on 2nd October, 2014,

SA Abhishek Mitra.pdf (D135026886)

203/223	SUBMITTED TEXT	22 WORDS	100%	MATCHING TEXT	22 WORDS

bring about an improvement in the general quality of life in the rural areas, by promoting cleanliness, hygiene and eliminating open defecation

SA Abhishek Mitra.pdf (D135026886)

204/223	SUBMITTED TEXT	16 WORDS	100%	MATCHING TEXT	16 WORDS

sanitation coverage in rural areas to achieve the vision of Swachh Bharat by 2nd October 2019.

SA Abhishek Mitra.pdf (D135026886)

205/223	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

encourage cost effective and appropriate technologies for ecologically safe and sustainable sanitation.

SA Abhishek Mitra.pdf (D135026886)

206/223	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

liquid waste management systems for overall cleanliness in the rural areas.

SA Abhishek Mitra.pdf (D135026886)

207/223	SUBMITTED TEXT	31 WORDS	63%	MATCHING TEXT	31 WORDS

health care to the rural population, especially the vulnerable groups. The thrust of the mission is on establishing a fully functional, community owned, decentralised health delivery system with inter-sectoral convergence at all levels,

SA Mithlesh_Rural Development Management.docx (D119259395)

208/223	SUBMITTED TEXT	13 WORDS	96%	MATCHING TEXT	13 WORDS

National Rural Health Mission The National Rural Health Mission (NRHM) was launched on 12

SA Mithlesh_Rural Development Management.docx (D119259395)

209/223	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

to ensure simultaneous action on a wide range of determinants of health

SA Mithlesh_Rural Development Management.docx (D119259395)

210/223	SUBMITTED TEXT	17 WORDS	91%	MATCHING TEXT	17 WORDS

Submitted text	Matching text
train and enhance capacity of Panchayat Raj Institutions (PRIs) to own, control and manage public health services. 2.	Train and enhance capacity of Panchayati raj institutions (PRIs) to own, control and manage public health services. 2.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

211/223	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

Submitted text	Matching text
promote access to improved healthcare at household level through the female health activist,	Promote access to improved healthcare at household level through the female health activist (

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

Ouriginal by Turnitin

212/223	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

Integrating vertical Health and Family Welfare Programmes at National, State, Block, and District levels. 4.

Integrating vertical health and family welfare programmes at national, state, block and district levels.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

213/223	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

Strengthening capacities for data collection, assessment and review for evidence based planning, monitoring and supervision. 7.

Strengthening capacities for data collection, assessment and review for evidence based planning, monitoring and supervision. 8.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

214/223	SUBMITTED TEXT	22 WORDS	100%	MATCHING TEXT	22 WORDS

Developing capacities for preventive health care at all levels for promoting healthy life styles, reduction in consumption of tobacco and alcohol etc. 8.

Developing capacities for preventive health care at all levels for promoting healthy life styles, reduction in consumption of tobacco and alcohol etc.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

215/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

water, sanitation, education, nutrition, social and gender equality. The NRHM

SA Mithlesh_Rural Development Management.docx (D119259395)

216/223	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

Promotion of public-private partnerships for achieving public health goals

Promotion of public private partnerships for achieving public health goals. 3.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

217/223	SUBMITTED TEXT	20 WORDS	92%	MATCHING TEXT	20 WORDS

Regulation of private sector including the informal rural practitioners to ensure availability of quality service to citizens at reasonable cost

Regulation of private sector including the informal rural practitioners to insure availability of quality service to citizens at reasonable cost. 2.

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

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218/223	SUBMITTED TEXT	18 WORDS	100%	MATCHING TEXT	18 WORDS

Effective and viable risk pooling and social health insurance to provide health security to the poor by ensuring

Effective and viable risk pooling and social health insurance to provide health security to the poor by ensuring

W http://osou.ac.in/eresources/DRD-2-4-Rural%20Development%20Programmes.pdf

219/223	SUBMITTED TEXT	25 WORDS	63%	MATCHING TEXT	25 WORDS

th Amendment to the Constitution of India making free and compulsory education to children between the ages of 6 and 14 a fundamental right.

th amendment to the Constitution of India making free and compulsory Education to the Children of 6-14 years age group, a Fundamental Right. •

W https://tarunguptaiitian.wordpress.com/ias/187-2/

220/223	SUBMITTED TEXT	25 WORDS	92%	MATCHING TEXT	25 WORDS

programme is also an attempt to provide an opportunity for improving human capabilities to all children through provision of community-owned quality education in a mission mode. 3.

programme is also an 24 Rural Development in India attempt to provide an opportunity for improving human capabilities to all children, through provision of community-owned quality education in a mission mode.

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

221/223	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

It is a response to the demand for quality basic education all over the country. 204

It is a response to the demand for quality basic education all over the country.

W https://egyankosh.ac.in/bitstream/123456789/59475/1/Unit1.pdf

222/223	SUBMITTED TEXT	15 WORDS	64%	MATCHING TEXT	15 WORDS

inter-sectoral District Health Plan prepared by the District Health Mission, including drinking water, sanitation and hygiene

SA Ishu_Economics_Chapter 5.docx (D53969364)

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223/223	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

Swarnjayanti Gram SwarozgarYojana (SGSY)/ Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). 3.

SA Impact of Rural Development Programmes on Socio-Economic Development of Parbhani District by Mani ... (D23330902)

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SA	**CU-BBA-SEM-III-Basics of Tourism- Second Draft-converted.pdf** Document CU-BBA-SEM-III-Basics of Tourism- Second Draft-converted.pdf (D103493783)	3
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SA	**062_Tourism Products of India _18-7-13.pdf** Document 062_Tourism Products of India _18-7-13.pdf (D142533405)	1

Entire Document

PREFACE In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. core, discipline specific, generic elective, ability and skill enhancement for graduate students of all programmes at Honours level. This brings in the semester pattern, which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. I am happy to note that the university has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade "A". UGC (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for UG programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English / Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisitioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor

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Unit - 1 ❒

Scope and Content : Concepts and Issues, 7-11 Tourism, Recreation and Leisure Interrelations; Geographical Parameters of Tourism Unit - 2 ❒ Types of Tourism : Ecotourism, Cultural 12-15 Tourism, Adventure Tourism; Medical Tourism, Pilgrimage, International, National.

Unit - 3 ❒

Factors influencing Tourism : Historical Natural, 16-18 Socio-cultural and Economic. Unit - 4 ❒ Spatial pattern of Tourism :

Domestic and 19-20 International,

areal and locational dimensions, comprising physical, cultural historical and economic. Unit - 5 ❒ Impact of Tourism : Physical, economic and 21-22
social, perceptive positive and negative impacts. Unit - 6 ❒ Environmental laws and tourism – current trends, 23-26 spatial patterns and recent changes.
Netaji Subhas Open University
UG : Geography (HGR) Geography of Tourism Code : GE - GR - 21
Unit - 7 ❒
Role of Foreign Capital and impact 27-30 of Globalisation on Tourism
Unit - 8 ❒
Recent Trends of Tourism : International 31-35 and Regional, Domestic (India) Sustainable Tourism, Meeting Incentives Conventions and Exhibitions (MICE) Unit - 9 ❒ Tourism in India : Tourism Infrastructure, 36-42 Regional Dimensions of tourist attraction. Case Studies of Dal Lake, Goa, Garhwal Himalaya, Desert and Coastal areas. Unit - 10 ❒ Promotion of Tourism : National 43-46 Tourism Policy. Unit - 11 ❒ Infrastructure and Support System : 47-49 Accomodation and Supplementary accommodation, other facilities and amenities. Unit - 12 ❒ Tourism Circuits–Short and Longer 50-54 detraction–Agencies and Intermedearies– Indian Hotel Industry
NSOU ● GE - GR-21-- 7
Unit - 1 ❑

79%	**MATCHING BLOCK 1/31**	**W**

Scope and Content : Concepts and Issues Tourism, Recreation and Leisure interrelations Geographical Parameters of Tourism by Robinson

Structure 1.1 Introduction 1.2 Scope and Content 1.3 Meaning And Definition 1.4 Interrelationship – Among Tourism Recreation And Leisure 1.5 Geographical Paramenters Of Tourism 1.6 Tourist Resources And Its Types 1.7 Socio-economic Significance of Tourism 1.8 Concept of Tourist, Visitors And Excursionist 1.9 Summary 1.1 Introduction The very concept of tourism as we see it today is widely considered as a new phenomenon. But in real spirit of the world 'tourism' this concept is as old as human civilisation. With the passage of time, significant growth of science and technology, economic advancement and a fundamental changes that have taken place in the field at transportation and communication which contributed enormously to the development of tourist trade all over the world. Tourism significantly contributes in the development of understanding among people, provide employment, create foreign exchange earning and finally raise living standard of people. 1.2 Scope and Content Tourism is primarily concerned with pleasure, holidays, travel and going and arriving somewhere. It is a human desire to make a sound of the places of interest religious, spiritual,
8-- NSOU ● GE - GR-21 natural, beautiful places, monuments, ancient cities, historical and archeological sites, places of pilgrimage and place of curiosity. In today's would tourism has became most reliable alternative economic activity over agriculture industry and tertiary activities. As human desire and curiosity to know and visit new places is ever increasing all the times, there is no consistant and permanent depression in tourism. Because of wheel tourism is gaining importance day by day. Tourism in general is perceived as an economic activity which provide to the recipient countries a definite source of foreign exchange and national income, creates job opportunities to reduce unemployment, fostirs entrepreneurship, stimulates production of food and local handicrafts, enhance communication facilities, cultural exchanges, and above all contributes to a better understanding of the host country. 1.3 Meaning and Definition International Dictionary of Tourism Published in 1953 by the International Academy of Tourism at Monte Carlo points out that tour in English and French means a journey, a circulative trip. On the other hand

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nineteenth century dictionary defines tourist as people who travel for pleasure for travelling, out of

curiosity. Scholars define tourism from different angles, because tourism has different dimensions. The world tourism is derived from the Greek word 'Tomos' meaning to move around a central axis in a circular manner. The first accepted conceptual definition of tourism was given by Prof. Hunzikor and Krapf in 1942, when they

64%	MATCHING BLOCK 4/31	SA	CU-BBA-SEM-III-Basics of Tourism- Second Draft ... (D103493783)

defined tourism as "Sum of the phenomenon and relationship arising from the travel and stay of non-resident so far as they do not lead to any permanent residence and not connected with earning activity.

Tourism
is often considered as synonymous to travel. Francis Bacon remarked that

61%	MATCHING BLOCK 5/31	SA	MTTSS-11 BASIC CONCEPTS OF TOURISM.docx (D117306477)

travel in the young sort is a part of education and in elder a part of experience.

On the other hand Burkart A.J. and S. Medik provided another
definition –"

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Tourism denotes the temporary, short term movement of people to destinations outside the

place
of normal residence. World Tourism organisation (WTO) while defining tourism also acknowledges the problem defining toursm. 1.4 Interrelationship – Among Tourism Recreation And Leisure In terms of meaning tourism, Recreation and leisure bears different meaning. But both recreation and leisure are inherent in tourism. Because tourism while travelling from one place to another enjoy scenic beauty, experience new thing i.e. culture of people which provide recreation in true sense. On the other hand people visit places outside normal place

of residence to spend leisure time. So these are interconnected. Tourism is phenomena in which, recreation and leisure are part of it. Through different tourism activities such as paragliding, rafting, mountaineering etc. one can have recreating. Contrary to this leisure boost-up human desire to visit new places, and acquire new experievos . To spend leisure time people visit new places and in between they indulge in difficult recreation activities. 1.5 Geographical Parameters of Tourism Geographical Parameters such as climate valiation, topography, rivers, forest, mountains, lakes, seas and oceans, desert etc. are backbone of tourism activites, relief or topographical valictions provide scenic beauty which is the source of attraction for tourist. Similarly climate vacation attracts tourist in large number. Similarly water boats of different dimensions are also source of attraction far tourist. Simultaneously deserts for its climate significant and topographical beauty also attends tourists. These parameters are called natural tourist resources. 1.6 Tourist Resources And Its Types Tourist resources can be defined as objects which used to attracts tourist towards it. They may be natural, manmade or pseudo natural. The geographical parameters described above are the natural or physical tourist resources. The characteristic features of manmade tourist resources is that, they are consulted, or created by man kind. The manmade tourist resources are building, monuments archieves, place of worship for different religious, such as temple, mosque, church, Gurudwara etc. Architectural design and their beauty attracts tourist. On the other hand pseudo-natural tourist resources are those tourist resource which are being created by man to give a natural look. Such as natural parts, eco-parks, riverside, social forest etc. 1.7 Socio-economic Significance Of Tourism Tourism is emerging as one of the most sought after industry in the world. Tourism as an economic activity which provides numerous benefits to a country as a whole. Tourism rationally solves employment problems of a country by providing a sound basis for income generation. Large and small societies are directly or indirectly dependent upon tourism. Developing countries and reigious with fewer prospects for mechanisation and lesser income

 for investment in the basic and heavy industries can open more opportunities in Tourism and in that base tourism creates immense socio-economic significance. The social significance of tourism can be assessed by analysing the existing societies where tourism flourishes. Tourism bring an all round development in the host regions and would the social student to a large extent. The social fabric of a country is this immensely influenced by tourism. Tourism can attended the society to a large extent by changing the lifestyle and occupation of the people living in an area. Social acculturation and unity develops in the host regions where the natives of the host regions adopt and absorb the culture of another group. The cultural treats, languages, customs of the tourists belonging to a particular region, who are most likely to visit the regions are adopted by the natives. Tourism wids in bringing cultured unity among different communities. The hospitality of the host regions are often talked about by tourist. The host regions act as the pivotal platforms where people belonging to different community interact with each other. In the economic sphere tourism wids in the development of a nation's economy by increasing employment opportunities and income. Tourism provides employment opportunities to a large number of masses in rural and urban sectors. Numerous business such as hotels, shops, and travel agencies, vehicular services revolve around tourism. Tourism being the driving force provided customers to these shops, hotels travel agencies and vehicular services. Many individuals depend upon tourism directly and indirectly. It provides employment opportunities to the educated and non-educated sectors by providing them opportunities for earning. Tourism can be adopted as alternative source of income. Tourism plays an important role in elevating poverty, increasing self reliance developing infrastructure. Development of infrastructure and basic amenities is accelarated by tourism. Development of transportation is an essential requirement for development of tourism. Development of tourism and transportation complement each other. Transportation increases the accessibility of the region and makes travelling easier for tourist. Tourism increase healthy competitions among difficult stakeholders. The stakeholders try their almost to attract as much tourist as possible for earning greater profit. 1.8 Concept of Tourist, Visitors And Excursionist People visiting a region can be grouped into tourists, visitors and excursionists. Though the term tourist, visitors, excursionist may seem similar but each of the concept is difficult from each other. International Onion of Office Travel Organisation (IUOTO), Now the world Tourism organisation (WTO) proposed the definition of tourists, visitors and excursionist for statistical purpose to

95%	MATCHING BLOCK 7/31	SA	MTTSS-11 BASIC CONCEPTS OF TOURISM.docx (D117306477)

the United Nations conference on Travel and Tourism held at Rome in 1963.

The definition are as follows:
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Tourist : A temporary visitors staying at least 24 hours over night

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in the country visited whose journey is for the purpose of

a) leisure (holiday recreation, sports etc.) or b) Business (family mission meeling, health study or religion). On the other hand a

67%	MATCHING BLOCK 9/31	SA	Chapter 1 - Introduction V4.pdf (D21086309)

person visiting a country other than that which he has usual place of residence for a reason after that following an occupation remunerated from withen the country visited.

Excursionists : A temporary visitors staying lss than 24 hrs. in the country visited. In the nutshell it can be inferred that tourist visit a destination with the purpose for pleasure without the intent of immigrating and not involved in any earning. A visitor is however not involved in laking up any economic occupation for earning in the destination visited by him/her. On the other hand an excursionist are people visiting country or destination other than his usual residence for a short period of 24 hrs or less. 1.9 Summary We have come to know about the different concepts of Tourism and the various interrelations among the various parameters.
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● GE - GR-21 Unit 2 ❑

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Types of Tourism : Ecotourism, Cultural Tourism, Adventure tourism, Medical Tourism Pilgrimage, International, National.

Structure : 2.1 Introduction 2.2 Eco-Tourism 2.3 Cultured Tourism 2.4 Health and Medical Tourism 2.5 Adventure Tourism 2.6 Pilgrimage on Religious tourism 2.7 Mass Tourism 2.8 Alternative Tourism 2.9 Business Tourism 2.10 Agro-tourism or Rural toursm 2.11 Internationational Tourism 2.12 Domestic Tourism 2.13 Summary 2.1 Introduction World Tourism Organisation (WTO) identified three different types of tourism. They are – (a) Domestic tourism or internal tourism (b) In boand tourism or National Tourism. (c) Out boand tourism or International tourism. These classification is basically done based on source of origin and destination of tourists. In addition to these tourist can be classified based on its characteristics features such as volume of tourist, purpose of visiting, environmental concern etc. These tourism are – (1) Eco tourism, (2) Cultural tourism, (3) Medical Tourism, (4) Adventure tourism, (5) Pilgrimage, (6) Mass tourism, (7) Alternate tourism, (8) Business tourism (9) Agro tourism, (10) Sex tourism.

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GR-21-- 13
2.2 Eco-Tourism The term eco-tourism was coined in the year 1965 by claus-Dieter Hetzer an academic and adventure from Forum International in Banking CA, Eco-tourism means travel to areas of ecological interest for recreation and to support conservation of eco-system. Aim of ecotourism is to develop tourism by safeguarding the nature this means tourism without any advise impact on nature. Eco-tourism is a friendly travel to undisturbed nature destination such as natural park and wild life sanctuaries. 2.3 Cultured Tourism Cultured tourism deals with the culture and lifestyle of people in different regions, Cultural tourism tourists in historical sites, such as museum, historic places, age old cities and difficult urban and rural regions. These regions are culturally rich and provided rich religiousand cultural heritage. 2.4 Health and Medical Tourism Health and medical tourism developed with the need of accessing cheap and effective medical facilities across difficult resions. With the growing expresses for a health living many people choose to travel to various destinations for medical wids. Travelling to the urban areas for the treatment of difficult disease boosts medicals tourism in the urban sector. 2.5 Adventure Tourism Adventure tourism is the form of tourism based on adventure and unusual experience. Tourists engage in risky and thrilling experience for recreation. It involves undertaking physical activities such as mountaining, paragliding, trekking, rock climbing, mountain biking, caroeing and kayaking. Adventure tour also include travel to natural spots, cultural destination such unusual and daring experiences might involve sufficient amount of risk which, requires skills on the past of tourist. Activities included in adventure tourism are physically challenging in nature. 2.6 Pilgrimage on Religious Tourism Tourists of different religion visit religious sites of their choice for the purpose worship.Some time a definite period in a year. Sometime tourist visit place of religious intust as and when they like to visit in most cases especially the old age people an tourist visit the religious place.
14-- NSOU ● GE - GR-21 2.7 Mass Tourism Mass tourism is the form of tourism widely prevalent in many countries. It is the oldest form of tourism practised on a very large scale and has been growing since the industrial period. As the most common form of tourism involves mass touring of people from their native place of residence to distart tourist destination Mass tourism acculturate the economy of the destination more bigway by earing foreign exchange. 2.8 Alternative Tourism Alternative tourism is tourism of non peak season. Alternative tourism deviates itself to not only providing the scenic pleasure and experiences but knowledge and information as well. Alternative tourism is a recent phenomenon and requires careful planning by the individual. Alternative tourism looks into the social, economic and environmental needs of the host regions and aims at relating the social, economic and environmental fabric of destination while engaging in tourism. 2.9 Business Tourism Travel for business is another important typology of tourism where people travel for the of purpose of earning and investing in the destination region. The sole purpose of such travel is business oriented and motivated by earning. The growth in the business opportunities has had enormous influence upon travellers. Regions laike developed into business centra with growth in primary, secondary and Tertiary Sectors. It is different from clothes forms & forms of tours. 2.10 Agro-tourism or Rural Tourism It has developed its approach and product and has gathered special altertion mostly in rural regions. The agricultural regions have immense political for the development of tourism. Best large scale and small scale farming are able to capture the tourests in large members. Promotion and implementation organic firming is source at attraction for the tourists. Organic farming, rural topography and natural beauty & rural areas boost the growth & Agro-tourism. Sex tourism is a new concept. In developed countries and areas, particulay in urban areas alone large number of moved into for earning livedhood. Most of these are age & sex specific, that is most are male people. Most rural people move alone for earning in urban
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areas. For the biological need male population which give rise the concept of sex tourism. In Singapore, Malayasia this type at tourism is find. 2.11 International Tourism As a whole International Toursism represents a productive new approach to the knowledge at modern tourism in its golbal perspective because it has become a global phenomenon today. It has gained importance because it has assumed the major form at economic activity and economic development. Tourism and its related activities started after the World was II and soon it has gained importance as an instrument for economic development, foreign encharge earning and employment generation.

44%	MATCHING BLOCK 11/31	SA	061_Tourism Principles,Policies and Practice _ ... (D142533404)

International tourism involves the movements at people between different countries in the world. Travel by people to a country olter than that in which they normally live and which

is a separate national unit with its own political and economic system,
constitute International tourism. Foreign travel and tourism essentially require its two important requirements of documentation and currency. 2.12 Domestic

70%	MATCHING BLOCK 13/31	SA	MTTSS-11 BASIC CONCEPTS OF TOURISM.docx (D117306477)

Tourism Domestic tourism where people travel outside, their normal place residence to other areas within the country.

They do not cross national boundary. In case of domestic tourism there are no languages or currency or document barriers. In tourism, domestic tourism has had major share. At global level domestic tourism constitutes more than 60% at tourest of a country. In domestic tourism movement of tourist is found theory out the year. On the other hand International tourism where movement of tourist's season selective and tourist resource selective. Economically both Domestic and international tourism are important. 2.13 Summary From this unit we came to know about the different types of tourism and its importance in the economy.
16-- NSOU ● GE - GR-21 Unit - 3 ❑ Factors influencing Tourism : Historical Natural, Socio-cultural and Economic. Structure : 3.1 Introduction 3.2 Geographical factors 3.3 Socio cultural factors of tourism 3.4 Cultural factors 3.5 Economic Factors of Tourism 3.6 Summary 3.1 Introduction There are number at factors, which play an important role in increasing mobility of tourists from one place to another. These factors are physical or natural or geographical, socio-cultural and economic factors. 3.2 Geographical factors In the development at tourism Geographical factors play very important role. The Geographical components which play very significant role are : 1. Aceessibility and location at tourest sites. 2. Scenery which include : (a) Land forms eg. mountains, conyon. carral reefs, cliffs etc. (b) Water bodier eg. rivers, laks, water falls, glysers and glaciers and sea. (c) Vegetation eg. foursts grass tends, moon, deserts etc. 4. Climate : It includes sunshine, clouds, temperature conditions, rain and show. 5. Animal life (a) Wild life eg. birds, wild animals, gane reservation and zoo. (b) Hunting and fishing
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6. Settlements and its features (a) Towns, cities and villages (b) Historical remains and monuments (c) Archaeological remains 7. Cultural aspects (a) Customs are traditions (b) Folklore—music (c) Arts and crafts. These geographical factors areal, immense importance for the development of tourism in modern times. A country with these is such in tourist resource and potential for tourism development. 3.3 Socio cultural factors of tourism Socio-cultural aspects such as, race, tribe, ethnicity, religion and social level also play important role in tourism development. Racial distribution of population, ethnic identity as well as way of life at people are also important. Racially and enthnically district areas also attract to must such as Jarwas at Andaman and Nicobar Island. 3.4 Cultural factors : Such as customs and traditions at ethnically district populat8ion group, folk culture or traditions such as folk dance folk musk, traditional art forms and paintings crafts etc. are also responsible to a great extent in attracting tourists. For example tribal, songs and music, dance, bamboo, cane ball metal, products etc. are at great magenetic attraction for tourists. 3.5 Economic Factors of Tourism Levels and Economy is another important aspect of tourism. Economically develolped as well as backward regions also can attract tourists. For example towns and cities with its economic base is another source of tourist attraction. Similarly rural areas i.e. villages can also attract tourist. In economically developed areas or country contain higheruse building

 with differential architectural style, old buildings etc. also play an important role in bringing tourists towards, itself. In addition, in develolped areas diversified economic activities also can attracts tourists. Because of which most develolped cities of the world attracts tourist in large number. Contrary to developed urban areas least developed remote villages also attract tourists. 3.6 Summary The factors influencing Tourism are very important for the growth of a tourist place and in this unit we have learnt about those factors.

Unit - 4 ❑

Spatial pattern of Tourism : Domestic and International, a real and locational dimensions, comprising physical, cultured historical and economic.

Structure : 4.1 Introduction 4.2 A Real and Locational Dimensions 4.3 Summary 4.1 Introduction Spatially tourism can be divided into Domestic and International. Spatial boundaries for domestic and international tourism are of different kind. Spatially domestic tourism is smaller in size that means it encompasses smaller geographical areas as compared to International Tourism. International Tourism is spatially much bigger sometime limitless. Because domestic tourism primarily confined to country only whereas international tourism not specifically confined to a single country but of hosts of a countries. Flow of tourist in domestic tourism is within a country, whereas in international tourism flow of tourist takes place from number of countries of near and distant areas. 4.2 A Real and Locational Dimensions A real and locational dimension of tourism are of varied nature in the content of physical, cultural, historical and economic character. Physical characteristics such as landforms, natural vetetation, water and waterbodies, relief, climate and its variations are very important in tourism. These physical or natural or geographical aspects are most cases point and area specific. They already exist on the nature and their location is fixed. Because it their magnatic attraction they pulled tourists towards themselves. Similarly culture and culturally district areas with their distinct identity are also at area specific though they are not permanently fixed to an area. Distinctiveness of

 culture and their identity also remain source of attraction for tourist irrespective of their location. Historical significance of a place or region also can pull towards itself. Place or areas of historical importance with its distinctive historical identities are also of area specific and confined to particular location. For example place with historical identity historical buildings and monuments re located in particular place which is fined. For example areas of origin of Aryan civilisation, Tajmahal etc. are located in particular areas. Similarly economic developments and its levels are primarily area or region specific. But their spread is very high. Areas or country's with higher level of economy also attract tourists. 4.3 Summary The unit deals with the study of domestic and international tourists its real and locational dimensions.

Unit - 5 ❑

Impact of Tourism : Physical, economic and social, perceptive positive and negative impacts

Structure : 5.1 Introduction 5.2 Economic Impact 5.3 Impacts of Tourism 5.3.1 The negative impact physical or natural surroundings are of alarming nature. 5.4 Summary 5.1 Introduction Tourism in general an activity with many factors. It is one one land leisure and recreational and on the other economic activity which generate income increase employment, reduce regional imbalances whereby raise living standards of people of all levels. In modern times tourism is becoming inseparable part of socio-economic activity which generate income increase employment, reduce regional imbalances already raise living standards of people at all levels. In modern times tourism is becoming inseparable part of socio-economic life of people. 5.2 Economic Impact The economic impact of tourism is seen every where in world. Its direct economic impact is found in the form of raising income both direct and indirect as well as generation of employment both direct and indirectly. In addition tourism extent impact on development of infrustructural facilities and transform economic structure of a region. Like physical and economic tourism also has an impact on social life of people. Development of tourism primarily event impact on life of people of the destination country or area. Tourism influence language education and culture. 5.3 Impacts of Tourism The impact of tourism on nature (Physical), economy and social life are both of positive and negative characters. Most of the discussions above mainly constitutes the positive side of the impact.

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• GE - GR-21 5.3.1 The negative impact physical or natural surroundings are of alarming nature. Constructions of infrastuctural facilities like hotels, buildings, roads etc. in mountain region caused landslide, river erosion, etc. which might lead to earthquike even. This kind of negative impacts are cause of natural manmade calamities in different geographical region. Similar kind of negative impact can be found in desert water bodies etc. The negative economic of tourism are of various kind. Though it generated employment opportunities on one hand, it also reduces opportunities of employment with higher levels of modernisation and mechanisation of economic activity which are not of labour intensive. Further economic developlemt of varied kind exert tremendous impact on our environment, such as pollution and environmental degradation. 5.4 Summary This unit deals with the impact of tourism, its positive and negative impacts.

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Unit - 6 ❑

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Environmental laws and tourism – current trends spatial patterns and recent changes		

Structure : 6.1 Introduction 6.2 Tourism and Environment 6.3 Key Policies 6.4 Forest Conservation and Law 6.5 Summary 6.1 Introduction Tourism as on economic activity attained a very important position owing to its rapid and significant growth over the last few decades; but quite surprisingly, with the rapid grwoth of tourism all over the world, far reaching impact on the environment is witnessed. The Pacific Asia Travel Association (PATA) and World Travel Organisation (WTO) have devoted a full time conference on environment at Bali in 1993 to discuss the relationship between tourism and environment. As a result main countries have introduced the laws elating to preservation of environment. Impact of tourism can be explained as the charges in the destination areas. These changes can be of various types but generally speaking these impacts can broadly be grouped into three categories i.e. economical, social and environmental. In reality these can overlap as well these three can occur simultaneously. The level and intensity of the impact depends upon the level of contact-between tourist and host. There is a inseparable link between tourism and environment. Environment both natural and manmade is the most fundamental ingredient of the tourism product. 6.2 Tourism and Environment 1. Unplanned and haphazard growth of tourism i.e. unplanned construction near beaches, mountains, hills, near heritage building, monuments etc. 2. Soil erosion and deforestation due to over construction. 3. Pollution such as water, air and noise pollution because of automobiles, airlines, ship and cruises etc.

 4. Littering garbage dumped by trekkars, mountaineers and tourist. 5. Hunting of animals. 6. Overgathering at places like beaches, mountains, treks, wild life sanctuaries and national parks etc. 7. Waste generated by hotels and other allied industries leading to water, air and soil pollution. 8. Though it is impossible to develop tourism without incurring environmental impacts, but it is possible with proper planning to manage development of tourism in order to minimize the negative impacts. In this content of preservation and conservation of environment, sustainable tourism development can play a positive and significant role in balancing tourism and environmental quality. The environment and development are for people, not people for environment and development (1987) defines sustainability

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as "meeting the needs of the present without compromising the ability of future generation to neat their own needs" (

kirkby s. l. 1995) concept of sustainability demands a longterm view of tourism and ensures that consumption of tourism does not exceed the ability of the host destination to provide for the future tourists. Since environment being the integral part of tourism, there is a direct correlation between the tourism and environment. There are large number of environmental laws having significance in the process of tourism development. These can be divided into key policies and different legislation and laws. 6.3 Key Policies: There are three policies relating to environmental protection in india. 1. The National Forest Policy 1988. 2. Policy statement for Abatment of Pollution 1992. 3. National Conservation Strategy and Policy. Statement Environment and Development, 1992. In addition to these policies there are large number of legislations and laws pertaining environment in India. These are :

• The Water (Prevention and Control of Pollution Act, 1974. • The Water (Prevention and Control) Act 1975. • The Water (Prevention and Control) Act 1977. • The Water (Prevention and Control act Pollution) Rules, 1978. • The Air (Prevention and Control of Pollution) Act, 1981. • The Air (Prevention and Control) Act, 1982. • The Environment Protection Act 1986. • The Environment (Protection) Rules, 1986. • Hazardous Waste (Management and Handing) Rules, 1989. • Manufacture, Storage and Import of Hazardous Chemical Rules, 1989. • The Forest Conservation Act, 1980. • The Forest (Conservation) Rules, 1981. • The Wild Life Protection Act, 1972. • The Wild Life (Stock Declaration) Central Rules 1973. • The Wild Life (Protection) Licensing (Additional matters for consideration) Rules, 1983. • The Wild Life (Protection) Rules 1995. • The Public Liability Insurance Act 1991 etc. • The Public Liability Insurance Rules, 1981. • The National Environment Tribural Act, 1995. • The National Environment Appellate Authority Act, 1997. Though altogether there are more than two hundred different laws dealing with environmental protection both before and after independence in India. But however, the pre-independence laws have not dealt with environmental protection enclusively and some of the major environment laws having impact on tourism are given below :— (i) Environmental Protection Act 1986 (EPA). (ii) The Environment Appellate Authority Act, 1997.

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• GE - GR-21 (iii) The Water (Prevention and Control of Pollution) Act, 1974. (iv) The Air (Prevention & Control of Pollution) Act, 1981. (v) The Air (Prevention and Control of Pollution) Act, 1981. (vi) Wild Life (Protection) Act, 1972. 6.4 Forest Conservation and Law. (vii) Indian Forest Act, 1927. (viii) Forest Conservation Act, 1980. It is true that laws, acts, regulations and guidelines for environmental protection has been drawn up by almost all the countries, states, legislative institutions and other organisation such as WHO, World Bank, UN, but they often go unnoticed because of lack of capacity of public management through laws helps in minimizing the negative impacts, but to make then more effective there is a need to adopt a process, whereby, a systematic, documented regular and objective evluation of the environment through methodological examinations involving analysis, tests and confirmations verifying weather they comply with legal requirements and internal policies and accepted practices can be an effective tool to achieve overall sustainable development objectives. In this case Environmental Impact Assessment (EIA) model and approach can be of multiple use to various community resources. 6.5 Summary Tourism as an industry has attained a very important oposition and the environmental laws related to it create link between tourism and environment.
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Unit - 7 ❒

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Role of Foreign Capital and Impact of Globalisation on Tourism		

Structure 7.1 Introduction 7.2 Tourism Earn Foreign Exchange 7.3 Concept Globalisation 7.4 Toursim and Globalisation 7.5 Impact of Globalisation on Tourism 7.6 Summary 7.1 Introduction The concept of tourism is a modern phenomenon. In today's world tourism as an economic activity is flourishing very fast and as a contributor to the global economy tourism has no alternative. The following facts and figures justify the role of tourism in economy. i. Tourism employs 243 million people world wide which is 10.9 percent global workforce. ii. Tourism is the world's leading economic contributor, producing an incredible 10.2 percent of the world's gross national product. iii. Tourism is the leading generator of task revenues at US $ 650 million. iv. Tourism is the world's largest industry in terms of gross output approaching US $384 trillion. v. Tourism accounts for 10.9 percent of all consumer spending. 107 percent of all capital investment 6.l9 percent of all government spending. Further, despite economically and politically induced setbacks and threats of tourism from number of global hot spots, economic recession in Europe and economic upheaval in Japan and the over Communist Eastern block, the future tourism is brighter than ever.
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• GE - GR-21 7.2 Tourism Earn Foreign Exchange Tourism is the one industry that earns foreign exchange for country without exhausting natural resources and without actually exporting any material goods The income from tourism has tended to increase at a higher rate than merchandise export in a number of countries. There is a continuous flow of income from richer country to comparatively poorer and developing ones. This has raised poorer or developing country's export earning and rate of economic growth. For example in countries like india and Spain, tourism is the single largest earner of foreign exchange. In tourism development the foreign capital earn through process of tourist's movement play a quite significant role in the development process of host countries. in today's world countries like Spain, America, indonesiam Malaysia, Singapore, Srilanka, Bhutan etc. are heavily dependent on tourism for their all recent development. The process of flow of foreign capital registered a upward trend. Development tourism is to a large entent dependent on foreign capital. Major tourist centres (tourist resources) are beneffited from foreign capital. Both national and Man-made tourist resources are bring developed by foreign capital. Particularly tourism in private sector are affected by it. Develolpment and improvement of infrastructure facilities is another important benefit offered by the tourism industry. infrastructural facilities such as airport, road,

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water supply and other public utilities may be widely shared by other sectors of the economy.

Further more

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the provision of infrastructure provide the basis or serve as an encouragement for greater economic diversification.

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Thus, indirectly tourist-expenditure may be responsible for stimulating other economic activities of

country. The role of foreign capital in the development of tourism is immense. The country with more foreign capital generated by tourism get more benefit than others. 7.3 Concept Globalisation The globalisation is the process of interaction and integration among people, companies and government world-wide. Advancement in transport and commuication technology has triggered the globalisation since 18th century. This increase in global

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interaction has caused a growth in international trade and exchange of ideas and culture. Globalisation is basically an economic process of interaction that is associated with social and cultural aspects. 7.4 Toursim and Globalisation There is a strong relation between tourism and globalisation. Tourism as an economic activity has long been claimed as a crucial force shaping globalisation, whole country to it the development of tourism sector are under the influence of growing inter dependence across the world. 7.5 Impact of Globalisation on Tourism The process of globalisation quite severly influence the growth and development of tourism 'Globalisation and tourism arevery dependent on each other. Due to globalisation people from any countryh or region can move anywhere depending upon his wish. The Globalisation reduced or emove the banner among countries. It is not only the movement of people but also the transfer of technology across the world. Development of transport and communication technology has widened the horizon of tourism. As a result international tourism is becoming more and more important. Furthermore due to globalisation opportunities of employment and foreign exchange earning in tourism sector has increased manifold. That is why there is an inseperable link between globalisation and tourism develolpment. It is quite evident that spread of technology, economic liberalization and mass tourism has made the world a global village. We have also seen that there are many pitfalls of insensitive development. The World Tourism Organisation (WTO) has highlighted three main issues that need to be kept in view in the liberalised scenario. These are: (i) The liberalisation should be temperated with the need for sustainable development. Therefore, whole tourism industry shares the urge for liberation with other industries, and grows together. And it should be controlled liberalisation consistant with global ethical concern. (ii) The impact of liberation on tourism needs to be very closely sutdied. There are feelings that developing countries are getting less than they can get from tourism because of leakages in the system. The developed countries are also not benefitting as much as they should because at imcomplete liberalisation and

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● GE - GR-21 the consumers are not getting the benefit from all the productivity gains brought in by technology and globalisation as they are entitled to expedite. (iii) Within the globalised systems of the United Nations, while the issues of sustainable development are addressed, tourism is neglected and as a result tourism is deprived of balanced growth. It is universally accepted that the process of liberalisation must not affect local employment. The liberalisation should be so guided that local skill is upgraded rather than being replaced by more skilful ones from outside. The process of liberalisation must also recognize cultural heritage and uniqueness of each place. Strength and variety and not-homogencity holds the key to the future of tourism. 7.6 Summary World Tourism as an economic activity is flourishing very fast and is one of the most important contributors of global economy.

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Unit 8 ❒ Recent Trends of Tourism: International and Regional, Domestic Structure 8.1 Introduction 8.2 Trends in International Tourism 8.3 Factors for International Tourism 8.4 Domestic Tourism 8.5 International Tourist Arrivals in India 8.6 Meeting, Incentives Conference and Exhibitors (MICE) 8.7 Summary 8.1 Introduction Generally speaking international tourism represents a productive new approach to the knowledge at modern tourism in its global perspective. The cumulative benefits of international tourism hardly be ignored. its importance as an economic factors also evident of its being a multi-billion dollar activity and second largest sector after oil and the single largest employment generator in the world.

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International tourism involves the movement of people between different countries in the world. The travel by people to a county other than

his normal place of residence (country) which is a separate national unit with its own political and economic system constitute International Tourism. Contrary to
International
tourism,

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domestic tourism—in which people travel outside their normal domicile to other areas within the

covering the domestic tourism, they do not cross national boundaries. in this case there are no language or currency or document barriers whereas in case of intenational tourism these are must. 8.2 Trends in International Tourism International tourists produce some of the most dynamic economic exchanges. Between 1970 and 1993 internal tourist arrivals trabled from 165 million to 500 million.

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• GE - GR-21 During the same period the international tourism receipts registered on 18 fold increase from US$ 324 billion. The growth international tourism was also in tghe first half of the century. The growth was rapid in the later part of the century and quite phanomenal since 1980. in 1950 the total tourist arrival was only 25 million generating foreign exchange receipts of µS$2.1 billion. The growth tourist arrival recorded slight improvement than that of 1950. Actually the real growth of tourist arrivals and receipts has started since 1980 onward. The receipts from tourism have grows even faster, $18 billion in 1970 increased to $105 bfillion in 1980. In 2000 the arrivals reached 698 million with a total receipts $ 476 billion. According to World Tourism Organisation (WTO), the number of international travels has risen to more than 500 million per annum which means that one are of every ten inhabitant of the world is a tourist. With rapid developments in the field of transport and communication, the global tourism industry is likely to double in the next decade. The 21st century will experience higher percentage to the total populations travelling particularly in developing countries. Tourism is the industry of industries and has a great multiplier effect on other industries. Tourism serves as an effective medium for the transfer of wealth. A total of 212 million persons are being employed globally through direct and indirect opportunities generated by tourism industry. Recent trends shows that international tourist arrivals in 1990 was 457 mjillion and foreign receipts 257 billion US dollars which has increased to 528 billion in 1995 and 320 million US dollars. Similar trend is observed in 2000 also i.e. 98 million and 476 billion US dollars and 1040 billion US dollars respectively. 8.3 Factors for International Tourism Tourism today has gained importance and developed all over the world. There are several key factors which are responsible for the spread and development of international tourism. Among these, following are the main factors. (i) Consumers : Inexperience mass consumers. (ii) Technology : Jet air crafts, automobiles computer reservation system, credit cards and accounting system.
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(iii) Production : Cheap Oil, Chartered flights, package tours, hotels and mass production. (iv) Management : Mass marketing, economies of scale, hotel and holiday branding, promotional airfares. (v) Frame Condition: Post war peace and prosperity, paid holiday, regulation of air transportation, Incentives for need tourist destination. The above factors highlighted that international tourism is fuelled by sustained prosperity and consequences rise in the level of income of a wide section of society. Increase of paid leisure time of working class and glowing numbers to the self- employed professionals also influence the international tgourism. The development and advancement of transport and communication system, particularly in the air transport have brought people very closer. Management practices of franchising mass marketing and integration between two country have also played their role in the creation of international tourism. 8.4 Domestic Tourism India—India is a country with most extreme climatic condition, distinctive natural vegetation, most fascinating and oldest civilisation with cultural diversity. India contains extreme diverse climatic condition with both hottest and wettest part of the world. it also contains highest peak of the world, it has dense forest cover. In addition to all, it has varied and diversified cultural characteristics with home of almost all religious community of the world as well as as contains more than 400 dialects and languages. Similarly India is the home of most primitive tribal group. All these natural and socio-cultural peculiarities are the source of tourist attraction for tourists. India is a country of all seasons and reasons. For the traveller India and her history are both an inspiration and a challenge. In the north of India are world's highest mounting, the mighty Himalaya offering heavens of unmatched beauty. On the western and the eastern coast lines are virgin beaches with a tropical ambiences of coconut, palm and white sands along with back waters forest, animals, fauna and flora, bird life and many more. For all these pecularities India is becoming most liked tourist destination in the world.

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• GE - GR-21 TABLE - 1 TOURISM STATISTICS, INDIA AT A GLANCE 2015 Year International Foreign eincharge Percentage share and Rank Tourist Arrivals earning (India) in tourism of India in (INDIA) (in Rs. Crore) in World (in million) Share (%) Rank 1999 2.48 12951 0.66 35 2000 2.65 15626 0.73 36 2001 2.54 15083 0.69 36 2002 2.38 15064 0.64 37 2003 2.73 20729 0.84 37 2004 3.46 27944 0.97 26 2005 3.92 33123 1.10 22 2006 4.45 39025 1.16 22 2007 5.08 44360 1.25 22 2008 5.28 51294 1.26 22 2009 5.17 53700 1.31 20 2010 5.78 64889 1.52 17 2011 6.31 77591 1.59 18 2012 6.58 94487 1.59 16 2013 6.97 107671 1.54 16 2014 7.68 123320 1.56 15 2015 8.03 135193 1.71 14 Source : Ministry of Tourism, Govt. India, 2015
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8.5 International Tourist Arrivals in India After the September 11, 2001, incident at the World Trade Centre, New york and the subsequent development leading to Afgan War, Indo-Pak Border tersion and terrorest attack on some places in India. Because of all these foreign tourist arrivals in India got a set back in the yhear 2001 and 2002. however, a revival trend has been observed from November 2002 onwards, while a growth rate of 16.8 percent was recorded for the month of November 2002 positive growth rate of 16.2 percent and 10.4 percent was withnessed during November and December 2002. There is a recorded growth of 15.3 percent in the year 2003-2004 in comparison to the year 2002. The international tourist arrivals in India from 1999 to 2015 shows that there is a phenomenal increase in tourist arrivals. In 1999 total number of tourst-arrieved over 2.48 million which has increased to 8.03 million, i.e. thee is an increase of 5.55 million tourists during last seventeen years. This shows that during this period tourist arrival increase by over 223.7 percent. Similar to the growth of tourists, the foreign enchange earnings also shows an increase at Rs. 122242 crores, which registered an percentage increase of 943.9 percent. The very interesting feature of Indian tourism is that increase in foreign encharge earning is almost five times higher than increase in tourist arrivals during the period 1999 to 2015. India's share of international tourism also reflect a very interesting features. India's share of tourism in world tourism was 0.cc percent which increased to 1.71 percent in 2015. Except 2002 and 2003 India's share in world tourism consistantly increased every year since 1999. With the passaged times India's share in world tourism registered an ever increasing trend which slows that Indias tourism industry is gaining its importance day by day. 8.6 Meeting, Incentives Conference and Exhibitors (MICE) MICE is

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a type of tourism in which large groups usually planned in advance are brought together. Recently there has been an industry trend towards using the term ‘meeting industry’ to avoid confusion from the acronym.

In this case meetings typically held in hotel conference room or at convention centers. They are single day events. 8.6 Summary The recent trends of tourism are known from this unit.
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• GE - GR-21 Unit - 9 ❐ Tourism in India Structure 9.1 Introduction 9.2 Tourism Infrastructure 9.3 Tourism Infrastucture —Indian Experience 9.4 Accomodation Facilities 9.5 Classification of Hotels 9.6 Case Studies 9.7 Summary 9.1 Introduction The concept of tourism, particularly in the Indian perspective is not new. It has tranditional significance embodied in history. The practices for travelling for different reasons are found in a resent India. For centures India has been a centre of attraction for different people for different reasons in the outside world. 9.2 Tourism Infrastructure The tourism infrastructure means on which the development of tourism is depended. Primarily tourism infrastucture includes transport and accomodation. In addition to these there are some other components—such as slopes, drainage and sewage system, communications services etc. 9.3 Tourism Infrastucture—Indian Experience Tourism is primarily concerned with movement of people. As a consequence the relationship between transportation and tourism is very important. In most cases, tourism has developed in those areas where extensive transportation may be defined as the means to reach the destination and also the means of movement at the destination.

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The tourism demand has stimulated the rapid development of transportation. Transport may be public on private, inland or international and airor surface. In modern times the fastest means of long distance tourist transport has been aircraft. A tourist's choice of mode of transport is affected by the following factors. (i) Distance and time factor. (ii) Status and comfort. (iii) Safety and utility. (iv) Comparative price of services offered. (v) Geographical position and isolation. (vi) Range of services offered and (vii) Level of compatition between services. In India road transport is dominated by automobiles. Car is the most perfect means for providing door-to-door service. The emergence of the automibiles has spread the benefits of tourism more widely and has provided more and more people with the means to travel individually or in small groups. Road transport has a number of attractions which differentiate it from other. The are : (i) The control of the route and the stops in route. (ii) The ability of carrying baggage and equipment easily. (ii) The ability to use the vehicle for accomodation. (iv) Privacy (v) Low expenses. In case India both road transport and real transport are of equal importance in tourism develolpment. In India railways provides the principal mode of transportation for freight and passengers. Real service is more advantageous in bringing people from distant places. Indian Railways is the nation's lifeline and the principal mode of transport in the country. Geographically a vast country like India, the use of real ways is very important. The development of Indian railways has had great effects on the mobility of people as well goods; by doing so it has played a crucial role in the development of tourism in
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--- NSOU • GE - GR-21 India. Cheap and easy transport as provided by the railways is the most important conditions of economic growth in a big country like India. The role and significance of railway transport in the exonomy is extremely important on many considerations—historical, economic environment, social and political. (i) Historically, because railways have provided the foundation for communicators trade and commerce and defence. (ii) In terms of economy, the networks plays a major role in opening up the hinterland and widening the markets. (iii) Environmentally, by being largely instrumental in the relative levels of ecological and environmental pollution. (iv) Socially, by determining the trends of urbanisation, population shifts, the levels of employment and (v) Politically as railways are vital to national defence and social securities. For the development of tourism in India, railway's contribution is of important the other means of transport such as waterways air ways, and metro's role in tourism develolpment is varied in nature. But among then aiways is the most important whereas metro is of best important. 9.4 Accomodation Facilities Accomodation is the basic component of tourism the vary concept of travel- accomodation has transformed itself as hospitality industry on account of its utility in tourism. Tourism to a great extent dependent on the range and type of accomodation available at the destination accomodation is a core area of tourist industry and plays a distinctive role in the development of tourism. Accomodation facilities are of different kind depending upon services and its extent size room etc. 9.5 Classification of Hotels During last few decades the concept and the format of hotel have charged a great deal. There are various types of accomodation facilities catering to the increasing
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demands of tourst. The size of the architectural features and the facilities provided and amenities provided differ from one establishment to another. The modern classification of hotels are as follows: (i)

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International Hotels These are modern western style hotels found in all metropolitan and large cities.

These hotels are luxuary hotels and are classified on the basis of internationally accepted system of classification. They

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are are star hotels. There are five such categories ranging from five star to one star depending upon facilities and services provided.

In addition to accomodation facility these hotels provide all other facilities which make the stay very comfortable and high quality food of various countries and quality services. (ii) Resort Hotels These resorts

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cater the needs of the holiday maker i.e. the tourists and those who by reasons of health desire a charge of atmosphere. Resort hotels are located near the sea, mountain and other areas

with natural beauty.
The type and quality

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of services amenities available in resort hotels include recreation facilities i.e. swimming pool, golf course, terms courts, skills, boating and various other indoor

games. It also provide, coffee shops, restaurants conference room, shopping complex etc. (iii) Commercial Hotels As compared to international hotels on resorts commercial hotels primarily direct their appeal to the individual traveller most of the commercial hotels receive guests who are on business trip. Because of which these hotels located in important commercial or industrial centres of large town and cities. Quality foods and services are characteristics features of these hotels. (iv) Residential Hotels Residential hotels can be named as apartment house also. These type accomodation facilities are fully complete with all hotel services. These are often returned as apartment hotels. The tariff of rooms in these hotels is charged on monthly, half-yearly or yearly basis. These type hotels are found mostly in large cities and olperate exclusively under the

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European plan where no meals are provided to the guests.
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Floating Hotels As the name suggests floating hotels are located on the surface of the water,

it may be on seawater, river water or on a lake. All the facilities and services available in hotels are also available in floating hotels. It is environment friendly are very popular among tourists. Heritage Hotels : Heritage Hotels have unique architectural design and features used in different periods of time which blend with the culture and tradition of the area. The main idea is to convert those properties which are not in use currently for residential purposes into hotels in order preserve their uniqueness. Heritage hotels are operating in palaces, forts, hunting lodges, havelis etc. or residence built several decades ago. In addition these hotels there are number of supplementary accomodation available. These are number of supplementary accomodation available. These are youth hotel, caravan and camping sites, bed and break-fast establishments, tourists holiday villages, etc. The facilities and services provided are not high quality. 9.6 Case Studies DAL LAKE Among all the lakes in the country will touristic significance Kashmir's Dal lake is the most important and popular. It is important because the Dal lake has a position in Kashmir's economy. Huge employment is generated directly or indirectly, and earn significant amount of foreign exchange. On the other hand it is popular because of the scenic beauty of Dal lake and surroundings. Natural beauty coupled with very pleasant weather condition makes Dal lake most popular and most preferred tourist destination of the state. All these together makes Dal lake the true pride Kashmir. The Dal lake is surrounded by splendid Pir Panjal mountain and Mughal Gardens. In terms of location Dal lake's location in Srinagar is the best. Not only the beauty of Dal lake, but also the beauty of its surrounding makes Dal lake, special. The surrounding provide some of the incredible vistas of rolling hills, distant snow capped mountain Shikharas crusing quietly and the houseboat standing still with the perfect poise.

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The canopied Shikaras sailing on the lake one of the major attraction of Dal Lake. The houseboat on the lake are also the prime attraction as best accommodation option in Srinagar to the tourist. Being a main source of attraction for the nature lovers. Dal lake even invites for fishing on the lake. In addition to all these the floating houseboat vegetable market for which Dal lake is still very attractive. GOA Goa is the state of beaches and places of worship. Goa is primarily source of natural tourist attraction. The economy of Goa is developed continuing tourism as main source of livelihood. Beach tourism is the prime source attraction for tourist. In terms of tourist arrival whole year in Goa can be divided into two pars winter months and summer months. Tourism during winter month is dominated by arrivals of European tourist and summer months are dominated by presence of Indian tourists. Major tourist attractions it Goa are- Major Jesus Basilica Fort Aguada A wax museum on Indian culture A Heritage museum Beaches of Goa The beaches of Goa cover about 125 km of its coastline these beaches are divided into North and South Goa. The North Goa beaches are Qruerim beach Kalacha beach, Arambol, Mandean, Ashvem Morjim beach etc. There are as many as 58 beaches in North and South Goa, located around 7 different locations Among them beaches of Mormugoa are most popular in times of tourist attraction. There are large number of museums in Goa which remains source of tourist attraction Important museums of Goa are - Museum of Goa, the Pilar museum, Wax world museum, Goa Chitra museum. Heritage homes of Goa also attracts tourists in large number. These heritage homes are - Fernandas house Monezas Braganca etc. In addition to heritage homes there are large number of forts of attraction in Goa. There are as many as 22 forts which also attracts tourist in large number.

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● GE - GR-21 Next to beaches is the wild life Sanctuary is the main source of attraction. There are as many as 15 wild life and bird sanctuary. Waterfalls are the next source of attraction for tourist. There are five water falls in the state. The museums of different kind are located in Goa. In terms of tourist resources Goa is very rich. But all the tourist resources are natural tourist resource. As the attractions towards natural resources are most preferred among tourist resources of all kind. That is in terms of tourism development Goa is highly developed. 9.7 Summary The unit gives the vivid analysis of the tourism infrastructure and its where abouts.

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Unit - 10 ❐ Promotion of Tourism-National Tourism Policy Structure 10.1 Introduction 10.2 National Tourism Policy of India (1982) 10.3 National Tourism Action Plan [1992] 10.4 Summary 10.1 Introduction As the role of tourism is ever increasing and everlasting and play very important role in the places of economic development, there is a need for planning for the promotion of tourism. Tourism planning is essential for its promotion. For the promotion National Tourism Policy and Tourism Action Plan. For execution Tourism Policy as well as Tourism Action Plan Govt. of India has number steps in this direction, these steps are being reflected in different five year plan. Development of tourism has gained importance in third, sixth, seventh, wighth and ninth five year plan. In third five year plan (1961-66) emphasis have been laid primarily on provision of facilities for accommodation and transport. Similarly the 6th five year plan is the beginning of a real thinking on tourism in India. Examples was given on socio-economic benefit of tourism and natural integration, emphasis was also hard on creation of employment, removal of regional imbalances, policy to increase foreign exchange earnings. The seventh five year plan (1985-90) emphasised on faster development of tourism for economic development. The Eight (1990-95) Five year plan document (1990-1995) makes a few very significant observation. Emphasis was laid on future development tourism. Different state Government are being advised to formulate their own plan based on local conditions. On the other hand the Ninth five year plan (1995-2000) emphasise once again on the development of tourism infrastructure. It also includes participation of locals at grassroots level. This has given tourism a new identity.
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● GE - GR-21 Different five year plan included emphasis on different aspects of tourism development. For smooth passage those suggestion and formulating planning strategy Govt. of India has formulated Tourism Policy. 10.2 National Tourism Policy of India (1982) For proper development tourism a policy is an essential requirement. Govt. of India formulated India's first and only National Tourism Policy in 1982. The main objective of the policy are- 1. Tourism becomes an unifying force nationally and internationally. 2. It helps on preserving Indian heritage and culture. 3. Tourism brings socio-economic development and by generating employment opportunities. 4.

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It gives direction and opportunity to the youth of the country to understand the aspiration and view of others. 5.

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Offers opportunities to the youth of the country not only for employment but also for taking up activities

for nation building and character building like sports adventure etc. Interestingly, the new tourism policy in the changed scenario has - (1) Placed tourism as a central input in the economic development process. (2) Focussed on the role of tourism in socio-economic development of the backward areas. Weaker sectors women and artisans. (3) Allowed these goals to be pursued in line with goal at the enrichment of the environment and the ecosystem. (4) Recognised the role of tourism as a potent global force for national and international understanding and for creating awareness for sustainable development. Any policy for sustainable development will naturally revolve around the following cardinal principles.

(i) That there is a need for striking a balance between development and conservation. (ii) That there is a need for commitment of the nation as a whole to the goals of sustainable tourism development. (iii) That the policy incorporates and motivates cooperation of the local community also must also perceive the benefit of such participation. India's only Tourism Policy (1982) which advocate a bold action for the development of tourism. The entire development of tourism today is rightly guided the policy. In addition to the Policy for smooth execution of the steps suggested in the policy an Action Plan has been formulated in 1992. 10.3 National Tourism Action Plan 1992 National Tourism Action Plan 1992 contains the following aspects. (1) Assessment of ground realities. (2) Based on such an assessment, making effective plans which in management terms will imply. (a) Setting down the objectives. (b) Taking stock of the organisational capabilities to achieve these objectives and (c) Assessing the physical, financial and human resources available to implement the objectives. The following ground realities will also have to be kept in view :- (a) Inadequate and poor quality of infrastructure (b) Carrying capacity by air, roads and railways (c) Clean and comfortable lodging facilities at reasonable price of international standard (d) Trained guides and tourist amenities of international standard. (e) Adequate entry points (f) Positive image building abroad
 (g) Publicity and (viii) The need to preserve heritage and natural attractions 10.4 Summary Following the implementation of National Tourism Policy in 1982 the development of tourism in India got fresh impacts for making policy implementation more smooth and successful a Tourism Action Plan 1992 was formulated. The development of tourism in India has become quite systematic and planned.

Unit - 11 ❒ Infrastructure and Support System- Accomodation and Supplementary Accomodation, other Facilities and Amenities. Structure 11.1 Introduction 11.2 Infrasturcture 11.3 Supplementary Accommodation 11.4 Other Facilities and Amenities 11.5 Summary 11.1Introduction One of the most significant factors responsible for the development of tourism in most part of the world requires tourism infrastructure primarily in the form of accommodation, transportation, services and public utilities. Tourism by definition is centred upon travel and staying away from home, hence the provisions both transportation and accommodation is an integral element in tourism development. 11.2 Infrasturcture The infrastructures are basically acknowledged as support system or life support system of tourism. Transportation facilities as infrastructure needs to take into account the needs for external linkages i.e. airport, port, rail terminals etc. which allow tourists to have an access to their destinations. It also allows tourists for circulation within destination areas e.g. through local road and vehicle hire services. Accommodation development in the form of hotel, apartment, huts, guest house, villa, tourist villages are very important which give life supports to tourism development. Therefore, accommodation is a fundamental necessity in any tourist destination.
 Accommodation Facilities : These days accommodation is a key and fundamental tourist facility for any destination area in a country. The very concept of travel- accommodation has transformed itself as hospitality industry, on account of its utility in tourism. Accommodation facilities are of different kind depending upon services, and its intent size room etc. Accommodation facilities are of different kind. They are international hotels, resort hotel, commercial hotels, residential hotels, floating hotels, heritage hotels etc. on the other hand international hotels are being further classified into star hotels, such as five star hotels, four star hotels, three star, two star and one star hotels. This classification is done on the basis of number of rooms, size and architectural design, services and quality of services and foods etc. The requirements of accommodation facilities for tourists is dependent upon his or her financial conditions. 11.3 Supplementary Accommodation The supplementary accommodation are basically accommodation of different kind. The

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supplementary accommodation are youth hostel, caravan, camping sites, bed and breakfast establishment, tourist holiday villages,

dakbunglow, guest house etc. The most striking features these facilities are- (i) Comparatively cheap in tariff. (ii) Most suitable for family and mass tourist. (iii) They are located away from crowded area. (iv) More spacious Because these features, in today's' context the supplementary accommodation are in more demand. 11.4 Other Facilities and Amenities For tourist of any kind i.e. international domestic as well as irrespective of economic level they require these facilities and amenities. Services like post, communication health services, law and order etc. are most essential requirement for tourist for safe and healthy stay.
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In addition to these civic amenities such as sewerage and drainage system, water supply, dumping of garbage, electricity supply etc. 11.5 Summary Attraction of tourists at destination is solely depended upon these infrastructure facilities like transporation, accommodation both main and supplementary as well as other facilities and amenities.
50-- NSOU ● GE - GR-21 Unit 12 ❒ Tourism Circuits-Short and Longer Structure 12.1 Introduction 12.2 Travel Agency and Tour Operators 12.3 Function of Travel Agency 12.4 Indian Hotel Industry 12.5 Summary 12.1Introduction A tourism circuit is defined as a route on which at least three major tourist destinations are located such that none of these are in the same town, city or village. At the same time they are not separated by a long distance. It should have well defined exit and entry points. A tourist also enters at the entry point of a circuit should get motivated to visit all the places identified on the circuit. The main objective circuit tourism is to increase the total number of visits at all the destinations, on the circuits on one hand, on the other to provide to the tourist the attractions of all the destinations located on the circuit. The introduction of tourism circuit's make tourism move popular. There are both short and long distance circuit. There 8 major circuits found in India. They are- 1. The Golden Triangle Circuit which constitutes - Delhi-Jaipur-Agra 2. The Desert Circuit - It includes Jodhpur-Bikaner-Jaisalmer 3. The Himachal Circuit 4. The Wildlife Circuit 5. The Nilgiri Circuit 6. The Back Waters Circuit
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7. The Buddhist Tourist Circuit 8. The Chota - Char Dham Circuit The tourism circuits encourage tourists to visit places in large number. It is a new dimension of tourism industry. Because of this tourism is gaining its importance day by day. There is another important aspect at tourism i.e. agencies and intermediaries. It is the Travel agency and Tour Operators. 12.2 Travel Agency and Tour Operators The travel agencies are basic and essential element of tourism industry. Irrespective of type of tourism, and nature of tourism the entire industry revolve around travel agency and tour operators. Travel agency and tour operator primarily function in private sector. The role of private sector in organizing travels is therefore very crucial. The most important travel agencies around the world are- (i) Thomas Cook (ii) American Express Co. Many concept in our modern life are the contribution these agencies. For example credit-card (bank) Hotel Coupons, concept of discount etc. 12.3 Function of Travel Agency The main functions of travel agencies are - - Travel information - Preparation of itinerary - Ticketing - Tour planning - Provision of foreign currency

52--- NSOU • GE - GR-21 Because of all these functioning, one hand travel agency is an integral part of modern tourism industry and on the other development in all terms is heavily dependent on travel agencies. In addition the popularity of tourism industry to a great extent relied on travel agencies. 12.4 Indian Hotel Industry Accommodation facilities are most important part of tourist supply, therefore it has developed into an industry turned as hospitality industry, which offers, a home away from home to the tourist. The development of hotel industry in India is also continuous and satisfactory. The British introduced Hotels in India mainly for their own use or for foreign visitors. The western style residential hotels are comparatively of recent origin in India. These hotels were first standard about 160 years ago mainly for member of royal family, abstract and high dignitaries. Today there are numbers of western style hotels in Kolkata, Mumbai, Chennai, Hyderabad and Bangalore. The twentieth century can be identified as turning point in the history of Hotel Industry in India. It was during this period many big business owners entered into the field. The Hotel Industry in India is not very old. There are large number of hotels that exist in India. The Hotel Industries mostly unorganised. But there are small number of hotels in organised sector also. This Hotel Industry in India provide service to around 1.8 billion traveller. Out of which 9-9.5 million are foreign traveller and remaining are domestic. Among states Tamil Nadu and Uttar Pradesh together constitute more than 35% of travellers. There are altogether 115 hotel chains in India. Making a mark in the hotel Industry are chain hotels that prove to be efficient at offering would class hospitality services not only in the metropolitan cities in India but in almost all important places around the country. In Metropolitan cities such as Delhi, Mumbai, Chennai, Hydrabad Bangalore and Kolkata, the 5 major luxury hotels like Leela, Oberoi, Hyatt, Welcome Heritage, Radison and Lalit along with other major hotel groups co-exist. Popular brands like Taj Hotels which is also one of the largest hotel chains in India.

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12.5 Summary As a whole the tourism industry along with the circuits is playing a very important role in India. MODEL QUESTIONS 1. Define tourism. Enumerate geographical parameters of tourism. 2. In what way tourist different visitors and excursionist? 3. Discuss briefly the socio-economic impact of tourism what is eco-tourism? 4. Classify tourist resources. Discuss them in details. Give example. 5. Enumerate the factory influencing tourism. 6. In what way environmental laws related to tourism? 7. Discuss the environmental laws. 8. Discuss the concept of tourism. Differentiate Inbound tourism from out bound tourism. 9. What are the characteristic features of domestic tourism? Write about mass tourism. 10. What do you mean by natural tourists? Assess the role of environment. 11. What is tourism? Enumerate the role of tourism in economic development. 12. What is meant by medical tourism? Discuss the role of medical tourism in tourism development. 13. Enumerate the role of tourism in the economic development. 14. Discuss the concept of Ecotourism. 15. What do you know about Globalisation? Relate Globalisation and Tourism. 16. Discuss the concept of Meeting Incentives Conventions and Exhibitions (MICE). Define tourism infrastructure. 17. Assess the role of Travel Agencies in tourism development. What is 'tour operator'? 18. Discuss the concept of Tourism Circuit. Name major tourism circuits. 19. Differentiate between natural and man-made tourist resource. Mention few major natural tourist resources of India.

54--- NSOU • GE - GR-21 20. Elucidate the Tourism Action Plan 1992. What are the main objectives National Tourism Policy 1982. 21. Briefly discuss the recent trends in international tourism. What is WTO? 22. Enumerate the salient features of National Tourism Policy 1982 23. Name major Hotel chains in India. Discuss importance of hotels in tourism development. 24. Bring out the interrelations among tourism, recreation and deisure. 25. Write concept of cultural tourism and adventure tourism? Define tourism infrastructure. 26. Discuss the salient touristic features of Goa. 27. Discuss environmental law with special reference to wild life protection? Suggested Readings 1. Ashcorlth G (1984) Recreation and Tourism (Belh and Hyman, London) 2. Bhatia A K. (1991) International Tourism : Fundamental and Practices; (Sterling, New Delhi) 3. Bhatia AK (2001) Tourism Development, Principles & Practices, (Sterling, New Delhi) 4. Bull A (1991)

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nineteenth century dictionary defines tourist as people who travel for pleasure for travelling, out of

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defined tourism as "Sum of the phenomenon and relationship arising from the travel and stay of non-resident so far as they do not lead to any permanent residence and not connected with earning activity.

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travel in the young sort is a part of education and in elder a part of experience.

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Tourism denotes the temporary, short term movement of people to destinations outside the

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the United Nations conference on Travel and Tourism held at Rome in 1963.

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in the country visited whose journey is for the purpose of

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person visiting a country other than that which he has usual place of residence for a reason after that following an occupation remunerated from withen the country visited.

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Types of Tourism: Ecotourism, cultural tourism, adventure tourism, medical tourism, pilgrimage, international, national [10] 2.

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International tourism involves the movements at people between different countries in the world. Travel by people to a country olter than that in which they normally live and which

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Environmental laws and tourism – current trends spatial patterns and recent changes

Environmental laws and tourism – current trends, spatial patterns and recent changes [5] 7.

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Tourism Domestic tourism where people travel outside, their normal place residence to other areas within the country.

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as "meeting the needs of the present without compromising the ability of future generation to neat their own needs" (

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water supply and other public utilities may be widely shared by other sectors of the economy.

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the provision of infrastructure provide the basis or serve as an encouragement for greater economic diversification.

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Thus, indirectly tourist-expenditure may be responsible for stimulating other economic activities of

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19/31	SUBMITTED TEXT	22 WORDS	54%	MATCHING TEXT	22 WORDS

International tourism involves the movement of people between different countries in the world. The travel by people to a county other than

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domestic tourism—in which people travel outside their normal domicile to other areas within the

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a type of tourism in which large groups usually planned in advance are brought together. Recently there has been an industry trend towards using the term 'meeting industry' to avoid confusion from the acronym.

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International Hotels These are modern western style hotels found in all metropolitan and large cities.

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are are star hotels. There are five such categories ranging from five star to one star depending upon facilities and services provided.

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cater the needs of the holiday maker i.e. the tourists and those who by reasons of health desire a charge of atmosphere. Resort hotels are located near the sea, mountain and other areas

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of services amenities available in resort hotels include recreation facilities i.e. swimming pool, golf course, terms courts, skills, boating and various other indoor

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European plan where no meals are provided to the guests.
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Floating Hotels As the name suggests floating hotels are located on the surface of the water,

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It gives direction and opportunity to the youth of the country to understand the aspiration and view of others.
5.

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Offers opportunities to the youth of the country not only for employment but also for taking up activities

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supplementary accommodation are youth hostel, caravan, camping sites, bed and breakfast establishment, tourist holiday villages,

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PREFACE In a bid to standardise higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. core, discipline specific generic elective, ability and skill enhancement for graduate students of all programmes at Honours level. This brings in the semester pattern, which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry acquired credits. I am happy to note that the University has been accredited by NAAC with grade 'A'. UGC (Open and Distance Learning Programmes and Online Learning Programmes) Regulations, 2020 have mandated compliance with CBCS for U.G. programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English / Bengali. Eventually,
the English version SLMs
will be translated into Bengali too, for the benefit of learners. As always,
all of our teaching faculties contributed in this process. In addition to this
we have also requisitioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor
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PREFACE In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. core, general elective, ability and skill enhancement for graduate students of all programmes at Honours level. This brings in the semester pattern, which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. UGC Open and Distance Learning (ODL) Regulations, 2017 have mandated compliance with CBCS for U.G. programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Bachelors Degree Programme (BDP) level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English/Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisitioned the services of the best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor
First Edition : May, 2022 Printed in accordance with the regulations of the Distance Education Bureau of the University Grants Commission.

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Subject: Honours in Geography (HGR) Choice Based Credit System (CBCS) Course Code : CC-GR-7 Course : Climatology Members of the Board of Studies in Under Graduate Geography Professor Kajal De Professor Apurba Rabi Ghosh (Chairperson) Retd. Professor of Geography Director, School of Sciences University of Calcutta NSOU Dr. Chhanda Dana, Professor Kanan Chatterjee * * * * * * * * * * ! " * * ! # $ " #
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Registrar
NETAJI SUBHAS OPEN UNIVERSITY Module-1 Unit-1 Elements of the Atmosphere 9-17 Unit 2 Insolation: Controlling factors. Heat budget of the Planet Earth 18-25 Unit 3 Temperature: Horizontal and Vertical distribution. Inversion of Temperature 26-40 Unit 4
Greenhouse Effect and Importance of Ozone Layer 41-61 Module-2 Unit 1 Condensation: Process and forms. Mechanism of Precipitation: Bergeron Findeisen Theory, Collision and Coalescence Theory. Forms of Precipitation 65-83 Unit 2 Air mass: Origin and Characteristics 84-95 Unit 3
Fronts: Warm and Cold; Frontogenesis and Frontolysis 96-106 Unit 4
Weather Stability and Instability 107-110
Unit 5 Circulation in the atmosphere: Planetary winds, Jet Stream 111-128 Unit 6 Tropical Cyclone and Mid-Latitude Cyclones 129-144 Unit 7 Monsoon Circulation and Mechanism with reference to India 145-161 Unit 8 Climatic Classification after Köppen and Thornthwaite 162-171
Unit 9 Differences and Brief Notes 172-195 UG : Geography HGR CORE COURSE (CC)-7 Paper Code : CC-GR-07 Course : CLIMATOLOGY
MODULE-1 ELEMENTS OF THE ATMOSPHERE
Module 1 : Elements of Atmosphere Learning Objectives: The objectives of the module are: 1. Climate has the immense influence on the earth's surface. Identify the interlinks of climate with lithosphere, hydrosphere, atmosphere and biosphere. 2. Trace the elements of atmosphere. 3. Explanation of the heat budget of the planet earth. 4. Identification of the factors controlling insolation. 5. Analyse of the horizontal and vertical distribution of temperature. 6. Analyse of the green house effects. 7. Identification of the importance of ozone.
Unit 1 Elements of the Atmosphere Structure 1.1 Introduction 1.2 Objectives 1.3 Nature, Composition of the Atmosphere 1.4 Layering of the Atmosphere 1.5 Conclusion 1.6 Summary 1.7 Key words 1.8 Model Questions 1.9 References 1.1 Introduction Weather is the physical state of the atmosphere at a given place and time. It refers to the physical condition of the atmosphere for a short period like one to seventy-two hours. Weather condition is therefore, regulated by the amount of solar radiation received at a particular place, and temperature, relative humidity, precipitation, evaporation, wind speed and wind direction. The state of atmosphere is never static but always it is changing to form equilibrium. Therefore, the climate is always in a dynamic equilibrium. Now a days, a variability in climatic components particularly the temperature and rainfall is observed. The rising trend in the maximum and minimum temperature and the erratic behaviour of precipitation are termed as significant features of climate change. 1.2 Objectives i. To know the nature of the atmosphere. ii. To know the composition of the atmosphere. iii. To know the layers of the atmosphere. iv. To know the structure of the atmosphere. *
A blanket of gases, suspended solid and liquid particles that

69%	MATCHING BLOCK 1/265	W

envelopes the earth's surface is called the atmosphere. The atmospherer is a mixture of many gases. In 10

NSOU CC-GR-07

100%	MATCHING BLOCK 2/265	W

addition, it contains huge numbers of solid and liquid particles,

they are

94%	MATCHING BLOCK 3/265	W

collectively called aerosols. Some of the gases may be regarded as permanents atmospheric components that remain in fixed proportions to the total gas volume. Other

components

100%	MATCHING BLOCK 4/265	W

vary in quantity from place to place and from time to time.

The

73%	MATCHING BLOCK 5/265	W

different components of the atmosphere have got their individual characteristics. These are– Gases: Of all the gases oxygen happens to be the most important as it is so essential to all life forms. No life is possible without it. It is capable of combining with all other element to form different components. It is

also essential for combustion. The proportions of the gases present in the atmosphere are given below– Constituents Percentage by volume Nitrogen 78.08 Oxygen 20.94 Argon 0.93 Carbondioxide 0.03 Neon 0.0018 Helium 0.0005 Ozone 0.00006 Hydrogen 0.00005 Atmospheric Layers: Nature, composition and structure Introduction–Atmosphere is described as 'a blanket of air' surrounding the earth. The density of atmosphere decrease with increase in altitude. About 97% of the air is concentrated in lower 29 km. Characteristics–The atmosphere is different from the lithosphere and hydrosphere as air in colourless, odourless and can be felt only when it blow as wind. Importance of terrestrial atmosphere–It provides oxygen and carbondioxide and maintain the requisite level of water and radiation in the earth system. It is gaseous covering of earth which maintain the temperature of earth that suits our planet. It also shields us from Sun's ultraviolet radiation and act as a protective wall against the bombardment of meteors of all size. * The atmosphere can be described as blanket of air surrounding the earth. This enveloping

75%	MATCHING BLOCK 7/265	W

mixture of gases contains huge numbers of solid and liquid particles collictively called aerosols,

mostly Nitrogen, Oxygen, Argon, Carbondioxide and Water vapour made the bulk of atmosphere. 1. (i)

57%	MATCHING BLOCK 8/265	W

Of all the gases Oxygen is the most important. All living organism inhale Oxygen. No life is possible without it.

Oxygen occurs throughout the year upto
11 NSOU CC-GR-07 120 km of the atmosphere. Below 60 km it exists as molecules of Oxygen (O_2) and above 60 km as dissociated atomic oxygen (O). It is only 20.94% by volume. (ii) It is another important gas which is about 78% present in atmosphere It serves mainly as diluent. It's

95%	MATCHING BLOCK 9/265	W

main function in atmosphere is to regulate combustion by diluting Oxygen

and indirectly helps in oxidation of different kind. Nitrogen is important for protein production. (iii) * The third important gas it is transparent to most of the solar radiaiton which are incoming but opaque to all outgoing terrestrial radiation. It is largely responsible for green house effect althrough about half of additional Carbondioxide is absorb by ocean or consume by planets. The

68%	MATCHING BLOCK 10/265	W

green plants in the process of photosynthasis extract Carbondioxide from the atmosphere and utilized it. It

help in respiration of green plants. (iv) It has least important of three major gases in terms of volume and its contribution. It enters the atmosphere as a result of radioactive breakdown of potassium within surface rocks. The name argon is derive from greek word pyov. meaning inactive. It is a noble gas. (v) 3)–It is another important gas. It

71%	MATCHING BLOCK 11/265	W

is a type of oxygen molecule form by three atoms. It is found in small quantity in upper atmosphere. It is

found between word 10 to 50

73%	MATCHING BLOCK 14/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

km above the surface. It act as a filter and absorbs the ultraviolet rays radiating from the sun and prevent them from reaching

earth surface. (vi) In our atmosphere we also found Neon, Helium, Hydrogen, Methane, Krypton and Xenon. 2. It

100%	MATCHING BLOCK 12/265	W

is one of the most variable gases in the atmosphere, which

decrease with altitude.

54%	MATCHING BLOCK 13/265	W

In warm and wet tropics, it account for 4%, while in dry and cold area of desent and polar region may be less than 1%.

Water vapour also decrease from equater to pole. It

79%	MATCHING BLOCK 16/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

absorbs part of insolation from the sun and preserues the earth radiated heat it thus act like a blanket allowing the earth neither to become too cold and too hot. Water vapour also contribute in stability and instability of air. Water vapour is a source of all cloud and precipitation. If there is high temperature in air, then larger the capacity to hold the moisture. 3. ! Atmosphere as a sufficient capacity to keep small solid particles which

64%	MATCHING BLOCK 15/265	W	
may orginate from different sources and includes sea salts, fine soil, smoke- soat, ash, pollen, dust and			

particles of meteors.

87%	MATCHING BLOCK 17/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)
Dust particles are generally concentrated in the lower layers of the atmosphere			

as conventional air current may transport them to great heights. The

100%	MATCHING BLOCK 19/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)
higher concentration of dust particles is found in subtropical and temperate regions due to dry winds in camparison to equatorial and polar			

region.
12 NSOU CC-GR-07 Dust and salt particles act as hygrosopic nuclei around which water vapour condenses to produce clouds. They absorb a part of incoming short wave solar energy.

94%	MATCHING BLOCK 18/265	W	
Dust particles by the process of scattering contribute a varied colours of red and orange at sunrise and sunset. The blue colour of the sky is also due to selective scattering by dust particles.			

91%	MATCHING BLOCK 20/265	W	
The duration of dawn and toilight as well as their intensity are all controlled by the presence of these solid particles in air. 1.4			

Layering of the

86%	MATCHING BLOCK 21/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)
Atmosphere Introduction: Atmosphere consists of different layers with varying density and temperature. Density is highest near the surface of the earth and			

decrease with increse in altitude. Structure of the a atmosphere can be analysed on the follwong bases: (i) On the basis of chemical composition. (ii) On the basis of temperature. (A) On the basis of chemical composition, atmosphere can be divided into two zones, viz. Fig. 1.1: Cross section of the atmosphere showing homosphere and heterosphere (affer Oliver & Hidore, 1984).

13 NSOU CC-GR-07 (i) Homosphere. (ii) Heterosphere. (i) Homosphere–It extends from the surface of Earth to 88 km. This region is the result of uniform mixing which is brough by turbulent mixing. Nitrogen, Oxygen, Argon and Carbon dioxide are constitute more or less hemogenous composition. (ii) Heterosphere–Above 88 km the atmosphere is refered as heterosphere. In heterosphere, turbulent mixing has been reduced that the composition is no longer uniform. The molecules and atome above 88 km arrange them in two layers. In lowest level of heterosphere is made with heaviest molecule where as upper level is made up of lightest gases forming four distinct layers: –Molecular Nitrogen Layer –Atomic Oxygen Layer –Helium Layer –Atomic Hydrogen Layer The upper reach of heterosphere is called exosphere. (B) On the basis of temperature: (i) Troposphere–Lowest part of atmosphere in which we live of most of the cloud form. It contains 75% of total gaseous mass. The term troposphere was first suggested by Teisserence de Bort. Tropopshere has been derive from Greekword 'tropos' means 'mixing of'. It average height in 13

75%	MATCHING BLOCK 25/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

km. and extends roughly to a height of 8 km near poles and 18 km at the equator. Thikcness of troposphere is more in equator because heat is transported to a great height by strong concustion currents. This layer contain dust particles and water vapour. All changes in climate and weather take place in this layers. The temperature in this layer decreases at the rate of 1°C for every 165m of height.

Importance of Troposphere (i) Earth temperature–The temperature decreases with 6.5 0 C for 1 km. height until. (ii) Atmospheric phenomena–All atmospheric phenomena such as rain, wind, clouds take place in this layer. (iii) The air movement–The hot air current move up while cold air current move down. (iv) Gaseous–It contain all the type of gases which are require by human to sustain life. Layer of trophosphere –Friction layer is about 1 km high from the surface of the earth. It controls wind speed and direction.
14 NSOU CC-GR-07 –Surface boundary layers extends upto few meters from the earth's surface. –Laminar layer extends only few milimeter. Tropopause–The separating zone between troposphere and stratosphere is tropopause. It is the upper limit of clouds and storm and temperature is constant here. (ii) Stratosphere–It is found above tropopause. The lower stratosphere is isothermal in character because temperature does not change. The height of the layer is 50 km. Stratosphere contains ozone layer, which absorbs ultra violet radiation and sheeld life on the earth. Pilot usually prefer flying aircraft through stratosphere because the lower part of stratosphere layer does not contain clouds or wather disturbance. (iii) Mesosphere–It lies above stratosphere and below thermosphere which is extended upto 80 km. Temperature start decreasing with increase in altitude and reach upto-100°C. This layer contain limited quantities of helium and hydrogen gases. Mesosphere layer protect the planet earth from the celestial rocky masses that enters the atmospheric envelops, where they burn as a result of friction with the air molecules and forming luminous meteors.

65%	MATCHING BLOCK 26/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

The upper limit of mesosphere is known as mesospause. (iv) Thermosphere (Ionosphere)–It is located between 80 and 400 km. above mesopause.

It contain electrically charged particles known as Ions.

100%	MATCHING BLOCK 22/265	W

Radio waves transmitted from the earth are reflected back to the earth by this layer.

Fig. 1.2: Regions of the atmosphere.
15 NSOU CC-GR-07 Layers of Ionosphere

90%	MATCHING BLOCK 23/265	W

D-layer– It reflects low frequency radio waves but absorbs medium and high- frequency waves.

It is found from 66 to 99 km. height.

63%	MATCHING BLOCK 24/265	W

E-layer– This layer is also called kennelly-heaviside layer. It reflect the medium and high frequency radio waves. It is produced by ultraviolet photons from sun interacting with nitrogen and nitrogen moleque. Sporadict E-layer– This layer occurs under special circumstances. It is caused by meteors and by the same process that cause aurora

light. It is at 110 km height and

70%	MATCHING BLOCK 27/265	W

it affects very high frequency radio waves. E 2 layers– This region is above E-layer. It produced by ultra violet photons acting upon oxygen molecules. Apper in day time and vanishes at the sunset.

Appleton Layers F 1 Layer– It appears during the day but disappears at night. It is important in long- distance radio communications. It extends from 145 to 240 km. F 2 Layer– This layer is characterized by diurnal and seasonal variation. It appears as directly related to sunspot activity. It extends from 240 to 465 km.

69%	MATCHING BLOCK 28/265	W

G-Layer– This layer is at 400 km. and above this layer existence came to be known as a result of the latest exploration carried into the upper part of the atmosphere. (

v) Exosphere–It is the outer most

63%	MATCHING BLOCK 29/265	W

layer of the earth's atmosphere which lies between 400 and 1000 km. The density of atmosphere is very low. The atmosphere in this region is rarefied that it

resemble nebula. Troposphere strom + cloud Stratosphere Ozone Mesosphere D Layer E Layer 10 50 100 200 500 Sporadict layer 300 E 2 Layer Idnosphere Exosphere Fig. 1.3: Layers of Atmosphere F Layer Altitude (Km)
16 NSOU CC-GR-07 Nature of Atmosphere 1. Compared to radius of earth, atmosphere is a very thin layer of air. The radius is 6371 km. which in height of the atmosphere is very small. 2. About 99% of atmosphere lies below 29 km. 3. Height of atmosphere is 0.47% of the radius of earth. 4. Atmosphere is made up of several layers of air and it is influenced by solar radiation, temperature are precipitation. 5. It contain a protective zone called ozone layer. 6. It contain gaseous, water vapour and dust particles. 7. Difference between lower and upper atmosphere is tabulated blow– Lower Atmosphere Upper Atmosphere Nitrogen and oxygen, together with tiny Slightly larger proportions of hydrgen, proportions of other gases helium, ozone, ionized gases, increasing with height above surface More water vapour Little water vapour More dust particles Few dust particles Large porportion of atmospheric gases Extremely rarefied 1.5 Conclusion The atmospherer is a mixture of many gases. Most of the gases is the permanents atmospheric components, having individual characteristics, that remain in fixed proportions.

100%	MATCHING BLOCK 30/265	W

In addition, it contains huge numbers of solid and liquid particles,

they are collectively called aerosols. Moreover,

76%	MATCHING BLOCK 32/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

the atmosphere consists of different layers with varying density and temperature which is

very important. *
Compared to radius of earth, atmosphere is a very thin layer of air. The radius is 6371 km. which in height of the atmosphere is very small. About 99% of atmosphere lies below 29 km. Height of atmosphere is 0.47% of the radius of earth. Atmosphere is made up of several layers and it is influenced by solar radiation, temperature etc. It contain a protective zone, called ozone layer. It contain gaseous, water vapour and dust particles.
17 NSOU CC-GR-07 1.7 Key words Atmospheric composition, Water Vapour, Carbondioxide, Ozone, Troposphere, Stratosphere, Ionosphere, Tropopause, Stratopause, Mesopause 1.8 Model Questions Short Answer type: Write note note: 1. Troposphere, 2. Stratosphere, 3. Tropopause, 4. Ionosphere, 5. Ozonosphere Long Answer type: 1. Give on account of nature and composition of atmosphere. 2. Describe the layers of atmosphere. 1.9

81%	MATCHING BLOCK 31/265	W

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Unit 2 * Structure 2.1 Introduction 2.2 Objectives 2.3 Factors Controlling Insolation 2.4 Heat Budget of the Planet Earth 2.5 Conclusion 2.6 Summary 2.7 Key word 2.8 Model Questions 2.9 References 2.1 Introduction The source of energy is the Sun, which is made of hydrogen and helium. The core of the sun acts as huge nuclear reator and convert hydrogen into helium. In this process, huge quantities of energy are generated which is radiated in all direction in space through short waves. This is known as solar radiation. In this portion we came to know about such solar radiation, insolation and albedo. Energy transfer processes including radiation, conduction and connection, maintain a balanced through the heat budget at the earth's surface. 2.2 Objectives i. To know the concept insolation. ii. To know the factors controlling insolation. iii.To know about albedo. iv. To know the heat budget of the atmosphere. v. To learn about heat balance of the earth. 2.3 Factors Controlling Insolation Introduction–Sun is made of hydrogen and helium. The core of the sun acts as huge nuclear reator and convert hydrogen into helium. In this process, huge quantities of energy are generated which is radiated in all direction in space through short waves.
19 NSOU CC-GR-07 This is known as solar radiation. The incoming solar radiation through short waves is termed as insolation. Factors affecting or controling Insolation–

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The amount of insolation received on the earth’s surface

is not uniform everywhere. It varies from place to place from time to time. The following factors which control insolation are: 1.

73%	MATCHING BLOCK 36/265	SA	MGDSC - 2.1 - Climatology.pdf (D155224061)

Angle of incidence of sun rays: The earth is geoid shape therefore sun rays strike the surface at different

angle. The vertical rays are spread over minimum Fig. 2.1: Effect of altitude on Insolation. Vertical ray Oblique ray

58%	MATCHING BLOCK 33/265	W

area of the earth's surface and they heat the minimum area but they received maximum solar energy. Oblique rays are spread over large area and therefore, the amount of solar energy receive per unit area decrease. Oblige rays have to pass through thicker portion of the atmosphere than vertical rays thus the oblique rays have to travel larger

distance. 2. Duration of Sunlight–The duration of sunlight hours determines the length of the day. It

71%	MATCHING BLOCK 34/265	W

varies from place to place and season to season. Greater the length of the

day more the amount of insolation received. Days are longer in summer hence more insolation receive and days are 20 NSOU CC-GR-07 shorter in winter, hence less insolation receive. 3. Transparency of the atmosphere–

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The amount of solar radiation reaching the earth's surface

also depend upon the atmospheric condition. The amount of clould cover and its thickness, dust and water vapour determind the transparency of the atmosphere. Transparency of atmosphere affect the reflection, absorption and transmission of solar radiation. Transparency are closly related to latitude. In higher latitudes the sun's rays are more oblique so they have to pass through thicker layers of the atmosphere than lower latitudes. 4. Rotation of the Earth (Distance between the earth and sun)–Since the earth revolves arround the sun, the distance between earth and sun keeps on changing which depend on the insolation received by the earth. Each year on January 3, the earth comes closer to sun and this position is known as perihelion and on 4 July the earth is the farther from the sun, this position is called aphelion. Fig. 2.2: The Earth–Sun relationship (after Oliver and Hidore) 5. Solar Constant (Sun Spot): Sun spot is defined as dark area

75%	MATCHING BLOCK 35/265	W

within photosphere of the sun and surrounded by chromosphere. These dark areas are cool areas because they are characterized by 1500 0 C less temperature than the chromospheres

which surrounded them. They are cooler because of intense magnetic fielding. The energy radiated from the sun increases when the number of sunsports increases.
21 NSOU CC-GR-07 Albedo : The term 'albedo' derive the from latin word 'Whiteness'. Albedo is defined as the reflective quality of a surface. It is expressed as a percentage of reflected insolation to incaming insolation and 0% is total absorption while 100% is total reflected. In terms of visible colour, darker colour have low albedo because they absorb more insolation and lighter colour have high albedo or rate of reflection in high. The angle of sun also impacts albedo value, lower sun angles create greater reflection because the energy coming from a low sun angle is not stronger as compare to higher sun angle additionaly smooth surface have higher albedo while rough surface reduce it. The earth average albedo is arround 31%. Albedo effect has a significant impact on our climate

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70%	MATCHING BLOCK 44/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

the lower the albedo, the more radiation from the sun that get absorbed by the planet and temperature will rise. If the albedo is higher and the earth is more reflective than more radiation is reflected to

the space and the earth would be cool. 2.4 Heat Budget of the Planet Earth Introduction–Heat budget is the perfect balance between incoming heat absorbed by earth and outgoing heat escaping it in the form of radiation. If the balance is disturbed then earth would get progressively warmer or cooler. Atmospheric balance Let consider
that

79%	MATCHING BLOCK 38/265	W

the insolation received at the top of the atmosphere is 100%. While passing through the atmosphere some amount of energy is reflected, scattered and absorbed. Roughly 35 units are reflected back to space before reaching the earth surface

so out of 100 – 35 = 65 left. About 27

89%	MATCHING BLOCK 39/265	W

units are reflected back from the top of clouds, 2 units from snow and ice

cover and 6 unit get scatter and absorbed. The remaining 65 units, out of which 14 units absorbed with in the atmosphere. Only 51 units received by the earth surface and this 51 radiates back by long wave. About 17 units are directly radiated to space. Now 34 units are absorbed by atmosphere when the earth radiates back the heat out of 34, 6 units absorbed by atmosphere, 9 units through connection and 19 units through the latent heat. Now the 14 units which radiates back before and the 34 units radiates after reaching the earth surface is (14 + 34 = 48).

84%	MATCHING BLOCK 40/265	W

Thus the total radiation returning from the earth and the atmosphere is 17 + 48 = 65 which is the total

unit received by earth.
22 NSOU CC-GR-07 Latitudinal Heat Balance–It is a state of balance which exist between the latitodinal belts. The insolation on the surface of the earth varies because of its tilted axis or angle. Insolation decreases poleward from equator. At latitude below 40° or more, the solar radiation received more than lost. Beyond 40° latitudes, more heat is lost than received. In tropics, where the insolation is high throughout the year, more solar energy is received than heat loss. In polar region on other hand, there is more heat loss than received. In this way

81%	MATCHING BLOCK 41/265	W

tropics should have been getting progressively hotter and poles pregressively cooler. But this is not so

because heat energy transfer within the atmosphere prevent such situation. The imbalance in the atmosphere and ocean created due to insolation, winds and ocean currents which transfer heat from surplus regions (tropical) to deficit (pole) regions and help in maintaining overall balance on the surface of the earth. Fig. 2.3: The Earth's radiation balance (Gross, 1977). Analysis of Heat Budget The radiation budget of a place is seldom in balance. Actually there is an annual deficit at high latitudes and annual surplus at low latitudes, because of the two factors:

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23 NSOU CC-GR-07 Fig. 2.4: Diurnal regimes of incoming and outgoing radiation at the earth's surface during a day near the time of an equinox. Earth radiation radiation Solar Surplus Deficit Time of day 0 6 12 18 24 Increasing radiation Angle of incidence of sun's light. Surface Albedo At any latitude, variation in slope, explosure, characters of surface cover (e.g. water, land or vegetation) produce regional difference in the radiation budget. In the middle and low latitudes, a true radiation balance may exist briefly at the beginning and end of each daylight period, when deficits and surples replace one another. Energy transfer processes including radiation, conduction and connection maintain a balanced heat budget at the earth's surface. Analysis shows that for the earth atmosphere system as a whole, the incoming short wave radiation on an average exceeds the outgoing long wave radiation equatorwards of 35° latitudes while the long wave radiation exceeds the short wave radiation polewards of 35° in both hemisphere. Since all latitudes find to maintain the same means annual temperature from year to year, there must be a continual poleward transfer of energy from those latitudes equatorwards of 35° (where there is an excess of radiant energy) to those latitude poleward of 35° (deficit areas). The transfer of this energy, which reaches a maximum at latitude 35° is the prime function of the general circulation of the atmosphere. Most of the energy treansfer (70°–90°) is done by atmosphere circulations, rest is tansfered by ocean currents.

24 NSOU CC-GR-07 Short wave Long wave and heat-flexes Total energy Space Extra terrestrial Radiation outer edge of atmosphere Planetary albedo 31 69 Gain 100 loss 31 69 (57+12) 3 S t r a t o absorption 15 T r o p o absorption (w a t e r vapour and aerosoles) 3 Reflected Atmosphere Earth absorbs cloud 20 Scatte- red Back Scatte- red 3 Reflected Surface 8 Surface Diffuse 48 absorbed at surface 27 21 } Atmospheric window 12 48 9 Cloud emission water vapours & CO 2 emission Multiple tropo absorps & radiation 6 102 Back radiaton from clouds Turbulent heat- flexes 114 Lu 96 Ld 23 L E 7 H From Short wave- 21 Long- 102 wave Latent- 23 heat Sensible- 7 heat 153 To Space 57 surface 96 153 Short wave—48 long wave—96 144 Long wave— 114 latent heat— 23 sensible heat— 7 144 by 100 Fig. 2.5: Heat Budget Incident solar radiation averaged over the globe is:– solar constant × π 2 /4πR 2 (where R = Radius of the earth and 4πR 2 is the surface area) This Figure is approx 342 wm −2 or 11 × 10 7 jm −2 y −1 This may be regarded as 100 units.

25 NSOU CC-GR-07 2.5 Conclusion The solar radiation, insolation and albedo are operated in the earth's atmosphere which helps to maintain the heat balance of the earth. The incoming solar radiation to the earth surface is very much essestial to heat the earth. Moreover, the reflected energy, i.e. albedo is also very significant as different surface have diverse amount of albedo. * Summary The incoming solar radiation is the insolation. The amount of reflecting solar enrgy is albedo. The amount of insolation is 66%. The amount of insolation is 34%. Heat budget is the perfect balance between incoming heat absorbed by earth and outgoing heat escaping it in the form of radiation. 2.7 Key words Insolation, albedo, heat budget, heat balance 2.8 Model Questions Short Answer type: 1. What is Albedo? 2. What is Insolation? * 1. Explain the factors or of Insolation. 2. Explain the heat budget of the earth. 2.9

81%	MATCHING BLOCK 43/265	W

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Unit 3 * * Structure 3.1 Introduction 3.2 Objectives 3.3

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Horizontal Distribution of Temperature 3.4 Vertical Distribution of Temperature 3.5 Inversion of Temperature 3.6

Conclusion 3.7 Summary 3.8 Key words 3.9 Model Questions 3.10 References 3.1 Introduction

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Temperature indicates the relative degree of heat of a substance. Heat is the energy which make them hot, while temperature measures the intensity of heat. There is a close relationship between heat and temperature as gain or loss of heat

depend on higher and lower tempreature. 3.2 Objectives i. To know the nature of temperature distribution pattern of the atmosphere. ii. To know the horinzontal distribution of temperature in the atmosphere. iii. To know the vertical distribution of temperature in the atmosphere. iv. To know the inversion of temperature in the atmosphere. 3.3 Horizontal

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Distribution of Temperature Introduction–Temperature indicates the relative degree of heat of a substance. Heat is the energy which make them hot, while temperature measures the intensity of heat. There is a close relationship between heat and temperature as gain or loss of heat

depend on higher and lower tempreature.
27 NSOU CC-GR-07 Distribution of temperature can be analysed as: (i)

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Horizontal distribution of tempreature (ii) Vertical distribution of tempreature (i) Horizontal distribution of tempreature–Distribution of temperature across the latitudes over the surface of earth is called horizental distribution. On map horizontal distribution is commonly shown by isotherms.

Isotherms are the line connecting point with equal tempreature. Isotherms is made up of two word 'iso' and 'therms'. 'Iso' means equal and 'therms' means tempreature. There are some parts of the earth where isotherms are closely spaced signifies temperature is changing rapidly in horizontal direction. Widely spaced isotherms signifies slight horizontal temperature difference. The rate of change of temperature is called the temperature gradient. Isotherms run parallel to latitude as

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same amount of insolation received by all the points located on same latitude.

Factors affecting the distribution of temperature: 1) Latitude–The sun ray strike differently in different part of earth surface at different angle. At equtor the rays hit the earth's surface at an angle of 90°, therefore, tempteature is higher rear equator and lower at the pole. 2) Land and Sea–The difference in heating of land and water affect the temperature of place, as land heat up more faster than sea similarly

50%	MATCHING BLOCK 49/265	W

it also cools down faster than sea. Hence during day time temperature is relatively higher an land during day time and

temperature is higher on sea at night time. When sea is cooler than the land in summer, it lower the temperature of coastal place and during the winter sea is warmer than the land and keep costal place warm. 3)

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Relief and Altitude–Relief features such as mountains, plateaus and plains control the temperature by way of modifying its distribution. Mountain act as barriers against the movement of winds. The Himalayan ranges prevent cold winds of central Asia from entering India during winter. 4)

Ocean Currents–There are two type of ocean currents, cold ocean currents and warm ocean currents. Cold ocean currents brings water from polar region to warm region and warm current bring warm water to cold or polar region. Therefore, warm current rise the tempreature in northern hemisphere and cold current decrease the tempreature. 5) Prevalling wind–Wind

100%	MATCHING BLOCK 51/265	W

also affect temperature because they transport heat from one region to the other. The

wind blow from land towards ocean drive
28 NSOU CC-GR-07 warm surface water away from the coast and uplight cold bottom water. 6) Vegetation cover–The land without vegetation cover absorb more heat as a result temperature rise, whereas land with vegetation cover absorb less heat as the vegetation receive more heat which don't allow radation to reach in soil. 7) Other factors–Other factors include nature of soil, slope, evaporation, condition etc.

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The horizontal distribution of temperature over the global can be studied easily from the maps of January and July

month. Pattern of Horizontal distribution of Temperature: (A)

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Horizontal distribution of temperature in January:- – In January, the sun shines vertically overhead near tropic of capricorn. Hence, it is summer in southern hemisphere and winter in northern hemisphere. – A high temperature is found over the landmasses mainly in 3 regions of southern hemisphere these regions are North-West Argentina, East and Central Africa and Central Australia.

The

84%	MATCHING BLOCK 55/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

isotherm of 30°C closes them. – In Northern hemisphere, landmasses are cooler than the ocean. As the air is warmer over the oceans than over landmasses in the northern region, the isotherms bend toward the north when they cross the oceans and to the south (equator) over the continents. – This can be clealry visible over the North Altantic Oceans. The presence of warm ocean

and isotherms bend towards the pole. Over the land, the temperature decreases sharply and the isotherms bend towards the equator in Europe. – In the southern hemisphere, the effect of the ocean is well pronounced due to few landmass. – Here the isothems are more or less parallel to the latitudes and variation in temperature is more gradual
than in northern hemisphere. (
B) Horizental

84%	MATCHING BLOCK 56/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

Distribution of Temperature in July:- – In July, the Sun shines vertically overhead near the tropic of cancer. Hence, high temperature are found in the entire northern hemisphere. – The regions having high temperature including South Western USA, the Sahara, the Arabia, Iraq, Iran, Afghanistan, desert region of India and China. – However, lowest temperature (0°C) is also noticed in the northern hemisphere during summer in the central part of Greenland. – During summer, in the northern region, isotherms bend towards the equator while crosses occens and towards the poles while crossing landmasses isotherms are wide spaced over oceans while they are closely spaced over landmasses. 29

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78%	MATCHING BLOCK 58/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

In July the deviation of isotherms is not that much pronouced as in January.

Cmparison between January and July isotherms: The maps reveals the following characteristics– 1 The latitudinal shifting of highest temperature as a result of migration of the vertical rays of the sun. 2. Highest value occur in low latitude equator to 40° and the lowest value in high latitude is due to decreasing insolation from equator to the pole. 3. In northern hemisphre, isotherms on land bend toward pole in winter and toward equator in summer. This is caused by difference of heating. Horizontal Distribution of Temperature in January

100%	MATCHING BLOCK 57/265	W

Because of the preponderance of land in the northern hemisphere, the

isotherms are more irregular and oosely spaced here. On the contrary, because of the larger percentage of water surface in the southern hemisphere, the earth's surface is more homogeneous there. This results in greater egularity in the east-west trends of isothermal lines in that hemisphere. The isothermal are relatively more symmetrical while passing from continents to oceans in the southern hemisphere. The northern hemisphere has a larger number of isothermal lines than the southern hemisphere.

97%	MATCHING BLOCK 59/265	SA	climatology book.docx (D49940943)

On the continents of the northern hemisphere, the isotherms for the month of January bend sharply towards the

equator. This clearly indicates that the cold polar winds lower down the temperature of even more southerly regions in this hemisphere because of the effect of continentality. The winter in the interior of the continents is more severe. On the other land, the isothermal lines on the oceans exhibit a poleward bend showing thereby that within the same latitudes, the oceans in the northern hemisphere are relatively warmer than the continents. This is quite natural, because of the surfaces cool more rapidly and to a greater degree than the water surface. In January, the coldest place on earth is found in north-eastern Siberia. Another coldest region lies in the Greenland. In the middle latitude region, the western coastal regions of the continents are warmer than their counter parts on the eastern side. This primarily due to the fact that the prevailing westerlies carry warmer temperature from the oceans towards the coasts. The isotherms in the vicinity of the north pole are conspicuous by their absense a fact which may be attributed to the pancity of climate data in the northern polar region. It may be pointed out that, due to the severity of winter and permafrost in the polar region, a large network of weather observing station is lacking there. Hence, the task of collecting weather data in this extremely cold region becomes very difficult. The close spacing of the January isotherms over the continents in the northern

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30 NSOU CC-GR-07 hemisphere represents a steep temperature gradient. The temperature gradient on the eastern side of North America and Asia has been calculated as 1.5°C per latitude, while on the western side of these continents the temperature gradient is reduced to the value of 0.44° to 0.55°C only. The mean January heat equtor is located to the south of equator. In this month, the belt of highest temperature on the earth's surface is located on the continents in the vicinity of latitude 35°C in the southern hemisphere. In Janaury, the effect of warm ocean currents on the horizontal distribution of temperature is well-marked one the ocean in the northern hemisphere. The warm currents cause the isotherms to deflect more towards the pole. At this time of the year, there is larger contrast in temperatrure over the continents and oceans in the northern hemisphere. January being the month of summer in the southern hemisphere, the isotherms are rather straight in that hemisphere. Horizontal Distribution of Temperature in July The isotherms in the Northern Hemisphere (where it is summer) are most irregular and zigzag. On the contrary, in the southern hemispher (where it is winter) they are Fig. 3.1 The distribution of average surface air temperature
31 NSOU CC-GR-07 relatively more regular and straight, except at the edge or the continents where there is a slight bend towards the equator. An elongated and extensive belt of high temperature about 32.2°C is seem exending from North Africa through south-west Asia to the North-western part of the Indian subcontinent. Another belt of high temperature is found in the south-western part of the United States of America. In July, the low temperature belt of the cold season now disappears from the north- eastern part of Syberia. This region, because of the effect of continentatily becomes warmer than other region within the same latidues. In the northern hemisphere, the continents are much warnner than the oceans which are relatively cooler. The maximum amount of temperature contrast is found between the North Pacific and the adjacent lands areas. During the Northern Hemisphere, in summer, there are lesser number of isotherms and they are widely spaced. With

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the apparent movement of the sun towards the tropic of cancer, all the isotherms are displaced slightly towards the North,

but there is little variation in their general tendency.

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In July the thermal equator is displaced to the North of the equator.

Another notewarthy feature of July isotherms is that over continents they towards the north pole and over oceans move towards the equator.

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Temperature gradient in the interior and the eastern margins of the continents becomes weak.

There is no substantial change in temperature gradient along the western margins of the continents. 3.4 Vertical Distribution of Temperature The temperature always decrease with the increase in altitude. This is called vertical distribution of temperature. Vertical temperature gradient are control by the lapse rate and adiabatic lapse rate. Lapse rate–

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The obseved rate of vertical decrease in temperature is called vertical temperature gradient or lapse rate. Lapse rate is not constant but varies with (1) height, (2) location or (3) season. The Lapse rate at a given place and time can be obtained only by actual observations. _ Lapse rate indicates the temperature conditions that are found in a stationary column of air. – The upward decrease in temperature of the air continues only upto the base of the tropopause.

32 NSOU CC-GR-07 – In the lower layers of tropopause the lapse rate may be very high on clear, sunny days. _ On occasions the rate of decrease of temperature may exceed the adiabatic rate. Where insolation is very intense, the lapse rate is super adiabatic upto 160 meters espacilly in dry summer. – Laspe rate is zero when temperature is constant with elevation and negative when temperature increases with elevation/altitude. – The conditions of atmosphere and the difference in elevation or local relief features also affected the vertical temperature gradient. – If a valley in a mountaineous region filled with cold air in upper part of atmosphere the vertical lapse rate becomes low. – If a surface is intensely heated during daytime the air lying close to it is also heated by the processes of heat transfer. – The difference between the normal lapse rate in the atmosphere and the dry and wet adiabatic lapse rate determines the vertical stability of the atmosphere (A) Vertical temperature profile of the Atmosphere Temperature decreases with increase in altitude, like:- Tropospherе–It is about 13 kilometers thick on an average, it is thicker in summer than in winter. The troposphere, over low latitude regions is usually thicker than over high latitude regions. Troposphere is 18 kilometers thick over the equator and 8 kilometer in pole. The temperature in the troposphere decrease with height at average lapse rate of 6.5°C per kilometer. The air in tropospher is more unstable with strong connection. Almost all the water vapour in the atmosphere exist with in this layer. Stratosphere–It extends from 13 to 50 kilometer. In lower part it has tropopause. up to 30–35 kilometer the temperature is almost constant. Above 35 kilometer the temperature actually increase with height at the average rate of 5°C per kilometers. Since almost no dust or water vapour from the land surface will reach the stratosphere the air flow in this layer is steady. The upper part of the stratosphere experiences an increase of temperature due to sun's ultra traviolet radiation which are absorbed by ozone layer. Mesosphere–The region of mesosphere is about 50 to 80 kilometers in altitude. The temperature in this layer usually decreases as the height increases up to the top of mesosphere where the temperature can be low as -95°C or even low. The composition of gases in the atmosphere from the ground to the top of the mesosphere are almost identical except for water vapour or ozone, therefore, region upto the mesosphere is also called homosphere.

33 NSOU CC-GR-07 Thermosphere–This region is above mesosphere and the temperature in this layer decreases as the height increases. Where sun activity is low, this layer can extend to 400 km. During high sun activity, this layer can reach upto 500 kilometer in altitude. The air in the lower region of thermosphere is extremely thin; therefore the particles in the air can easily be ionized and hence it also called ionosphere and it is effecting in reflecting radio waves. (B) Inversion of temperature In lower part of the atmosphere upto a height of 881 kilometers from the surface, temperature normally decreases with increasing altitude. The normal lapse rate, as started earlier, is 6.5°C. But sometimes, under special circumtance temperature increase with altitude known as inversion of temperature. Temperature inversion may occur at lower layer close to the land surface or it may develop at various atmospheric levels at different altitude from the earth's surface. 3.5 Inversion of Temperature Temperature inversion is a reversal of the normal behavior of temperature in the troposphere, in which a layer of cool air at the surface is overlain by a layer of warmer air. (Under normal conditions, temperature usually decreases with height). Effects

Inversions play an important role in determining cloud forms, precipitation, and visibility.

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An inversion acts as a cap on the upward movement of air from the layers below. As a result, convection produced by the heating of air from below is limited to levels below the inversion. Diffusion of dust, smoke, and other air pollutants is likewise limited. In regions where a pronounced low-level inversion is present, convective clouds cannot grow high enough to produce showers. Visibility may be greatly reduced below the inversion due to the accumulation of dust and smoke particles. Because air near the base of an inversion tends to be cool, fog is frequently present there.

Inversions also affect diurnal variations in temperature.

Dirnal variations tend to be very small.

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Ideal Conditions For Temperature Inversion 1. Long nights, so that the outgoing radiation is greater than the incoming radiation. 34 NSOU CC-GR-07 2. Clear sky, which allow unobstructed escape of radiation. 3. Calm and stable air, so that there is no vertical mixing at lower levels.

Types of Temperature Inversion (
a) Temperature Inversion in Inter mountain Valley (Air Drainage Inversion):

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Sometimes, the temperature in the lower layers of air increases instead of decreasing with elevation. This happens commonly along a sloping surface. Here, the surface radiates heat back to space rapidly and cools down at a faster rate than the upper layers. As a result the lower cold layers get condensed and become heavy. The sloping surface underneth makes them move towards, the bottom where the cold layer settles down as a zone of low temperature while the upper layers are relatively warmer. This condition, opposite to normal vertical distribution of temperature, is known as Temperature Inversion. In other words, the vertical temperature gets inverted during temperature inversion.

This kind of temperature inversion is very strong in the middle and higher latitudes. It can be strong in regions with high mountains or deep valleys also. (b) Ground Inversion (Surface Temperature Inversion) A

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ground inversion develops when air is cooled by contact with a colder surface until it becomes cooler than the overlying atmosphere; this occur most

Fig. 3.2: Ground Inversion
35 NSOU CC-GR-07

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often on clear nights, when the ground cools off rapidly by radiation. If the temperature of surface air drops below its dew point, fog may result.

This kind of temperature inversion is very common in the higher latitudes. Suface temperature inversion in lower and middle latitudes occurs during cold nights and gets destroyed during daytime. (c) Subsidence Inversion (Upper Surface Temperature
Inversion) A

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subsidence inversion develops when a widespread layer of air descends. The layer is compressed and heated by the resulting increase in atmospheric pressure, and as a result the lapse rate of temperature is reduced. If the air mass sinks low enough, the air at higher altitudes becomes warmer than at lower altitudes, producing a temperature inversion. Subsidence inversions common over the northern continents in winter (

are atmosphere)

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and over the subtropical oceans, these regions generally have subsiding air because they are located under large high-pressure

centres.

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This temperature inversion is called upper suface temperature inversion because it takes place in the upper parts of the atmosphere. (

d) Frontal Inversion (Advectional type of
Temperature Inversion)

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A frontal inversion occurs when a cold air mass undercuts a warm air mass

Fig. 3.3: Subsidence Inversion
36 NSOU CC-GR-07 (Cold and Warm Fronts: we will study in detail later)

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and lifts it aloft. the front between the two qair masses then has warm air above and cold air below. This kind of inversion has considerable slope, whereas other inversions are nealry horizontal. In addition, humidity may be high, and clouds may be present immediately above it.

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This types of inversion is unstable and is destroyed as the weather changes.

Economic Implications of Temperature Inversion– Sometimes, the temperature of the air at the valley bottom reaches below freezing point, whereas the air at higher altitude remains comparatively warm. As a result, the trees along the lower slopes are bitten by frost, whereas those at higher levels are free from it. Due to inversion of temperautre, air pollutants such as dust particles and smoke do not disperse in the valley bottoms. Because of these factors, houses and farms in intermontane valleys are usually situated along the upper slopes, avoiding the cold and foggy valley bottoms. For instance, coffee growers of Brazil and apple growers and hoteliers of mountain states of Himalayas in India avoid lower slopes. Fog lowers visibility affecting vegetation and human settlements. Less rainfall due to stable conditions. Fig. 3.4: Frontal Inversion

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37 NSOU CC-GR-07 Inversion of Temperature : Brief Note:– As one moves from the equator towards the pole, steadily decreasing temperature are observed. In the same way there is a leady decrease of temperature with increasing elevation in the atmosphere. This is called vertical temperature gradient. Vertical temperature gradient are controlled partly by energy transfer and partly by vertical motion in the air. However, various factors affecting interact in a complex manner. Energy treansfer involve the latent heat of condensation, cooling of air by the process of radiation and sensible heat transfer from ground. vertical motion is closely related to the pressure systems. High pressure systems produce descending air currents which leads to warming of extensive layers of air. This results in the decrease of vertical temperature gradient. On the other hand low pressure systems give rise to assending air currents which cool by expansion. This increases vertical temperature gradient moisture is an aditional factor which creates a lot of complication in the vertical distribution of temperature. The fact that temperature in the lower layers of troposphere shows an upward decrease goes to prove that the direct source of atmospheric heat lies at the earth's surface. It is noteworthy that heating of the lower layer of air is not caused because of nearness to the earth's surface alone, but there are other factors as well. The air close to the earth's surface is denser than the upper air and contains a larger quantity of water vapour, dust particles and water droplets. On the contrary, the air in the upper strata of the atmosphere is varified, dry and there are little dust particles. Therefore because of the lesser amount of water vapour and carbondioxide the upper air does not absorb as much as heat received from terrestrial radiation as is done by the lower air. Moreover the apper air being more transparent has a low temperature. There is smaller vertical temperature gradient, if the layer of air near the surface, gets colder because it's contact with the chilled surface of the earth. On the contrary, if the surface is extreamly heated during daytime, the air wing close to it is also heated by the process heat transfer. Under these conditions the lapse rate becomes steeper. Thus, it is clear that sometimes the actual lapse rate is larger than the normal lapse rate and at times smaller than that. Thus it may be noted that the temperature variation with altitude is many times greater than the latitude variation. Continents and oceans along with harizontal distribution of temperature also influence vertical distribution of temperature. There are certain levels in the atmosphere where under certain conditions the normal condition of a decrease in temperature with increase in altitude is reversed and temperature increases with increase in altitude. Since in these conditions the cold air
38 NSOU CC-GR-07 is overlaid by warmer air, the normal lapse rate is reversed. This phenomenon is known as inversion of temperature. In the lower part of the atmosphere upto a height of 8–18 kilometer from the surface, temperature normally decrease with increasing altitude. The normal lapse rate is where with every 1 km. rise in altitude the temperature decreases at 6.5°C. But sometimes under special circumstances, it is reversed and the temperature instead of decreasing is found to increase with elevation. According to the processes that cause then and the relative heights from the earth's surface at which they develop, the temperature inversion can be classified into the following types– 1) Ground or surface inversion: a) Radiation inversion b) Advection inversion 2) Upper air inversion: a) Subsidence inversion b) Turbulence and convection inversion 3) Frontal inversion Fig. 3.5 Inversion of temperature
39 NSOU CC-GR-07 3.6 Conclusion Temperature is an important weather elements and the distribution of it varies from space and time. It depend on a large number of factors, like latitude, land and sea, altitude, relief, ocean currents, prevailing winds, vegetation cover etc. Moreover, the worldwide, the horizontal distribution of temperation varies in January and July months. Apart from that the vertical distribution of temperation is also varies according to atmospheric layers and temperature inversion occurred in the atmosphere. 3.7 Summary An isotherm is a line that connects places that have the same air temperature. Distribution of temperature can be analysed by its horizontal and vertical pattern.

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The obseved rate of vertical decrease in temperature is called vertical temperature gradient or lapse rate.			

The temperature in the troposphere decrease with height at average lapse rate of 6.5°C per kilometer. Laspe rate is zero when temperature is constant with elevation and negative when temperature increases with elevation/altitude. Under special circumtance temperature increase with altitude known as inversion of temperature. " There are surface, upper air and frontal types of temperature inversion occurred. 3.8 Key words Horizontal and vertical distribution of temperature, lapse rate, inversion of temperature 3.9 Model Questions Short Answer type: 1. What is Albedo? 2. What is Temperature inversion? 3. What is Lapse rate? Long Answer type: 1. Explain the vertical distribution of temperature. 2. Describe the horizontal temperature distribution in Jannuary and July.

40 NSOU CC-GR-07 3. State the factors that controls horizontal temperature distribution. 3.9

81%	MATCHING BLOCK 74/265	W
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Unit 4 *
Structure 4.1 Introduction 4.2 Objectives 4.3 Greenhouse effect 4.4 Importance of Ozone layer or Ozonosphere 4.5 Formation and Depletion of Ozone 4.6 Ozone depletion and its effects 4.7 Conclusion 4.8 Summary 4.9 Key words 4.10 Model Questions 4.11 References 4.1 Introduction A beam of solar radiation (short wave) passes through the glass house, easily however the long wave radiation cannot pass through the glass and warms the glass house. The solar radiation when falls on the ground and any object, the surface is heated. The long wave radiations emitted by the surfaces are captured by carbon-di-oxide, water vapour, methane and oxides of nitrogen. This process warms atmospheric air thus increased the air temperature. The atmospheric gases which cause the temperature rise are known as Greenhouse gases. Global warming is a long term rise in the average temperature of the earth's climatic system. The global warming commonly refers to the observed and continually increased in average air and ocean temperatures since 1900 caused mainly by emissions of greenhouse gases in the modern industrial economy. The effects of global warming include sea level rise, regional changes in precipitation, more frequent extreme weather events such as- heat waves and expansion of deserts. Surface temperature increases are greatest in the Arctic, with the continuing retreat of glaciers, permafrost and sea ice. Overall higher temperatures bring more rain and snowfall in some areas but droughts and wild fire in some other areas. A majority of people consider global warming a serious threat to the existence of this planet.
42 NSOU CC-GR-07 4.2 Objectives i. To know the gaseous component of the atmosphere. ii. To know the effect of greenhouse gases. iii. To know the causes of global warming due to greenhouse gases. iv. To know the effect of global warming. 4.3 Greenhouse Effect Worldwide changes in climate and sea levels caused by a warming of the atmosphere due to the realease of gases, principally carbon-di-oxide, which are transparent to shortwave radiation, but absorb radiation at certain long wavelengthes. Incoming short wave solar radiation (including visible light) and heat are absorbed at the ground surface by objects which then behave as black bodies, radiating heat (i.e., albedo radiation) back into space, certain, ‘greenhouse gases’, (e.g. carbon dioxide, water vapour and chlorofluro-carbons) absorb part of this radiation, then radiate it in all direction, some downwards and some to the side where it may encounter other molecules of these gases and continue the process. Thus the gases form a ‘blanket’ trapping outgoing heat, much as the glass or plastic does in a greenhouse, which lets through most of the incoming short wave solar energy but greatly retards the outgoing long wave earth radiation, thus surface temperature considerable higher than they otherwise would be. This is the so called ‘greenhouse effect’ of the earth’s atmosphere. Greenhouse-A greenhouse (also called a glasshouse, or, if with sufficient heating, a hothouse) is a structure with walls and roof made chiefly or transparent meterial, such as glass, in which plants requiring regulated climatic condition are grown. These structure range in size from small sheds to industrial-sized buildings. A miniature greenhouse is known as a cold frame, the interor of a greenhouse exposed to sunlight Glass Glass Earth radiation Solar radiation Earth radiation Solar radiation Figure 4.1: Greenhouse

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43 NSOU CC-GR-07 becomes significantly warmer than the external ambient temperaure, protecting its contents in cold weather. Uses– 1. Greenhouse allow for greater control over the growing environment of plants. Depending upone the technical specification of a greenhouse, key factors which may be controlled include temperature, levels of light and shade, irrigation, fertilizer application, and atmospheric humidity. 2. Greenhouses may be used to overcome shortcomings in the growing qualities of a piece of land, such as a short growing season or poor light levels, and they can thereby improve food production in marginal environments. 3. Greenhouses in hot, dry climates used specifically to provide shade are sometimes called ''Shade houses''. 4. As they may enable certain crops to be grown throughout the year, greenhouses are increasingly important in the food supply of high-latitude countries. One of the largest complexes in the world is in Ameria, Andalucia, Spain, where greenhouses cover almost 200 km 2 (49,000 acres). 5. Greenhouses are often used for growing flowers, vegetables, fruits, and transplants. Special greenhouse varieties of certain crops, such as tomatoes, are generally used for commercial production. 6. An ''alpine house'' is a specialized greenhouse used for growing alpine plants. The purpose of an alpine house it to mimic the conditions in which alpine plants grow; particularly to provide protection from wet conditions in winter. Alpine houses are often unheated, since the plants grown there are hardy, or require at most protection from hard frost in the winter. They are designed to have excellent ventilation. Greenhouse effect Mechanism: Greenhouse effect is the mechanism by which thermal radiation from earth's surface is reabsorbed by greenhouse gases and redirected in all directions. Some of the major greenhouse gases are water vapour, carbon dioxide, methane and ozone. Most of these gases are poor absorbers of solar radiation, therefore allowing much of the solar energy to pass through the earth's atmosphere thereby warming up the earth's surface. On the other hand, a proportion of the outgoing energy is absorbed by these gases, which is then redirected to earth's surface therefore further wrming up the atmosphere. This is what is called a greenhouse effect. For ages there has been a delicate balance between how much solar energy is redirected to earth and how much is reflected back to the space. With the increased burning of fossil fuels, the percentage of carbon dioxide in the atmosphere has significantly increased thereby adding to the greenhouse effect.

44 NSOU CC-GR-07 Disadvantages of Greenhouse effect : Since greenhouse gases helps to maintain the temperature, the primary effect of the increase in greenhouse gases would be on climate. This would mean warmer summers with natural disasters. Hurricanes have become common in recent years. Water level balance of the earth would be destroyed. Polar ice caps would melt leading to an increase in the ocean level. Floods will inundate low lying areas. Marine life and ecosystem would be destroyed. Oceans absord carbon dioxide thereby affecting the level of alkalinity. Many forms of marine life would be adversely affected if alkalinity increases. Polar ecosystems would be destroyed. In the Arctic, melting polar caps are threatening the habitats of polar bears and penguins. Global warming would also affect the weather pattern. Rainfall would become erratic in many parts of the world. This might eventually lead to desertification. The effect on human and economic life would also be tremendous. It is estimated that the rise in temperature would reduce global output by 2 to 3 percent. This cost would run into trilions of dollars. As agricultural production is affected, this might lead to frequent famines and famine related diseases. Overall the impact of increased greenhouse effect on climate and human life would be disastrous. The world community therefore needs to wakeup now before it is too late. Causes of the Greenhouse Effect :- 1. Burning of Fossil Fules: Fossil fules like coal, oil and natural gas have become an integral part of our life. They are used on large basis to produce electricity and for transpor ation. When they are burnt, the carbon stored inside them is released which combines with oxygen in the air to create carbon dioxide. With the increase in the population, the number of vehichles have also increased and this has resulted in increase in the pollution in the atmosphere. When these vehicles run, they release carbon dioxide, which is one the main gas responsible for increase in greenhouse effect. Apart from that, electricity-related emissions are high because we are still dependent on coal for electricity generation which releases large amount of CO 2 into the atmosphere and is still the primary source of fuel for generating electricity. Although, renewable sources are catching up, but it may take a while before we can reduce our dependance on coal for electricity generation. 2. Deforestation: Forests hold a major green area on the planet earth. Plants and trees intake carbon dioxide and release oxygen, through the process of

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45 NSOU CC-GR-07 photosynthesis, which is required by humans and animals to suvive large scale development has resulted in cutting down of tress and forests which has forced people to look for alternate places for living. When the wood is burnt, the stored carbon in converted back into carbon dioxide. 3. Increase in Population: Over the last few decades, there have been huge increase in population. Now, this has resulted in increased demand for food, cloth and shelter. New manufacturing hubs have come up cities and towns that release some harmful gases into the atmosphere which increases the greenhouse effect. Also, more people means more usage of fossil fules which in turn has aggravated the problem. 4. Farming: Nitrous oxide is one the greenhouse gas that is used in fertilizer and contributes to greenhouse effect which in turn leads to global warming. 5. Industrial Waste and Landfills: Industries which are involved in cement production, fertilizers, coal mining activities, oil extraction produce harmful greenhouse gases. Also, landfills filled with garbage produce carbon dioxide and methane gas contributing significantly to greenhouse effect. Greenhouse Gases Water Vapour - It is the most abundantly found greenhouse gas constituting around 36–70% of all the gases contributing to greenhouse effect. Increase in temperature results in a relatively high presence of water vapour in the atmosphere. Carbon Dioxide - Although this gas is present in a small amount naturally, urbanization, industrial revolution, and other human activities have largely contributed to the levels of carbon dioxide present in the atmosphere today. It roughly amounts to 9–26%. Methane - Atmospheric methane is present as a result of both natural and anthropogenic sources. While manure of domestic livestock is one of the major natural contributors, landfills is the prime example of anthropogenic sources. Methane contributes 4–9% to the greenhouse effect. Nitrous Oxide - This gas is produced by agricultural activities, landfills and burning of fossil fuels. Chlorofluorocarbons (CFCs) CFCs have an entirely anthropogenic origin, primarily industries. Until recently, they were also used in refrigerators, aerosols, fire extinguishers and air conditioners. As mentioned previously, greenhouse effect is a natural phenomenon. However, if the percentage of these gases increases to dangerously high levels, the repercussions are for everyone to see.

46 NSOU CC-GR-07 How to Prevent Greenhouse Effects : Greenhouse Gases According to the U.S. Environmental Protection Agency, or EPA, carbon dioxide makes up more than 80% of the greenhouse gas emissions in the country. Methane, nitrous oxide and fluorinate gases also have the ability to trap heat in the earth's atmosphere and create the greenhouse effect. Most of these gases enter the atmosphere when fossil fuels, like coal, oil and natural gas are burned. Paying close attention to energy use is an excellent way to help prevent the greenhouse effect. Conserve Energy Almost half of the greenhouse gas emissions in the U.S. are the result of electricity production and other industrial process that rely on the burning of fossil fuels, according to the EPA. To help prevent the greenhouse effect caused by these emissions, take steps to conserve energy. Turn off lights when you leave the room. Buy a programmable thermostat, and wear a sweater instead of turning up the heat, replace incandescent light bulbs with CFLs, and buy appliances with the EPA's energy star label. Walk or Ride a Bike According to the EPA, the transportation sector accounts for nearly 30% of greenhouse gas emissions, so if you have to drive to work, try car pooling with coworkers. Using public transportation, walking or riding a bike whenever possible will also help prevent the greenhouse effect. Buying locally made products reduces the distance that products need to be shipped to reach consumers, thereby reducing the greenhouse gas emissions caused by freight transportation. Hybrid cars also emit less greenhouse gases and consume less gasoline. Plant a Tree Trees and plants store carbon dioxide; during the process of photosynthesis, plants absorb carbon dioxide from the air, convert it to sugar for growth, and release oxygen back into the atmosphere. Planting a tree means another plant is absorbing carbon dioxide from the atmosphere and preventing the greenhouse effect. Deforestation releases stored carbon back into the atmosphere, so using wood and paper products sparingly will also help prevent the greenhouse effect by reducing the release of greenhouse gases. A Global Issue Everyone is affected by the greenhouse effect. Local changes are unlikely to prevent this global problem. United Nations climate scientists have set an upper limit for the amount of carbon dioxide that can be emitted before the greenhouse effect is irreversible. Unless all countries particlpate in plant to reduce carbon emissions and deforestation, this limit will be exceeded in a matter of decades. Individual, lifestyle changes are a

47 NSOU CC-GR-07 good first step towards preventing the greenhouse effect, but this goal will not be achieved without large-scale changes in industrial practices. Effects of increased greenhouse gas emissions : The main effect of increased greenhouse gas emissions is global warming. Carbon dioxide, methane, nitrous oxide and fluorinated gases all help trap heat in the Earth's atmosphere as a part of the greenhouse effect. The Earth's natural greenhouse effect makes life as we know it possible. However, human activities, primarily the burning of fossil fuels and deforestation, have intensified the greenhouse effect, causing global warming. Effects of increased greenhouse gas emissions Increases in the different greenhouse gases have other effects apart from global warming including ocean acidification, smog pollution, ozone depletion as well as changes to plant growth and nutrition levels. Global warming Greenhouse gas levels have been increasing since the start of the Industrial Revolution, but over the last few decades growth has been particularly fast. Total greenhouse gas emissions have increased by about 80% since 1970, creating a radiative forcing of 2838 mW/m∧2 equivalent to an atmospheric concentration of 473 ppm CO 2 . With increasing levels of greenhouse gases being added daily, the greenhouse effect is now enhanced to the point where too much heat is being kept in the Earth's atmosphere. The heat trapped by carbon dioxide and other greenhouse gases has increased surface temperatures by 0.75°C (1.4°F) over the last 100 years. Global warming is harming the environment in several ways including: Desertification Increased melting of snow and ice Sea level rise Stronger storms and extreme events * Increases in carbon dioxide levels have made the world's oceans 30% more acidic since the Industrial Revolution. The ocean serves as a sink for this gas and absorbs about a quarter of human carbon dioxide emissions, which then goes on to react with seawater to form carbonic acid. So as the level of carbon dioxide in the atmosphere rises, the acidification of the oceans increases.
48 NSOU CC-GR-07 Changes to plant growth and nutrition levels Since plants need carbon dioxide to grow, if there are higher amounts in the air, plant growth can increase. Experiments where carbon dioxide concentrations were raised by around 50% increased crop growth by around 15%. Higher levels of carbon dioxide makes carbon more available, but plants also need other nutrients like nitrogen, phosphorus etc. to grow and survive. Without increases in those nutrients as well, the nutritional quality of many plants will decrease. In different in different experiments with elevated carbon dioxide levels, protein concentrations in wheat, rice, barley, and potato tubers, decreased by 5–14%. Smog and ozone pollution Over the last century, global background ozone concentrations have become two times larger due mainly to increases in methane and nitrogen oxides caused by human emissions. At ground level, ozone is an airpollutant is a major component of smog which is dangerous for both humans and plants. Long-term ozone exposure has also been shown to reduce life expectancy. 362000- 700000 of annual premature cardiopulmonary deaths worldwide are attributable to ozone. Recent studies estimate that the global yields of key staple crops, like soybean, maize (corn), and wheat, are being reduced by 2–15% due to present-day ozone exposure. Ozone layer depletion Nitrous oxide damages the ozone layer and is now the most important ozone depleting substance and the largest cause of ozone layer depletion. This is because CFCs and many other gases that are harmful for the ozone layer were banned by the Montreal Protocol (MP) which has reduced their atmospheric concentration. Nitrous oxide is not restricted by the MP, so while the levels of other ozone depleting substances are declining, nitrous oxide levels are continuing to grow. The Greenhouse Effect and Global Warming:- How the Greenhouse Effect Works– Carbon dioxide (CO 2) is an atmospheric constituent that plays several vital roles in the environment. It absorbs infrared radiation in the atmosphere. It plays a crucial role in the weathering of rocks. It is the raw material for photosynthesis and its carbon is incorporated into organic matter in the biosphere and may eventually be stored in the Earth as fossil fuels. Most of the sun's energy that falls on the Earth's surface is in the visible light portion of the electromagnetic spectrum. This is in large part because the Earth's atmosphere is transparent to these wavelengths (we all know that with a functioning

49 NSOU CC-GR-07 ozone layer, the higher frequencies like ultraviolet are mostly screened out). Part of the sunlight is reflected back into space, depending on the albedo or reflectivity of the surface. Part of the sunlight is absorbed by the Earth and held as thermal energy. This heat is then re-radiated in the form of longer wavelength infrared radiation. While the dominant gases of the atmosphere (nitrogen and oxygen) are transparent to infrared, the so-called greenhouse gasses, primarily water vapour (H 2 O), CO 2 , and methane (CH 4), absorb some of the infrared radiation. They collect this heat energy and hold it in the atmosphere, delaying its passage back out of the atmosphere. Due in part to the warming effects of the greenhouse gases, the global average temperature is about 15°T (59°F). Without the greenhouse gases the global average temperature would be much colder, about -18°C (0°F). Greenhouse Gas Induced Global Warming Since the industrial revolution got into full swing in the 19th century we have been burning ever increasing amounts of fossil fuels (coal, oil, gasoline, natural gas) in electric generating plants, manufacturing plants, trains, automobiles, airplanes, etc. Burning releases CO 2 into the atmosphere (much the same as respiration does). These fossil fuels may have formed tens or hundreds of millions of years ago from the buried and preserved remains of plant and animal matter whose carbon originated via photosynthesis. Photosynthesis and respiration in animal, fungi, bacteria, etc. exchange carbon between the CO 2 in the atmosphere and carbon compounds in organisms. But humans are now putting this natural carbon cycle out of balance. Because of the emission of CO 2 long-stored in fossil fuels the percentage of CO 2 in the atmosphere has increased from about 289 parts per million before the industrial revolution to over 360 parts per million and rising. Sometime during the 21st century the concentration of CO 2 will be twice what it was before the industrial revolution. Photosynthesis-Respiration-Combustion photoshynthesis CO 2 + H 2 O + sunlight-< CH 2 O + O 2 respiration O 2 + CH 2 O -< energy + H 2 O + CO 2 combuston O 2 + Hydrocarbons Energy -< + H 2 O + CO 2

50 NSOU CC-GR-07 With higher CO 2 concentrations come expectations of a stronger greenhouse effect and therefore warmer global temperatures. This was originally proposed by a chemist named Arrhenius about a century ago. Global average temperatures have risen by a small, but measurable amount in the past 100 years, apparently in large part because of the higher level of atmospheric CO 2 . Global average temperatures are expected to be on the order of 2–5°C (3.6-9°F) higher by the time Co 2 doubles the pre-industrial concentration. The temperature rise will be small in the tropics but much greater at high latitudes. Consequences of Global Warming Temperature measurements of the sea surface and deep ocean indicate that the oceans are warming. Rising ocean temperature causes rising sea level from thermal expansion of the water. Rising temperature also means melting glaciers and rising sea level through addition of meltwater to the oceans. Sea level rose about 1 foot during the last century, mostly from thermal expansion of the oceans. Sea level is expected to rise closer to 3 feet during the coming century. Rising sea level will cause increasing coastal erosion, flooding, and property damage during coastal storms on top of the potential for major loss of life from storms in low-lying coastal countries like Bangladesh and Island nations in the Indian and Pacific Oceans. Warmer sea surface temperatures will result in more and stronger tropical storms (hurricanes and typhoons). Coastlines already ravaged by these storms will expect to see more strong storms than before, increasing the loss of life and damage to infrastructure. It is much more difficult to predict how regional and local weather patterns will change but there will certainly be changes. While higher temperatures will produce more rainfall across the globe, the regional rainfall patterns will likely change. Some areas will get more, some areas will get less. The timing of wet and dry periods may change. But higher temperatures will also mean more evaporation. Higher temperatures may also mean stronger storms with damaging winds. All of these mean new risks and changing conditions for agriculture. Centuries old farming practices will have to change. Some areas may go from being marginal to becoming a breadbasket region, while other regions may go from major agricultural production to marginal. Higher CO 2 allows plants to grow faster (more CO 2 enhances photosynthesis). That would sound good for agriculture. However, weed species tend to grow even better than crop plants under erihanced CO 2 conditions so improved crop growth may be nullified by weed competition. Natural ecosystems will be hard pressed to keep up with the changing climate because the rate of change will be faster than typical long-term natural climate change.

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51 NSOU CC-GR-07 Many species, especially plant species, will not be able to migrate to cooler areas fast enough to keep up with the warming of their habitats. And arctic species will have no place to go and may not be able to adapt to the new conditions. Severe summer heat in areas not used to it can lead to deaths. Higher heat and expansion of tropical areas may lead to increased incidence of malaria. What Can We Do About Global Warming :– We can't realistically stop the rise of CO 2 in the near term, but we can slow it and therefore, reduce the consequences that will occur. More fuel-efficient cars, less frivolous driving, more use of mass transit, improved insulation to decrease the fuel burned to heat and cool our homes, more efficient appliances, use of fluorescent rather than incandescent light bulbs, and careful monitoring of home electricity usage (turn off the lights and TV when not using them) can reduce our energy needs. Conversion to alternatives like wind and solar power which don't burn fossil fuels and emit CO 2 into the atmosphere. Planting large areas with trees will consume CO 2 as the trees grow, until the forests mature. Stopping deforestation in the tropical forests around the world, especially in the Amazon and Indonesian rain forests, will keep that carbon in the forest rather than sending it back into the atmosphere as the trees are burned or decay and are not replaced by more. Other techniques have also been proposed such as the chemical removal of CO 2 from smokestacks and burial in deep underground reservoirs, though only certain areas can benefit from this, or disposal in the deep ocean where they will form a semi-stable compound under the cold temperatures and high pressures, though the CO 2 could too easily come bubbling back up. These latter solutions are not well studied and wouldn't be especially cheap. Moreover, leaders, societies, communities, local planners, farmers, health organizations, need to recognize the changing climate and rising sea level as they make plans for the future. Our citizens need to be educated as to likely changes and how best to deal with the changing conditions. Evidence of Global Warming: 1. Breaking up of Antartica ice sheet in 1995, 1998 and 1999. 2. Melting of Earth moutain glaciers, Eg. Mt Kenya and Alps in Eurpoe. 3. Rise of Sea level in 1961 to 2003 (the rate of increase is 1.8 mm per annum) 4. Thicking of Arctic ice and retreat. 5. During 1900–2005, precipitation has increase significantly in North and South America, North Europe and decrease in mediterranean region and some other parts of the world.

52 NSOU CC-GR-07 4.4 Importance of Ozone Layer or Ozonosphere Ozone Layer/ Ozonosphere:

72% MATCHING BLOCK 75/265 W

There is a maxium concentration of ozone between 30 to 60 km. above the surface of the earth. Becasue of the concentration of ozone in this layer it is called ozonosphere. It's existance come to be known from the studies of meteors.

Importance: (A)

84% MATCHING BLOCK 76/265 W

There is a general agreement among the scientists that this warm layer is deu mainly to selective absorption of ultravioeet radiation by ozone. (

B)

78% MATCHING BLOCK 77/265 W

In fact, the ozone layer acts as a filter for the ultraviolet rays of the sun. (C) According to scientists, the presence of ozone layer in atmosphere is a boon to humanity as it protects us from sunburn by absorbing larger percentage of the ultraviolet radiation. (D) The environmentalists are much concend that the emission of nitrogen oxide by large number of supersonic transport airplanes may lead to a deterioration of the ozone layer are also to a serious biological damage to people, animals and plants life. (E) In this layer the temperature increases with height at the rate of 5°c/km. The maximum temperature recorded in the ozonosphere is some what higher than that at the earth's surface. (F) It may be noted that because of the prepond erance of chemical processes, this sphere is sometimes called 'chemosphere'. (

G) The ozone layer plays a vital role on the earth's environment. Ozone is a form of oxygen which consists of three molecules. This ozone is formed in the ozonosphere just above the troposphere. (H) Ozone is much more susceptible or weaker, it breaks and thus returns to it's oxygen form. It is found at 16–18 km at the polar latitude and upto 25 km at the equator. (I) This ozone helps to keep the temperature of the earth's surface at a certain level as it absorbs the ultraviolet radiation from the sun. (J) Hence the importance of this ozone layer autometically increases. This ozones are constantly being created and destroyed through natural chemical reaction. (K) Oxides of nitrogen, hydrogen, bromide, chlorine etc are accelerating in the nature and destroying the ozone that are being created certain substance such as chloro-fluro-carbon (CFCs) and carbon tetra chloride (CCL) are harmful for ozone. This distruction of ozone layer is very harmful for mankind.

53 NSOU CC-GR-07 Ozone hole: 'British Antarctica Survey' found that there has been a 'ozone hole' created in the stratosphere. This ozone hole will have many considerable effects on the earth's environment. Such as– i) The temperature of the earth's surface will increase steeply and as a result it will lead to more extinction of living being. ii) Due to breakege, of ozone, the increasing temperature will lead to melting of glaciers. iii) Due to melting of glaciers, floods will be created in large number of areas across the world. iv) This uprising sea level which will result due to metting of glaciers will lead to submergence of the lands. Thus it is evident that breakage of ozones will land to extinction of life from the earth's surface. This decomposition takes place under conditions of ultraviolet radiation into free chlorine atoms, which can react with ozone breaknig it down into ordinary oxygen and chlorine. Cl + O 3 →→→→→→ * 2 Cholorine Ozone Chlorine monolide Oxygen The simplified reactions are O 3 + O * * * * * *
* * * * * * * * * * * * ! ! " # $ % ! & ! & ! ! ! # We know that in order to survive, mankind and other living beings has to depand on the ozone layer. So, human being has to be aware of the possible results due to the breakage of ozone and should take sufficient measures to stop this ozone depletion which will destroy life on earth. Hence we can understand how important this ozone layer is to mankind and other living organisms on the earth. 4.5 Fomation and Depletion: Ozone (O 3) Layer Introduction–The Ozone layer or Ozone shield is a region of Earth's stratosphere that absorbs most of the sun's ultraviolet radiation. It contains high concentration of ozone (O 3) in relation to other part of atmosphere. This layer is mainly found in

54 NSOU CC-GR-07 lower stratosphre. This layer was discovered in 1913 by french physicist Charles Fabry and Henri Buisson. Role of Ozone Layer– 1. The absorption of ultra-violet radiation by ozone creates a source of heat. Thus it play a key role in temperature structure of earth's atmosphere. 2. The filtering action don't allow Sun's UV radiation to penetrate the atmosphere and reach earth surface. 3. If there is no ozone layer than sun UV radition cause harmful effect to crop, forest growth and human health. 4. It play an important role in preventing ice shifting. 5. It protect the environment and ecosystem of the earth. Ozone hole–Excessive thinning of ozone layer when more than half of the ozone gas in a particular area is depleted and harmful ultraviolet rays can pass through it and reach earth surface, is called ozone hole. Some parts of Antarctica upto 60% of the total ozone is depleted during Antarctic spring (September to November). O 3 – Under the influence of ultraviolet rays of sun, oxygen (O 2) of the atmosphere decempose to Oxygen atoms (O) and one oxygen molecule combinees chemical with an oxygen atom to form ozone molecule of three oxygen atoms. (i) one oxygen molecule (O 2) → two oxygen atom (O+O) (ii) one oxygen molecule (O 2) + one oxygen atom (O) = one molecule of ozone (O 3) * 1. * * * * –This is are formed by chlorine, fluorine and carbonfare used in refrigerator, soluents and for manufacturer of spongy plastic. The most common are CFC 11, CFC 12, CFC 113, CFC 114 and CFC 115. The chemicals caused a reaction which made the ozone layer break down into Oxygen molecule and atom. 2. * * * * This are used as substitutes for CFCs as many of their properties are similar and are less harmful to ozone. They realese fewer Clorin atom. But their use has been banned in developed countries since 1930. 3. They are compound formed by Br, F and C. Because of their ability to pur out fires, and are used in fire extinguishers. Their ability to harmful ozone layer is very high because they contain Br. Thus halon 1301 and halon 1211 have ozone deplation potentials of 13 and 14 respectively.

55 NSOU CC-GR-07 4. * 3 Br) It is very effective pesticide that is used to fumigate soils and in many crop production. The Br damages the ozone layer. 5. * ! * ** 4)–It is widely used as a raw material in many industires for manufacture CFCs and as solvent. 6. " * It is also affected by natural phenomena such as sun-spots and stratosphare wind but this cause not more than 1–2% depletion of ozene layer. # $ % 1. # $ (i) &' * $ –The most common type of skin cancer called non-melanoma cause by exposures to UV-B radiation for several year. (ii) ! –The exposure to ultraviolet light reduces the effectiveness of the immune system. The exposure to UV-B radiation reduce the of immune system to tolerate diseases. (iii) It also cause sunburn, quick aging and catared problem. 2. # $ () $ $ The loss of phytoplanktan, the basis of the marine food chain has been observed as the cause of the increase ultravioled radiation which can disrupted the marine food chain. 3. # $ $ (i) (UV-B radiation casue skin cancer which has been seen in goat, cow, cat, dog. Infection in cattle can be increase by increases of ultraviolet radiation. (ii) * –UV-B radiation affect and damage the word plant growth and reduce resproduction capacity of plants. 4. + $ $ Material like plastic, wood, fabrics, rubber are degraded too much by ultraviolet ray. 5. # $, $ $ $ $ It increase greenhouse gases in biosphere Eg. carbondioxide, carbon monoxide etc. & 1. * $ Pesticides are great chemicals to rid your form of pests and weeds but may cause ozone layer depletion. Farmer should use alternative ecofriendly chemicals. 2. $, - , - - $ $ To minimize ozone depletion we should limit the number of vehicles on the road. As this vehicles emit lot of green house gases and smog.

56 NSOU CC-GR-07 3. . $ $, $ Usage of eco-freindly and natural clearing products to prevent ozone layer depletion. So we should use toxic free products. 4. * / Government must take action to reduce the use of nitrous oxide to reduce ozone depletion. 5. 0 , $' $ –A lot of rocket launches happening in the world over without consideration about its damages to ozone layer. A study shows the harm caused by rocket lunches due to CFCs. 4.6 Ozone Hole Formation and its Effects Introduction: Ozone, is an inorganic molecule with the chemical formals O 3 . It is a pale blue gass with a distinctively pungent smell. Ozone is formed from dioxygen by the action of ultraviolet light and also atmospheric electrical discharges and is present in very low concentrations throughout the Earth’s atmosphere. Its concentration is highest in the ozone layer region of the atmosphere, which absorbs most of the Sun’s ultraviolent (uv) radiation. Ozone Depletion: There are many situation, where human activities have significant effects on the environment. Ozone layer damage is one of them. The CFC and the holons are patent ozone depletors. One of the main reason of the widespread concern about depletion of the ozone layer is the anticipated increase in the amounts of ultraviolet radiation received at the surface of the earth and the effect of this on human health and on the environment. The ozone layer is a layer in Earth’s it atmosphere, which contains relatively high concentrations of ozone (O 3). This layer absorbs 93-99% of UV light here. Without ozone, life on earth would not have evolved in the way it has. Ozone Hole: This term applied to regions, where stratosphere ozone depletion is so severe that it fall below 200 dobson unis (D.U.). Normal ozone concentration is about 300 to 350 D.U. Such ozone loss now occurs every spring time above Antartica and Arctic region.

57 NSOU CC-GR-07 Measuring Ozone Depletion: The most common stratospheric ozone measurement unit in the Dobson Unit (D.U.), named after GMB Dobson. D.U. are measured by how thick the layer of ozone would be if it were compressed in a layer of 0°C and with a pressure of one atmosphere above it. The average amount of ozone in the stratosphere across the globe is about 300 D.U. Causes of ozone depletion: (1) Ozone is a triatomic form of oxygen (O 3). A combination of low temperature. elevated chlorine and bromine concentrations in the upper stratosphere is responsible for the distruction of ozone. The Fig. 4.2: Winter conditions related to ozone formation and destruction

58 NSOU CC-GR-07 production and emission of CFCs is the leading cause of ozone layer depletion. CFC's account for almost 80% of the total deplection. (2) Other ozone-depleting substances (ODS)– include HCFCs and volatile organic compounds (VOCs). ODS are relatively stable in the lower atmosphere of earth, but in the stratosphere they are exposed to UV ray and thus they break down to release a free chlorine atom. (3) Chlorine Monoxide (ClO)– It is free chlorine atom reacts with an ozone molecule (O 3), and forms chlorine monoxide, and a molecule of oxygen. Now ClO reacts with an O 3 and form a chlorinc and 2 oxygen atoms. The free cl malecule again reacts with O 3 to form ClO. This process continues and results in the depletion of the ozone layer. Effects of Ozone layer Deplition: Effect on human and animal health— UV-B ray is likely to have profound impact on human health with potential risk of eye discases, skin cancer and infection diseases. UV ray is konwn to damage the cornea and lens of the eye. UV-B ray can affect the immune system causing a number of infections diseases. Effects of Aquatic Ecosystems— Increase levels of UV exposure can have advanse impact on the productivity of aquoatic systems. High levels of exposure in tropics and sub-tropics may affect the distribution of phytoplanktons which form the foundation of aquotic food webs. UV-B can also damage to early development stages of fish shrimp, crab. and other animals. The most severe effect being decreased reproduction capacity. Effect on Air Quality– This can increase both production and destruction of ozone and related oxidants such as hydrogen peroxide, which are known to have adverge effects on human health, terrestrial plants and outdoor materials. Effects on Climate Change— Ozone depletion is not a major cause of climate change. radiation Sabar Stratosphere Ozone layer Troposphere CFCs. HCFCs Fig. 4.3: Ozone depletion Sun

59 NSOU CC-GR-07 O 3 absorbs solar UV rays, which heats the stratosphere. Therefore, the climatic impact of changes in ozone concentration varies with the altitude at which these ozone changes occur. Effects on Materials— UV-B ray acclerates the photo degradation rates of these materials, thus limiting their lifetimes. Typical damages range from discolaration to loss of mechanical integrity. Such a situation would eventually demand substitution of the affected materials by more photo stable plastics and other materials in future. International Actions— Australian Chlorofluorocarbon Management Strategy provides a framework for the responsible management and use of CFCs in Australia. Environmental Protection Policy (2000) aims to minimise the discharge of ozone-depleting substances into the environment and has been extended to cover use of altarnative refrigerants. United Nation Environment Programme has published several assessments of the environmental effects of ozone depletion. Ultraviolet Index Forecast is designed to help people to minimise their exposure to dangerous levels of UV ray. It is a model to predict the amount of UV exposure. 4.7 Conclusion The concept of greenhouse, greenhouse effect, global warming and climate change is known to all and a interesting matter of research. The facts an figures related to this phenomena is going beyond to the matter of climatologist, meteorologist. The major greenhouse gases are carbon-di-oxide, water vapour, methane and ozone. The greenhouse gases caused global warming, which intended to climate change. 4.8 Summary The atmosphere contains several gases - nitrogen, oxygen, carbon-di-oxide, methane etc. The atmospheric gases which cause the temperature rise are known as Greenhouse gases.

60 NSOU CC-GR-07 The greenhouse gases caused global warming. The effects of global warming include sea level rise, regional changes in precipitation, more frequent extreme weather events such as- heat waves and expansion of deserts. Surface temperature increases are greatest in the Arctic, with the continuing retreat of glaciers, permafrost and sea ice. 4.8 Key words Greenhouse effect, greenhouse gases, global warming, climate change 4.10 Model Questions Short answer type: 1. Name the major greenhouse gases. 2. Write down the concentration of nitrogen and oxygen in the atmosphere. 3. Define greenhouse gases. 4. What do you mean by global warming? 5. Write the percentage of different greenhouse gases. 6. What is ozone hole? Long answer type: 1. What are greenhouse gases? 2. How does the greenhouse gas affect global warming? 3. Describe the causes and consequences of Green House Effect. 4. Explain the formation and depletion of Ozone in atmosphere. 4.11

81%	MATCHING BLOCK 78/265	W
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61 NSOU CC-GR-07 change, Climate change 1995. Lal, D.S, (2016): Climatology, 'harada Publishing House, Allahabad, ISBN: 81- 8620-4-26-1 Oreskes, N, (2004): The scientific consequences of climate change, Science 306 (5702), 1686-1686 Robinson, PJ, Sellers A.H (1987): Contemporary Climatology, Longman Scientific and Technical, England, ISBN: 0 582 02700 4 Singh, S (2015): Climatology, Trayag Pustak Bhawan, Allahabad.
MODULE-2 ATMOSPHERIC PHENOMENA AND CLIMATIC CLASSIFICATION
Module 2 : Atmospheric phenomena and climatic classification Learning Objectives: The objectives of the module: 1. Indentification of the condensation process. 2. Explation of the mechanism of precipitation. 3. Tracing the origin and characteristics of air mass. 4. Indentification of the fronts. 5. Explation of the stability and instability of atmosphere. 6. Analyses of the atmospheric circulation, planetary winds. 7. Explation of the formation and features of Jet Stream. 8. Analyses of the monsoon circulation and mechanism with special reference to India. 9. Indentification of tropical and temperate cyclone. 10. Analyses of the climatic classification of Koppen and Thornthwaite.
Unit 1
Condensation: Process and forms. Mechanism of Precipitation: Bergeron Findeisen theory, Collision and Coalescence Theory. Forms of precipitation
Structure 1.1 Introduction 1.2 Objectives 1.3 Condensation 1.4 Precipitation-Types and Forms 1.5 Mechanism of Precipitation 1.6 Conclusion 1.7 Summary 1.8 Key words 1.9 Model Questions 1.10 References 1.3 Introduction

94%	MATCHING BLOCK 81/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

The transformation of water vapour into water is called condensation. Condensation is caused by the loss of heat (latent heat of condensation, opposite to latent heat of

vaporization). It helps to generate precipitation. Precipitation has been difined as water in liquid or solid forms falling to the earth. Precipitation includes all form of water particles that fall to the ground. 1.3 Objectives i. To know the process of condensation. ii. To know the different forms of condensation. iii. To know the classification of clouds. iv. To know the types of precipitation. v. To know the forms of precipitation. vi. To know the theories of formation of precipitation.
66 NSOU CC-GR-07 1.3

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Condensation The transformation of water vapour into water is called condensation. Condensation is caused by the loss of heat (

latent heat of condensation, opposite to latent heat

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of vaporization). When moist air is cooled, it may reach a level when its capcity to hold water vapour ceases.

Saturation Point = 100% Relative humidity = Dew Point reached). Then, the excess water vapour condenses into liquid form. It
if directly condenses into solid form, it is knows as sublimation.

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In free air, condensation results from cooling around very small particles termed as hygroscopic condensation nuclei. Particles of dust, smoke, pollen and salt from the ocean are particularly good nuclei because they absorb water. Condensation also takes place when the moist air comes in contact with some colder object and it may also take place when the temperature is close to the dew point. Condensation, therefore, depends upon the amount of cooling and the relative humidity of the air.

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Condensation takes place: 1. When the temperature of the air is reduced to
dew point with its volume remaining constant (adiabatically). 2. When both the volume and the temperature and reduced. 3. When moisture is added to the air through evaporation.

82%	MATCHING BLOCK 83/265	W	

After condensation, the water vapour or the moisture in the atmosphere takes one of the followings forms—

dew, frost, fog and clouds. Condensation takes

76%	MATCHING BLOCK 86/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

place when the dew point is lower than the freezing point as well as higher than the freezing point.

Fig. 1.1 : Process of Condensation
67 NSOU CC-GR-07 Processes of Cooling for Producing Condensation These processes can be studied unter the headings, adiabatic and non-adiabatic. Adiabatic Temperature Changes occur in the following situations:-

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When the air rises, it expands. Thus, heat available per unit volume is reduced and, therefore, the temperautre is also reduced. Such a temperature change which does not involve any subtraction of heat, and cooling of air takes place only by ascent and expansion, is termed 'adiabtic change'. The vertical displacement of the air is the major cause of adiabatic and katabatic (cold, dense air flowing down a slope) temperture changes. Near the earth's surface, most processes of change are non-adiabatic because horizontal movements often produce mixing of air and modify its characteristics. Non-Adiabatic Temperature Changes

occur in the folowing conditions:–

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Non-adiabatic processes include cooling by radiaton, conduction or mixing with colder air. The air may be cooled due to loss of heat by radiation.

95%	MATCHING BLOCK 89/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

In case there is direct radiation from moist air, the cooling produces fog or clouds, subject to presence of hygroscopic unclei in the air. Cooling by contact with a cold surface produces dew, frost or fog depending on other atmospheric conditions.

But the effect of cooling produced by radiation, conduction and mixing is confined to a thin layer of the atmosphere.

100%	MATCHING BLOCK 90/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

The non-adiabatic processes of cooling produce only dew, fog or frost. They are incapable of producing a substantial amount of precipitation. (1)

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Adiabatic processes: 1. Cooling by expansion is far more important than any other process so far as condensation in free air is concerned. This type of cooling is due to lifting of the air. Since an ascending air mass undergoes ever decreasing pressure exerted on it, it expands and cools. 2. Such temperature changes are brought about without any heating added to or subtracted from the rising air. These temperature changes are, therefore, called adiabatic. Unsaturated air cools at the dry adiabatic rate of 10°C per km. 3. However, after passing beyond the condensation level, the latent heat of condensation lowers the rate of cooling. This modified rate of cooling is called the wet or moist adiabatic rate. 4. The average rate of this cooling is about 6°C per km, but the actual values vary with pressure. Adiabatic cooling may be accomplished due to convection, convergence of different air masses as along the fronts, or orographic uplifting.
68 NSOU CC-GR-07 (2)

91%	MATCHING BLOCK 91/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

Non-adiabatic processes: 1. Non-adiabatic processes include cooling by radiation, conduction or mixing with colder air. The air may be cooled due to loss of heat by radiation.

In case there is direct radiation from the moist air, the cooling produces fog or clouds provided hygroscopic nuclei are present in the air. 2. Cooling may also be produced by conduction or advection of warm air across a cold surface.

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Cooling by contact with a cold surface produces dew, frost or fog depending on other atmospheric conditions.

Sometimes the air is cooled due to its mixing with colder air. 3. It is noteworthy that the effect of cooling produced by radiation, conduction and mixing is confined to a thin layer of the atmosphere.

100%	MATCHING BLOCK 93/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

The non-adiabatic processes of cooling produce only dew, fog or frost. They are incapable of producing a substantial amount of precipitation. 4.

The only process capable of reducing the temperauture of deep and extensive air masses, so that cloud formation and appreciable precipitation may be possible, is the expansion associated with rising air currents or the adiabatic cooling. Types of Condensation: Different forms of condensation near the ground are: * Dew is formed directly by condensation near the ground, when the surface has been cooled by outgoing radiation. Dew formation mainly occurs when the nights are clear and wind is calm. Generally dew forms on the grass, on leaves of the plants and any other solid object near the ground surface. (i) Radiational cooling during night, (ii) Calm condition/light winds, (iii) Clear sky, cool and long nights, (iv) Sufficient availability of water vapours, (v) Anticyclone wind, (vi) Cold advection. (i) Cloudy sky, (ii) Strong surface winds, (iii) Presence of cyclonic circulation, (iv) Warm advection.

69 NSOU CC-GR-07 II. Fog: Fog results from the condensation of atmospheric water vapours into water droplets that remain suspended in the air in sufficient concentrations to reduce the surface visibility. Fog is simply a cloud layer very close to the surface. It is a major hazard in the industrial area. It is very common during winter. It is also very common near coastal areas. Conditions Favourable for Fog: 1. Excessive moisture, 2. Calm/light winds, 3. Anti-cyclonic winds, and 4. Relative humidity should be greater than 75 per cent. Types of Fog: (1) Evaporation Fog: Evaporation fog is caused by cold air passing over warmer water or moist land. It often causes freezing fog, when some of the relatively warm water evaporates into low air layers, it warms the air causing it to rise and mix with the cooler air that has passed over the surface. The warm, moist air cools as it mixes with the colder air, allowing condensation and fog to occur. Evaporation fog can be one of the most localised forms of fog. It can happen when: Cold air moves over heated outdoor swimming pools or hot tubs, where steam fog easily forms. Cold fronts or cool air masses move over warm seas. This often occurs in autumn when sea temperature are still relatively warm after the summer, but the air is already starting to cool. (a) Frontal fog: When warm rain falls through cold air, fog or stratus clouds form at the frontal surface due to super saturation caused by evaporation from warm rain into cold air. (b) Steam fog: It is an unstable type of fog produced by intense evaporation from water surface into relatively cold air. Steam fog is found in the middle latitudes in the vicinity of lakes and rivers in autumn when water surfaces are still warm and air is cold. (2) Cooling Fog: (a) Advection fog: Advection fog is produced by the transport of warm moist air over a colder surface, resulting in the cooling of the surface layers below their dew points, with condensation taking place in the form of fog. It can also be produced, if the cold air mass moves across warm sea surface.
70 NSOU CC-GR-07

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Advection fog occurs when moist air passes over a cool surface and is cooled.

A common example of this is when a warm front passes over an area with snow cover. It is also common at sea when moist tropical air moves over cooler waters. If the wind blows in the right direction then sea fog can become transported over coastal land areas. (b) Radiation fog: Radiation fog or ground fog is produced when stagnant moist air is in contact with ground that has become progressively cooler during the night because of an excessive outgoing radiation. Radiation fog usually occurs in the winter, aided by clear skies and calm conditions. The cooling of land overnight by thermal radiation cools the air close to the surface. The reduces the ability of the air to hold moisture, allowing condensation and fog to occur. Radiation fogs usually dissipate soon after sunrise as the ground warms. An exception to this can be in high elevation areas where the sun has little influence in heating the surface. (c) Inversion fog: It is the name given to any type of fog or stratus cloud that initially develops at the top of a moist layer, accompanied by subsidence above the inversion, intensifies the latter and produces the stratus cloud that may build down to the ground as fog. (d) Upslope fog: Upslope fog is a stable type fog resulting from the gradual orographic uplifting of convectively stable air. The air cools adiabatically and the fog begins to form when it reaches an elevation where the air has cooled to saturation. III. Frost: It is not the frozen dew. Frost occurs when dew point of the air falls below freezing point (0°C). When condensation starts with temperature below 0°C, the water vapours in the air pass directly from gaseous to solid state (sublimation). Frost may be light or havey. When the frost is heavy, crops are damaged. It is also called killing frost. Frosty nights are more common during winter season in north-west India. The crops, which are sensitive to low temperature injury, suffer a great damage. a. Radiation frost: It occurs on calm, clear nights when terrestrial radiation is lost to the space. The absence of clouds and heavy concentration of water vapours leads to the formation of radiation frost. b. Advection frost: It occurs in those areas where cold air is advected from colder areas by stronger winds. Advective frost or wind frost can occur on any time of the day or night irrespective of the sky conditions. In some cases, the advective frost may be intensified by radiation frost.

71 NSOU CC-GR-07 c. Hoar frost or white frost: It is caused by the sublimation of ice crystals on objects such as tree branches, wires etc. These objects must be at a temperature below freezing as air with a dew point below freezing is brought to saturation by cooling. d. Black frost: It occurs when vegetation is frozen because of a reduction in the temperature of air that does not contain sufficient moisture. Difference between Radiation Frost and Advection Frost: In case of radiation frost, calm, clear nights and temperature inversion are the main conditions. It is of short duration. It case of advection frost, strong, winds and absence of temperature inversion are the main conditions. It is of long duration. Frost control: Frost should be controlled to maintain the tissues of vegetation above lethal temperature. Vegetable crops are damaged by the frost. The damage of the crop plants depends upon the type of crop. The presence of frost on the leaves hampers the normal functioning of the stomata. As a result, photosynthesis is adversely affected. Under severe frosty conditions, the crop plants may be killed. Therefore, is becomes essential to save the crops against frost damage. Following methods may be adopted to save the crops from frost damage: 1. Selection of site, 2. Increased radiation interception (smoke screen), 3. Thermal insulation, 4. Air mixing (engine driven propellers and hot fans to drive warm air in the inversion layer downwards), 5. Direct air and plant heating, 6. Water application, 7. Soil manipulation. IV. Smog: It is the combination of fog and smoke which is found over big industrial cities in the middle or high latitudes. Since it persists for days together and causes so many diseases and deaths, therefore it is also knows as killer fog. Condensation above the Ground: During summer season, the air mass at the ground surface is heated due to intense heat energy. This air mass becomes warmer as compared to surrounding environment. Strong vertical currents are generanted, which uplifts the warm and light air mass. The rising air mass gets saturated due to cooling.

72 NSOU CC-GR-07 Further cooling of the saturated air mass leads to condensation. The uplift of the air mass continues even though the original cause of the uplift has ceased to be effective. Later on, upward movement of air is caused by the buoyancy force. Often the air mass sinks back to the former level. The upward and downward movement of the air mass depends upon the stability and instability of the atmosphere. V. Clouds Cloud is a mass of minute water droplets or tiny crystals of ice formed by the condensation of the water vapour in free air at considerable elevations. Clouds are caused mainly by the adiabatic cooling of air below its dew point. As the clouds are formed at some height over the

87%	MATCHING BLOCK 94/265	W

surface of the earth, they take various shapes. According to their height, expanse, density and transparency or opaqueness clouds are

grouped under four typs: (i) cirrus; (ii) cumulus; (iii) stratus; (iv) nimbus. Cirrus Clouds Cirrus clouds are formed at high altitudes (8,000–12,000m). They are thin and detached clouds having a feathery appearance. They are always white in colour. Cumulus Clouds–Cumulus clouds look like cotton wool. They are generally formed at a height of 4,000–7,000m. They exist in patches and can be seen scattered here and there. They have a flat base. Fig. 1.2: Cumulus Cloud

73 NSOU CC-GR-07 Stratus Clouds As their name implies, these are layered clouds covering large portions of the sky. These

78%	MATCHING BLOCK 95/265	W

clouds are generally formed either due to loss of heat or the mixing of air masses with different temperatures.

Nimbus Clouds Nimbus clouds are black or dark gray. They from at mieddle levels or very near to

84%	MATCHING BLOCK 96/265	W

the surface of the earth. These are extremely dense and opaque to the rays of the sun. Sometimes, the clouds are so low that they seem to touch the ground. Nimbus clouds are shapeless masses of thick vapour.

81%	MATCHING BLOCK 98/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

A combination of these four basis types can give rise to the following types of clouds: 1. High clouds–cirrus, cirrostratus, cirrocumulus; 2. Middle clouds–altostratus

and altocumulus; 3. Low clouds–stratocumulus and nimbostratus (long, duration rainfall cloud) and 4. Clouds with extensive vertical development-cumulus and cummulonimbus (thunderstorm cloud). Fig. 1.3 : Stratus Clouds
74 NSOU CC-GR-07 1.4 Precipitation-Types and Forms Concepts: Precipitation has been difined as water in liquid or solid forms falling to the earth. According to Foster, precipitation in deposition of atmospheric moisture and is perhaps the most important phase of the hydrologic cycle. Precipitation includes all form of water particles that fall to the ground. It is not only rain but other forms of precipitation such as hail, sleet or fog-drip, which have considerable local significance. The forms in which precipitation in occur depends on the temperature structure of the air layer between cloud base and the ground. 1.2.1 Types of Precipitation:–

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Precipitation is a product of the condensation of atmospheric water vapour that falls under gravity. The

first step in precipitation is evaporation then condensation. The process of condensation involves change of water vapour to liquid, while the process of precipitation involves the falling out of that water as rain, snow, hail etc. *
All types of precipitation occurs from clouds and causes of clouds is the adiabatic cooling resulting from the upward movement of air. Fig. 1.4 : Clouds
75 NSOU CC-GR-07 Therefore, precipitation is classified on the basis of condition under which large masses of moist air induced to higher elevation, like– (i) Convectional precipitation (ii) Orographic precipitation (ii) Cyclonic or frontal precipitation. (I) Convectional precipitation–The causes of such precipitation occur through two conditions:– i) The intense heating of surface ii) Abundent supply of moisture in the air.

90%	MATCHING BLOCK 99/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

The air on being heated, becames light and rises up in convection currents. As it rises, it expands and loses heat and consequently condensation takes place and cumulous clouds are formed.

With thunder and lightering heavy rainfall takes place but this does not last long. Such rain is common in the summer or in one hotter part of the day. It is very common in the equatorial regions. Connective precipitation is less effective for crop growth than the steady rain. However, in the temperate regions, it is most effective in promoting the growth of plants. Clouds involved in this types of precipitation are generally cumulonimbus or clouds with greater vertical development. II) Orographic precipitation–When mountains or highlands acts as barriers to the flow of air force it to rise, and cloud forms. Clouds Cold air Cold air Fig. 1.5 : Convectional Precipitation
76 NSOU CC-GR-07

70%	MATCHING BLOCK 101/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

When the saturated air mass comes across a mountain, if force to ascend and as it rise it expands, the temperature falls and the moisture is condensed.

94%	MATCHING BLOCK 104/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

The chief characteristic of this sort of rain is that windward side receive greater rainfall. After giving rain on the windward side, when these winds reach the other slope, they descend and their temperature rise. The

86%	MATCHING BLOCK 108/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

capacity to take moisture increases and hense these leeward slopes remain rainless and dry. The area situated on the leeward side, which get less rainfall

are called rain- shadow area. Another salient features of orographic rain is invension of rainfall. An air stream approaching the mountain ranges is given an uplift by the air masses lying close to them. Therefore, the amount of precipitation starts increasing some distance away from the mountain.

74%	MATCHING BLOCK 102/265	W

There is a continuous increase in precipitation on the windward slope upto a certain height beyond which starts diminishing. This is called inversion of rainfall.

In India the

63%	MATCHING BLOCK 103/265	W

south-west monsoon gives copious rainfall on wind ward slope of western ghats, whereas on leeward side there are extensive rain shadow

area. III
Cyclonic or frontal precipitation–This rainfall

92%	MATCHING BLOCK 105/265	W

occurs when deep and extensive air masses are made to converge and move upward so that their adiabatic cooling

results. Cyclonic precipation in tropical regions–When currents of

65%	MATCHING BLOCK 106/265	W

air with differing temperature and moisture content meet at an angle, the warm and moist air will be forced to rise over the heavier air. In addition, when air masses from different

direction coverge toward a centre, some of the air is forced up. In both these cases of convergences, cloudiness and precipitation result. Rain shadow Leeward side Windward Side Fig. 1.6 : Orographic Precipitation Cloud Rainfall Mountain 77 NSOU CC-GR-07 *
*In temperate regions, the zones of contact between relatively warm and cold air masses are known as fronts.

76%	MATCHING BLOCK 107/265	W

Frontal precipitation occurs when the warm and moit air gradually rises above the front created by contact with the cold air. In stable air convergence is generally attended by stratiform clouds providing a gray overcast sky and cause steady long-continued precipitation. In Europe and North-America, most of the winter precipitation is frontal in origin 1.4.2 Forms of Precipitation: Precipitation is the moisture falling on the ground into various forms which depend on the following conditions:- (a) The temperature at which the condensation take place (b) Types of cloud and their height from ground (c) The processes generating precipitation Forms of precipitation are as follows– * It is precipitation of liquid water particles. The drops are larger than drizzle whenever the rain drop fall from high-altitude clouds, some of them evaporate where passing through dry air. There are three types of rainfall– a) Convectional rainfall b) Orographic rainfall c) Cyclonic rainfall (2) –

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Drizzle is very light rain. It is stronger than most but less than shower.

They are formed in very low stratus clouds with higher water content Drizzle is associated with fog. In same place drizzle is often called mist.

90%	MATCHING BLOCK 110/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

They arise from low stratocumulus clouds they evaporate even before reaching the ground due to their minute size. Drizzle can be

presistent Fig. 1.7 : Frontal Precipitation
78 NSOU CC-GR-07 is cold atmospheric temperature. (3) – Precipitation of solid wateris called snow. It consists of wide variety of crystal forms of ice. It may fall from pure ice clouds or from such clouds as are formed of super cooled water vapour. In winter, when temperature are below freezing in the whole atmosphere, the ice crystals falling from the altostratus do not melt and reach the ground as snow. Heaviest snowfall is reported to occur when temperature of air from which snow is falling is not much below 0°C. (4) Sleet– Sleet refers to the precipitation in the form of a mixture of rain and snow. But in American terminology sleet means a form of precipitation consisting of small pellets of transparent or tranlucent ice. Thus it refers to frozen rain in America. Sleet is often experienced during thunderstorm. Sometime sleet may grow into hailstorms when violent vertical current are produced in the atmosphere.

82%	MATCHING BLOCK 111/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

Sleet don’t freeze into solid mass except when it combines with freezing rain. (5)

Hail– It is precipitation of big ball on pieces of ice with diameter ranging from 5 to 50 mm or sometime more. Hail is the most dreaded and destructive form of precipitation produced in violent thunderstorms or cumulonimbus clouds. As this are big balls of ice due to which

100%	MATCHING BLOCK 112/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

they are highly damaging to crops, tearing leaves apart and reducing their value.

Hailstornes as

76%	MATCHING BLOCK 113/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

formed from super-cooled droplet that slowly freeze and result in clear ice. (6)

Sun Shower– It is a precipitation which

89%	MATCHING BLOCK 114/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

falls which the sun shines. It occurs when the winds bearing rain together with

rain storms and blow several miles thus give raindrop into an area without cloud. Cloud base Freezing line Typical Environmental lapse rate RAIN SNOW SLEET FREEZING RAIN ICE PELLETS Increasing temperature Fig. 1.8: Types of precipitation that reaches the ground
79 NSOU CC-GR-07 1.5 Mechanism of Precipitation Ice Crystal Theory of Bergeron–Fiendeisen: The ice-crystal theory to explain precipitation was propounded by Tor-Bergeron, an eminent meteorologist from Norway, in 1933. It is based on two special meteorological properties of water: Firstly, (i) The water droplets in a cloud do not freeze at 0°C. (ii) In the atmosphere, super-cooled water has been observed down to below- 40°

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C. (iii) When water remains in liquid state below 0°c, it is referred to as super-cooled. The super-cooled water

tends to freeze if it is distributed. (iv) Besides, super cooled droplets also freeze when they come into contact with the freezing nuclei. (v) An ice crystal is often found to certain a tiny solid nucleus of about 1 micrometer in diameter. This is called freezing nucleus. Most of the nuclei become active at 20°C to 25°C. (vi) However, freezing nuclei

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are spares in the atmosphere. Thus, when the ascending air currents rise well above the freezing level, some

of the

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water droplets will be changed into ice and through sublimation, water vapour will enter into solid state.

According to Taylor,

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if a single ice crystal is introduced into a cloud of super cooled water droplets, the entire cloud rapidly changes over to an all-ice cloud.

This abrupt change from a water to an ice cloud is caused by different vapour pressure existing over super-cooled water droplets and ice crystals at the same temperature. Secondly, (i) Over ice, the saturation vapour pressure is lower than what it is over water. In other words,

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when air is saturated with respect to water, it is supersaturated with respect to ice. (

ii) In this case, vapour diffuses rapidly from air to ice crystals so that the ice crystals being to grow at the expense of water droplets. (iii)

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The growth of ice crystals is rapid enough to generate crystals large enough to fall. While falling from the cloud, the ice crystals grow by intercepting cloud droplets that freeze upon them. (iv) Sometimes, these falling ice crystals are broken up into fragments which again become freezing nuclei for other

water droplets.

80 NSOU CC-GR-07 (v) A chain reaction take place. The ice crystals by accretion grow further in size to become snowflakes before leaving the cloud. (vi) Snowflakes generally meet before raching the ground and fall as rain. Ice Nucleus ↓ Growth by sublimation ↓ Larger cycle crystals → Coagulated with super cooled droplets ↓ ↓ Continued sublimation hailstone ↓ ↓ Large dentritic crystals melting ↓ ↓ Splintering crystal → snowflaks raindrop coagulation This theory is mainly emphasis on the following basis: 1) Water vapour, water particles and ice crystals exists. 2) Different level of pressure of saturated water vapour. 3) Low pressure on ice surface than water surface of the saturated water vapour. (B) Collision–Coalescence Theory: Collision coalescence ideas were put forword by. George Simpson and Mason. It is based on the fact that clouds contain a variety of sizes of water droplets. Uniformly small droplets tend to move at the same speed 40 30 20 10 Saturated air pressure on vapour material (mb) on ice 0.6 0.4 0.2 0 –20 –10 0 Temperature ((0 C) Fig. 1.9 : Ice Crystal formation -40 -30 -20 -10 0 10 20 30 Saturated air pressure on ice (mb)

81 NSOU CC-GR-07 in the cloud but if they are mixed with larger, slow moving droplets that have formed around hydroscopic nuclei, then this will encourage collisions and amalgamations. These ideas were modified by Langmuir. He pointed out that the termainal velocities of falling drops are directly related to thier diameters. These diameters, in turn are determined by the size of the condensation nuclei. Drops that have grown on large condensation nuclei become larger. The larger drops will have a higher terminal velocity than the smaller ones and so collide with them. Raindrops or ice crystals often stick after colliding and thus, grow in finite steps i.e. collide and coalesce. The large drops then fall faster, as they overcome air resistance more easily. By falling faster, they are able to catch up even more rapidly with other droplets and crystals. So that the larger they grow, the faster they grow. For collision to occur, several conditions are necessary— (a) As the larger droplets descend, they produce an air stream, a minature air current that blows the small particles out of their path i.e. smaller drops are swept away. Larger cloud droplet Coalescence with smaller droplets large unstable drop Several large drop More unstable drop Coalescence with smaller drops Drizzle Many large raindrops Fig. 1.10: Collision-coalescence process

82 NSOU CC-GR-07 (b) Colliding droplets may bounce away from each other as there is little surface tension. Because of these two effects, the collection efficiency is very small. Thus, when both the collection efficiency and the fall rate of the droplets and crystals are taken into consideration. It is found that coalescence is almost nil until the droplets or crystals exceeds 40 microns. Once the collecting perticles are larger than this coalescence proceeds so rapidly that raindrops would offen be for larger if they did not break apart once they exceeded a few milimeter in diameter. (c) Even with collision, growth will only occur if the two drops coalesce. This will occur most rapidly if– (i) The drops are of considerably different sizes. ii) Atmospheric electricity is present to hold the droplets together, if a droplet with a negative charge should collide with a positively charged droplet their electrical attraction will bind them together. Continued collision, thus leads to coalscence resulting in many large unstable drops which on further disruption produce several large drops and its continued coalescence and further disruption leads to many larger drops. 1.6 Conclusion Condenstion is the change of water vapour into liquid state. The condensation occurs through two process- adiabatic and diabatic process. It helps in precipitation. Precipitation includes all forms of water particles that fall to the ground. Rain is the name given to all liquid precipitation other than drizzle. The formation and growth of raindrops is a complicated and less understood process. The two process that describes the mechanism of raindrop formation are - Bergeron-Fiendiesen process and Collision- Coalescence process, which are elaborated in this unit. 1.7 Summary Condensation is caused by the loss of heat.

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Condensation depends upon the amount of cooling and the relative humidity of the air.

Condensation takes

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place when the dew point is lower than the freezing point as well as higher than the freezing point.

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After condensation, the water vapour or the moisture in the atmosphere takes one of the followings forms-

dew, frost, fog and clouds. The two processes of condensation are adiabatic and non-adiabatic.
83 NSOU CC-GR-07 According to their height, expanse, density and transparency or opaqueness clouds are grouped under four typs: (i) cirrus; (ii) cumulus; (iii) stratus; (iv) nimbus. Precipitation has been difined as water in liquid or solid forms falling to the earth. Precipitation includes all form of water particles that fall to the ground. The ice-crystal theory to explain precipitation was propounded by Tor-Bergeron. The collision coalescence theory was put forword by George Simpson and Mason. 1.8 Key words Condensation, adiabatic process, diabatic process, forms of condensation, forms of precipitation, ice-crystal theory, collision coalescence theory. 1.9 Model Questions Short answer type: 1. What are the types of fog? 2. Classify clouds. 3. What are the forms of precipitation. 4. Briefly state about the types of rainfall. Long answer type: 1. Discuss the forms of Condensation. 2. Explain the process of Condensation. 3. Elucidate the mechanism of rain drop formation in atmosphere. 4. Explain the theories of precipitation. 5. Discuss different forms of precipitation and types of rainfall. 1.10

81%	MATCHING BLOCK 123/265	W

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Unit 2 * Structure 2.1 Introduction 2.2 Objectives 2.3

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Air Mass 2.4 Classification of Air mass 2.5 Origin of Air mass 2.6 Conclusion 2.7 Summary 2.8 Key words 2.9 Model Questions 2.10 References 2.1 Introduction Air mass is defined as an extensive portion of the atmosphere whose physical properties, especially temperature, moisture content and lapse rate are homogeneous horizontally and vertically for hundreds of

kilometers. Thus, an air mass has two basic characteristics, vertical temperature distribution, i.e. lapse rate, a measure of warmth or coldness which affects it's stability; and homogeneous moisture content, which is an indication of latent heat. 2.2 Objectives i. To know the air mass. ii. To know the types of air mass. iii. To know the origin of air mass. iv. To know the dynamics

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of air mass. 2.3 Air Mass Air mass is defined as an extensive portion of the atmosphere whose physical properties, especially temperature, moisture content and lapse rate are homogeneous horizontally and vertically for hundreds of

kilometers. Thus, an air mass has two
85 NSOU CC-GR-07 basic characteristics— i) Vertical temperature distribution, i.e. lapse rate, a measure of warmth or coldness which affects it's stability; and ii) Homogeneous moisture content, which is an indication of latent heat. 2.4 Classification

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of Air Mass Air masses are classified on the basis of–

a) the location of their source region. b) the nature of the surface over which they move towards other region.

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There are two approaches to the classification of air masses, e.g.– 1) Geographical classification and 2) Thermodynamic classification 1) Geographical Classification–

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Trewartha has classified air masses on the basis of their geographical locations into two broad categories, viz-i) Polar air mass (P) which originates in polar areas. Artic air masses are also included in this category. ii) Tropical air mass (T), which originates in tropical areas. Equatorial air masses are also included in this category. These two air masses have been further divided into two types on the basis of the nature of the surface of their source region, i.e. land or water. a) continental air mass indicated by a small letter c. b) maritime air mass indicated by a small letter m. It may be pointed out that a continental air mass gets modified and is transformed into maritime type while passing through ocean surface but maritime airmass is seldom transformed into continental type while passing through land surface. Based on

the

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above facts air masses are classified into the following four principal types according to their geographical locations– i) Continental Polar air mass (cP) ii) Maritime Polar air mass (mP) iii) Continental Tropical air mass (cT) iv) Maritime Tropical air mass (mT) 2) Thermodynamic Classification–Theromodynamic modification of an air mass

includes such effects as heating from below which decreases the vertical stability. On the basis of theronodynamic modification of air masses under the influence of underlying surface. They can be classified in two categories–
86 NSOU CC-GR-07 i) cold air mass (k) ii) warm air mass (w) Cold air mass is defined as one which has lower temperature than the underlying surface. It is indicated by small letter 'k'.

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Cold air masses originate in the polar and arctic regions.

The warm air mass is described as one which has relatively high temperature than the temperature of underlying surface. It is denoted by small 'w' letter.

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Warm air masses generally originate in the subtropical regions characterised by anticyclone conditions.

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Both cold and warm air masses may be stable or unstable due to different kind of modifications through exchange of temperature between overlying and underlying air. Thus cold and warm air masses may be classified also as–a) stable (s) and b) unstable (u) airmass. i) Continental Polar Air Masses (cP)–These air masses have their source origin in central Canada and Siberia. These air messes have different physical characteristics during summer and winter seasons. They are extremely cold, dry and stable in winter but when they move over warm, surfaces they are heated from below and become unstable. The source areas, due to their location in high altitude, are frozen in winter season, the air mass is cold, dry and stable. In the summer, the snow cover disappeares because of the surface heating but still summer time continental polar air masses are cool and dry in their source region of Canada and Siberia. This type of air masses can be sub-grouped as under– a)

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Continental Polar Cold Stable Air Mass (cPks) b) Continental Polar Cold Unstable Air Mass (cPku) c) Continental Polar Warm Stable Air Mass (cPws) d) Continental Polar Warm Instable Air Mass (cPwu) ii) Maritime Polar Air Masses (mP)–

They are orignally continental polar air masses (cP) which have undergone modification when they move out from the source region and travel oceanic surfaces of high latitudes, their lower parts are heated from below by the relatively warm surfaces of open oceans and thus become maritime polar air masses (mP) after such modification. This modificatin increases temperature lapse rate and causes connective instability in the lower part. On the other hand the upper part is cool. This types of air masses can subgrouped as under– a)

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Maritime Polar cold stable Air Mass (mPks) b) Maritime Polar cold unstable Air Mass (mPku) c) Maritime Polar warm stable Air Mass (mPws) d) Maritime Polar warm unstable Air Mass (mPws) 87 NSOU CC-GR-07 iii) Continental Tropical Air Masses (cT)–

These air masses have their source region in the

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subtropical high pressure land areas. They have high temperature and low moisture content.

Subsidence and stability are

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found in the upper parts of these air masses in their source

region. These air masses can be subgrouped as under– a)

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Continental Tropical cold unstable Air Mass (cTku) b) Continental Tropical cold stable Air Mass (cTks) c) Continental Tropical warm unstable Air Mass (cTwu) d) Continental Tropical warm stable Air Mass (cTws) iv) Maritime Tropical

Air Masses (mT)–They have their source region over the warm oceans in both the hemisphere. They are warm moist and unstable air masses. They yield terrestial rainfall when they are forced to ascent by mountain bariers. They are asociated with connective instability, cumulonimbus rainfall when the airmass is associated with frontal activity or is forced to ascend by mountain barriers. These air masses can be subgrouped as under– a)

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Maritime Tropical cold stable Air Mass (mTks) b) Maritime Tropical cold unstable Air Mass (mTku) c) Maritime Tropical warm stable Air Mass (mTws) d) Maritime Tropical warm unstable Air Mass (

mTwu) Dynamic changes–Dynamic (mechanical) changse involves mixing or pressure changes asociated with the actual movement of air masses either by turbulence, high level convergence and divergence prolonged period of turbulent mixing causes substantial change in the physical properties of air masses. Dynamic changes may be brought about by a combination of one or more factors– Turbulent mixing at a lower level, where natural friction provides a ready mechanism for the upward transfer of the effects of thermodynamic effects by eddy formation. Large scale lifting resulting from forced ascent by mountain barrier or by air stream convergence. Sinking caused by high level convergence or by descent of air in the lee of high ground caused by pressure gradient. Litting caused by horizontal convergence at low level. Advection. Turbulence causes thorough mixing, sometimes up to a considerable height and transfer heat and moisture up to a considerable height. Subsidence causes stable stratification in the atmosphere while lifting and ascent causes steepending lapse rate and therefore, promotes instability.
88 NSOU CC-GR-07 Fig. 2.1 : World Air Mass distribution. (Jannuary and July)
89 NSOU CC-GR-07 Thus, thermodynamic modification causes air mass to become cold or warm represented by letters * for warm and (from German 'Kalt', meaning cool) for cold. While mechanical or dynamic modification causes it to become stable and unstable . Although it must be strictly borne in mind that the effects of dynamic and thermodynamic modifications are clearly inseparable. P cP mP cpk cPw mPk mPw T cT mT cTk cTw mTk mTw cPks cPku mPks mPku mPws mPwu cPws cPwu cTks cTku mTks mTku mTws mTwu cTws cTwu P = Polar C = continent K = heated from below S = stable aloft T = Tropical m = maritime w = cooled from below u = unstable aloft Fig. 2.2 : Classification chart of Air mass
90 NSOU CC-GR-07 2.5 Origin of Air Mass Indroduction-

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In meteorology, an air mass is volume of air defined by its temperature and water vapour content. Air masses cover many hundreds or thousands of square miles, and adapt to the characteristics of the surface below them. They are classified according to latitute and their continental or maritime source regions. Colder air masses are termed polar or arctic, while warmer air masses are termed tropical. Continental and superior air masses are dry while maritime and monsoon air masses are moist.

Classification Pettersen has classfied air masses into the following five major categories on the basis of their of their source regions: 1. Tropical air masses : There is a chain of tropical air masses source regions that encircles the northern hemisphere and another in southern hemisphere near tropic of cancer and tropic of capricorn. These are fromed over Sahara, S.W. USA in summer, northern Mexico in summer. 2. * The polar air masses lie between 55 o to 65 o latitudes in both hemisphere. There are number of region for polar air in northern hemisphere, like Siberia in winter, gulf of Alaska etc. 3. The trade wind converge at the equator forming inter tropical convergence zone. At some places there are regions of stagnant air that serve as source of air mass formation that are mainly formed over water in these latitude. 4. This air mass forms over large area of snow and ice mainly near pole in both the hemispheres. Artic air masses tend to form in winter (December to March) in northern hemisphere and in (June to September) in southern hemisphere. According to , there are only three major categories of air masses i.e. arctic, polar, and tropical air masses. , on the basis of gographical location of air masses classifies them into the following two broad categories: 1) Polar air mass (P) 2) Tropical airmass (T). He further subdivides

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the two air masses into two types on the basis of the nature of the surface of their source regions

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i.e. land and water-the lowercase letter (for maritime) and the lowercase letter (for continental).

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Air masses are commonly classified according to four basic source regions with respect to latitude. 91

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air masses

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usually forms during the cold period of the year over extensive land areas such as central Asia and northern Canada. It is likely to be stable and is characteristically free of condensation forms. When heated or moistened from the ground with strong turbulence, this type of air mass develops limited convective stratocumulus cloud forms with scattered light rain or snow showers. In summer strong continental heating rapidly modifies the coolness and dryness of the CP air mass as it moves to lower latitudes. Daytime generation of cumulus clouds in the rule, but the upper-level stability of the air mass is usually such as to prevent rain showers. * * air masses develop over the polar areas of both the Northern and the Southern hemispheres. They generally contain considerably more moisture than the cP air masses. As they move inland in middle and high latitudes, heavy precipitation may occur when the air is forced to ascend mountain slopes or is caught up in cyclonic activity.

The

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air mass originates in arid or desert regions in the middle or lower latitudes, principally during the summer season. It is strongly heated in general, but its moisture content is so low that the intense dry convection normally fails to reach the condensation level. Of all the air masses, the cT is the most arid, and it sustains the belt of subtropical deserts worldwide. is the most important moisture-bearing and rain- producing air mass throughout the year. In winter, it moves poleward and is cooled by the ground surface. Consequently, it is characterized by fog or low stratus or stratocumulus clouds, with drizzle and poor visibiliy. A steep lapse rate aloft in regions of cyclonic activity ensures the occurrence of heavy frontal and convective rains. In summer, the characteristics of the mT air mass over the oceans and in zones of cyclonic acitivity are basicaly the same as in winter. Over warm continental areas, however, the air mass is strongly heated so that, instead of fog and low startus clouds, widely scattered and locally heavy afternoon thunderstorms occur.

Air Masses and Source Regions: Origin

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The principal source regions of the earth may be classified according to the nature of surface (land or water) and the latitude of the region. Thus, the source regions are classified as under: The Article source regions are located in the high latitudes,

where the surface is permanently covered with snow and ice. Thus, they are the coldest regions on earth. The polar source regions do not mean the regions around the geographic poles. The area situated between the Arctic source regions and the sub-tropical highs. None that the Arctic source regions are colder than the polar source regions. The tropical source regions occupy the subtropical high pressure belt. The equatorial source regions are

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located around the equator between the trade winds of the northern 92 NSOU CC-GR-07 and southern hemispheres. The

following discussion relates to the major air masses that form during the winter and summer months in different regions of the world: * These aur nasses have their source regions in the central Canada and Siberia. They are extremely cold, dry and stable. Since the surface is completely frozen and is snow- or-ice-covered, these air masses are the coldest wintertime air masses. They produce intense cold waves when they move out to some other regions. Because of extreme dryness of the air, there are no clouds in these air masses. However, after these air masses move out of their source regions, they are modified while they pass over a warm surface. When cP air mass becomes cPK after modification, cumulus or stratocumulus is not uncommon. ! " * These air masses have their source regions in the central parts of high-latitude contitents. Central Canada offers a typical example of such a source region. Because of the surface heating, snow cover disappears. Summer time, cP air masses in their source regions are cool and dry, but not necessarily stable. Actually these are the modified forms of the winter-time cP air masses which have been heated in the lower layers. Their lapse rates are comparatively less steep. When cPK air mass

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moves out to oceanic surface, it is modified into cPW air mass with haze, fog and low stratus clouds. # *

These air masses are cool and moist and form over the open oceans in the higher latitudes. They are originally cP air masses which have undergone extensive modification over the open oceans. These air masses contain few clouds in their source regions. But when they are dragged into cyclones or are forced to ascend mountain barriers, extensive precipitation is produced by them. Their lower layers are moist and unstable, but they are dry and cold in their upper parts. The convective instability in the lower layers of these air masses produces showry, squally weather. $ " * These air masses originate in the source regions of mP air masses. They are

88%	MATCHING BLOCK 146/265	W

cool and moist in the lower parts, but dry aloft. A temperature inversion

in produced sometimes with moisture discontinuity. They are stable upto moisture discountinuity.
93 NSOU CC-GR-07 The general temperature is slightly higher than that in the mP air masses. % They have their source regions over the warm oceans in both the hemispheres. They are warm, moist and unstable. They release abundant precipitation whenever Fig 2.3 : Typical characteristics of air mass Iropical Continental (Tc) Summer Winter Very worm or hot Average Relatively dry Rather moist Little change Cooled from below Generally stable Stable Clear occasional thundery showers Clear Moderate or poor Moderate or poor Tropical Maritime (Tm) Exposed Sheltered Near Sea tem Warm Very moist Moist Cooled from below Warmed in summer Stable Stable aloft Low cloud drizzle Broken cloud dry Often poor with coasta fog Moderate Arictic Maritime (Am) Cold (colder than porn) Fairly moist (not as moist as pm Heated from below Un stable Showers (mainly costal) Very good Fig. 2.4 : Source regions of air masses
94 NSOU CC-GR-07 they ocur. The lapse rates in the lower levels often approach the dry-adiabatic rate, and the lapse rates are steep up to tropopause. Moisture is

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well distributed to high levels. When these air masses are lifted over fronts or high mountains, they produce heavy precipitation. & "

The source regions of these air msses are located in the belt of the

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great semi- permanent highs of the tropical oceans including the Caribbean Sea.

The mT air masses are very warm and moist and highly unstable. These are masses have convective instability. ' These air masses have their source regions in the

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subtropical high pressure land areas. They have high temperatures and low moisture content.

The tropical continental air does not spread extensively beyond its source regions. In the United States these air masses are important only in the sumer season. They are dry

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both in winter and summer. In summer they are very hot. Subsidence and stability are found in the upper parts of these air masses in their source regions. When cT air is found aloft over warm, moist air at the surface,

the atmosphere becomes convectively unstable, and violent thunderstorms or tornadoes are produced. 2.6 Conclusion The airmass

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is volume of air defined by its temperature and water vapour content. Air masses cover many hundreds or thousands of square miles, and adapt to the characteristics of the surface below them. They are classified according to latitute and their continental or maritime source regions. Colder air masses are termed polar or arctic, while warmer air masses are termed tropical. Continental and superior air masses are dry while maritime and monsoon air masses are moist. 2.7 Summary Air masses

cover many hundreds or thousands of square miles. Pettersen has classfied air masses into the following five major categories on the basis of their

75%	MATCHING BLOCK 152/265	W

of their source regions. Trewartha has classified air masses on the basis of their geographical locations into two broad categories, - Polar air mass (P) &

Tropical air mass (T). According to Byers, there are only three major categories of air masses i.e. arctic,
95 NSOU CC-GR-07 polar, and tropical air masses. Dynamic changes involves mixing or pressure changes asociated with the movement of air mass.

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Colder air masses are termed polar or arctic, while warmer air masses are termed tropical. Continental and superior air masses are dry while maritime and monsoon air masses are moist. 2.8

Key words Airmass, Polar airmass, Tropical airmass, dynamic changes of airmass, modification of airmass 2.9 Model Questions Short answer type: 1. What is air mass? 2. Classify air mass. 3. State the characteristics of air mass. Long answer type: 1. Classify different air masses and account for their modification. 2. Explain the source regions of the major air masses forms during winter and summer season. 2.10

81%	MATCHING BLOCK 154/265	W

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Chritechfied, H. J. (2004): General Climatology, Prentice Hall of Indian Private Limited, New Delhi (4th Edn). Lal, D.S, (2016): Climatology, 'harada Publishing House, Allahabad, ISBN: 81- 8620-4-26-1 Robinson, PJ, Sellers A.H (1987): Contemporary Climatology, Longman Scientific and Technical, England, ISBN: 0 582 02700 4 Singh, S (2015): Climatology, Trayag Pustak Bhawan, Allahabad.

Unit 3 * Structure 3.1 Introduction 3.2 Objectives 3.3 Fronts: Characteristics of warm and cold fronts 3.4 Frontogenesis 3.5 Frontolysis 3.6 Classification of fronts 3.7 Conclusion 3.8 Summary 3.9 Kew words 3.10 Model Questions 3.11 References 3.1 Introduction Front is three-dimensional boundary zone formed between two converging air masses with different physical properties. Fronts are the typical features of mid- latitudes temperate region. They are uncommon in tropical and polar regions. The two air masses don't merge readily due to the effect of the converging atmospheric circulation, relatively low diffusion coefficient and a low thermal conductivity. 3.2 Objectives i. To know the front. ii. To know the types of front. iii. To know the origin of front. iv. To know the features of front. v. To know about frontolysis. 3.3 Fronts: Characteristics of warm and cold fronts Introduction : Fronts are the typical features of midlatitudes weather (temperate region: 30 o –65 o N and S). They are

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uncommon (unusual) in tropical and polar regions. 97 NSOU CC-GR-07 Front is three-dimensional boundary zone formed between two converging air masses with different physical properties (

temperature, humidity, density etc.). The two air masses don't merge readily due to the effect of the converging atmospheric circulation, relatively low diffusion coefficient and a low thermal conductivity. Characteristics 1: Temperature Larger differences in the air temperature are recorded across a front. But the changes in the temperature may be abrupt or gradual depending on the nature of the opposing air masses. Larger the temperature difference, the thinner the frontal zone and the vice versa. Besides, the fronts are always characterized by the temperature inversion layers. 2: Air pressure The wedge formed by the bending of the isobars across the front always points toward the higher pressure. It is noteworthy that mostly the fronts lie in the trough of the low pressure. 3: Winds South-westerly wind in a tropical air mass gives way to the north-westerly wind in the polar air mass across the front. The lines of the abruptly shifting winds were formerly knows as windshift lines. 4: Cloud and precipitation The type of the clouds and the precipitation falling from the depend on the slope of the front and the amount of the moisture in ascending mass of the air. Types of Weather Fronts When large masses of warm air and cold air meet, the boundary zone between them is called front. They do not mix. Instead, they form a front, usually hundreds of miles long. When a front passes, the weather changes. 1) Cold front-A cold front originates between the centers of high and low pressure. Pressure difference cause the flow of air from high pressure to low pressure. Typically colder air from the high pressure flows towards low pressure, where the warm air rises. With large pressure diffrences, the speed and amount of air flow increases. Thereby larger amounts of cold air are put into motion and aggregate into a large front of several hundred kilometers of width. Weather: It brings thunder which can form thunderstorm as the moisture in the warm air mass rises, cools, and condenses. As the front moves through, cool, fair weather is likely to follow.

98 NSOU CC-GR-07 Characteristics of Cold Front i) Cold fronts are boides of air with cooler temperatures than the surrounding air. ii) They normally move from northwest to southeast. iii) The temperature shift between cold and warm fronts can be drastic, from freezing. iv) On a weather map, cold front are shown as curved blues lines with traingles pointing in the direction that the front is moving. v) Drizzle rainfall occur. vi) Clouded sky is observed. vii) Low temperature is noticed. viii) The stope varies from 1 : 5 to 1 : 100. 2) Warm front–Warm fronts are at the leading edge of a homogeneous warm air mass, which is locted on the equtorward edge of the gradient in isotherms, and lie within broader troughs of low pressure than cold fronts. A warm front moves more slowly than the cold front which usually follows because cold air is denser and harder to remove from the earth's surface. Thi s also forces temperature differences across warm fronts to be broader in scale. Weather: As the warm air mass rises, it condenses into a broad area of clouds. A warm front brings gentle rain or light snow, followed by warmer, milder weather. Clouds ahead of the warm front are mostly stratiform and rainfall gradually increases as the front approaches. Fog can also occur preceding a warm frontal passage. Characteristics of Warm Front Weather fronts are responsible for the majority of our clouds and precipitation. In the case of a warm front, you should definitely break out your umbrella and rain gear. Fig. 3.1 : Vertical cross-section of a cold front and associated clouds and precipitation

99 NSOU CC-GR-07 i) Warm Front Basis Fronts represent the boundaries between collinding air masses. Warm fronts represent the transition zone where warm air is replacing colder air. These fronts typically form east of a center of low pressure. Warm fronts generally move from the southwest to the northeast. ii) Structural and Behavioural Characterisitics As the warm air advances, the cold air acts as a gently sloping ramp. This ramp gently uplifts large areas of the warmer, less dense air. The slope of a typical warm front is 1:200, compared with the much steeper 1:100 slope of a cold front. This is why warm fronts are charrracterized by a much large area of cloud cover and precipitation. Because the advancing warm air is less dense, it has a difficult time pushing the heavier cold air back. This is way warm fronts over more slowly than cold fronts, and contribute to the longer periods of clouds and precipitation. iii) Cloud and Precipitation Characteristics Clouds and precipitation can extend for hundreds of miles both in advance and behind the warm front precipitation associated with a warm front is typically steady and light to moderate in intensity. Warm fronts can occasionally produce thunderstorms with more intense precipitation. iv) Additional Characteristics Warm fronts are typically characterized by a transition from south-easterly to south-westerly winds. Unlike cold fronts, winds along the front itself are generally light and variable. Warm fonts, as their name implies, are also characterized by a rise in temperature, but also humidity. Warm fronts are generally characterized by poor Fig. 3.2 : Vertical cross-section of a worm front and associated clunds and precipitation.

100 NSOU CC-GR-07 visibility due to low layers of overcast and steady precipitation. v) Clear weather followd hy warm front. vi) High temperature arround the warm front. 3) Stationary front– From when warms and cold air meet and front reamin stationary is called stationary front neigher air mass has the force to move the other. They remain stationary, or 'standing still.' A stationary front is a non-moving (or stalled) boundary between two air masses, neither of which is strong enough to replace the other. They tend to remain essentialy in the same area for extended periods of time, usually moving in waves. There is normally a broad temperature gradient behind the boundary with more widely spaced isotherm packing. A wide variety of weather can be found along a stationary front, but usually clouds and prolonged precipitation are found there. Stationary fronts may bring snow or rain for a long period of time. Weather : Where the warm and cold air meet, clouds and fog form, and it may rain or snow. Can bring many days of clouds and precipitation. 4) Occluded front– An occluded front is formed when a cold front overtakes a warm front, and usually forms around mature low-pressure areas. The cold and warm fronts curve naturally poleward into the point of occlusion, which is also known as the triple point. A wide variety of weather can be found along an occluded front, with thunderstorms possible, but usually their passage is accociated with a drying of the air mass. Within the occlusion of the front, a circulation of air brings warm air upward and sends drafts of cold air downward, or vice versa depending on the occlusion the front is experiencing. Precipitations and clouds are associated with the trowals (Short for through of warm air aloft), which are formed when a warm air mass gets caught between two cold air masses. The warm air mass rises as the cool air masses push and meet in the middle. There are two types of occlusion: (a) cold front type occlusion and (b) warm front type occlusion. (a)

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Cold front occlusion. It occurs when the cold air chich overtakes the warm air is colder than the retreating cold air.

It is illustrated in Fugure 3.3. In the initial stages of the cold fron type occlusion, the weather system of the warm front still persists. Later on, when the warm front has been pusbhed-further upward it has little effect on weather conditions. At the later stages the weather conditions resemble those of the cold front. Cold front type occlusion is the most common type.
101 NSOU CC-GR-07 (b) Warm front occlusion. The warm front type occlusion occurs when

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the retreating cold air mass is colder than the advancing cold air mass.

In this case the advancing cold air being relatively less dense overrides the retreating cold air mass (Fiture 3.4). This type of occlusion generally takes place when the retreating cold air becomes progressively colder by radiation, and when the advancing cold air mass is of the maritime polar type. Weather: The temperature drops as the warm air mass is occluded, or "cut off," from the ground and pushed upward. Can bring strong winds and heavy precipitation. 3.4 Frontogenesis Frontogenesis is a meteorological process of tightening of horizontal temperature gradients to produce fronts. In the end, two types of fronts form: cold fronts and warm fronts. A cold front is a narrow line where temperature decreases rapidly. A warm front is a narrow line of warmer temperatures and essentially where much of the precipitation occurs., frontogenesis is, devided from Latin word, means 'creation of altogether new fronts' or 'the regeneration of decaying fronts already in existence. * 1) was the first to use the term 'frontogenesis' for the creation of new fronts. 2) Frontogenesis occurs as a result of a developing baroclinic wave. 3)

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Frontogenesis is likely to occur when the wind blows in such a way that the isotherms become packed along the leading edge of the intruding air mass. Convergence of the wind toward a point or contraction toward a line augments the process of frontogenesis. 4)

Divergence of the wind from a point or dilation from a line is helpful to the process of frontolysis. Fig. 3.3 : Frontal symbols used on weather maps.
102 NSOU CC-GR-07 5) When contrasting air masses have convergent movement, the frontogenesis occurs. The temperature contrast in the converging air masses is most important for the process of frontogenesis to occur. *

When the distribution of frontogenesis was studied, it was noticed that this process doesn't occur everywhere. Frontogenesis requires certain characteristics for processes to occur. They are: The two opposing air masses that converge to form a front must have a contrasting temperauture. If one air mass is warm, moist and light, a front can only be created when the other air mass is cold, dry and dense. This also explains why no frontogenesis takes place in the equatorial region. Two air masses also converge at the equator (trade winds) buu the temperature of both these air masses is uniform. So, the temperature difference is the missing factor here because of which no frontogenesis takes place at the equator. In the very definition of frontogenesis, the word 'convergence' has been used and thus it is understood that it is the pre-requistite for the frontogenesis process. When two air masses having different temperature converge, leads to the formation of the fronts. For frontolysis to occur, the air masses have to diverge or get diluted by mixing and the contrast being removed. By Frontogenesis four types of fronts occurs– 1) cold fronts 2) warm fronts 3) stationary fronts 4) occuluded front 3.5 Frontolysis Frontolysis in meteorology, is the dissipation or dying or weakening of an atmospheric front. In contrary to areas of "Frontogenesis", the areas where air masses diverge are called areas of frontolysis. * : 1) When contrasting air masses lose their characteristics and difference decay occurs. 2) In other words, when the air masses move away from each other or when the temperature contrast between the adjacent air masses, diminishes due to one reason or another the fronts start declining. 3) The dissipation of fronts takes place in three ways: (a) through front's stagnation over a similar surface;
103 NSOU CC-GR-07 (b) as a results of both the air masses cold and warm moving on parallel tracks at the same speed; (c) by the system entering air of the same temperature. 4) Frontolysis happens in the area of Siberia, Northern America etc. 5) It is mostly occur when fronts move into a regions on divergent air 6) It is mostly found in sub-tropical high-pressure region 7) When the air masses move away from each other fronts may dissipate 8) The dissipation of a front or frontal zone. In general, a decrease in the horizontal gradient of an air mass property, density, and the dissipation or dying of the accompanying features of the wind field. Conditions Necessary for Frontolysis 1) Frontolysis, or

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the dissipation of a front, occurswhen either the temperature difference between the two– a) air masses disappears or the wind carries the air b) particles of the air mass away from each other.

Frontolytical process are more common in the atmosphere then are frontogenetical processes. 2)

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Frontolytical processes are most effective in thelower layers of the atmosphere since surface heating and turbulent mixing are the most intense of then on conservative influences on temperature.

Frontogenesis and Frontolosis Front is that sloping boundary which separates two opposite air masses having contrasting characteristics in terms of air temperature, humidity, density, pressure and wind direction. An extensive transitional zone between two converging air masses is called or which represents zone of discontinuity in the properties of opposing contrasting air masses. *

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The process of formation of front is frontogenisis. Infact the process of

birth and growth of fronts is known as
. Frontogenesis is a latin derived word which means 'creation of altogeather new fronts' or 'the regeneration of decaying fronts already in existence.' * On the contrary, * means the process of destruction or dying of fronts. It is the process of warking of the thermal gradient at a frontal zone. This is produced in the reverse conditions of frontogenesis i.e with surface divergence of

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air. If convergence of wind towards a point or contraction towards a line arguments the process of frontogenesis,

the divergence of the wind from a point or dialation from a line is helpful to the process of 'frontolysis'.
104 NSOU CC-GR-07 warm air warm front cold air Ground Warm Front Cold Front Occluded Front Stationary Front cold front warm air Ground cold front worm front upper front cold air cold air Occluded front cold air warm air Stationary front Fig. 3.4 : Types of fronts 3.6 Classification of Fronts Fronts are classified into four principal types on the basis of their different characteristic features, like– 1) Warm front 2) Cold front 3) Occluded front 4) Stationary front. 1) ! A warm front is defined as a gently sloping frontal surface in which there is active movement of warm air over cold air. The average slope of warm fronts in middle latitudes ranges between 1:100 to 1:200. The gradually rising warm air along the gently sloping warm front is cooled adiabatically, gets saturated and after condensation precipitation occur over a relatively large area. 2)

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Cold front is that sloping frontal surface along which cold air becomes active and aggressive and invades the warm air territory and being denser 105 NSOU CC-GR-07 remain at the ground but forcibly uplifts the warm

and light air the slope of cold front varies from 1:50 to 1:100. A cold front is associated with bad weather characterized by thick clouds, heavy downpower with thunderstorms etc. 3) " Occluded front is formed when cold front overtakes warm front and warm air is completely displaced from the ground.

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The cold front moves faster than the warm front with the result the warm sector is

progressively reduced in size. Warm air is fully uprooted from the ground. It overlies the cool and colder air masses, ultimately the cold and warm front combine into one. There are two types of occlusion: a) cold front occlusion and b) warm front occlusion. 4) # Stationary front is formed when two contrasting airmasses converge in such a way that they become parallel to each other and ther is no ascent of air. It's ground position does not now either forword or backword but reamin stationary. 3.7 Conclusion The extratropical cyclone which is actually a mid latitude depression, plays a very significant role in transfer of energy from equator to poles. The orgin and depletion of front, different types of front, salient features and associated weather with different front are very significant so far the climatic condition of temperate region is concerned. 3.8 Summary Front is that sloping boundary which separates two opposite air masses having contrasting characteristics in terms of air temperature, humidity, density, pressure and wind direction. Fronts are classified into four principal types on the basis of their different characteristic features. The process of birth and growth of fronts is known as frontogenesis. Tor Bergeron was the first to use the term 'frontogenesis' for the creation of new fronts. Frontogenesis occurs as a result of a developing baroclinic wave. Frontolysis is the dissipation or dying or weakening of an atmospheric front. The areas where air masses diverge are called areas of frontolysis.
106 NSOU CC-GR-07 3.9 Key words Front, Frontogenesis, Frontolysis, Warm Front, Cold Front, Occulded Front, Stationary Front 3.10 Model Questions Short answer type: 1. State about the types of front. 2. State about the characteristics of fronts. 3. What are the conditions responsible for frontogenesis and frontolysis? 4. Distinguish between warm front and cold front. Long answer type: 1. State the concept of Frontogenesis and Frontolysis. 2. Classify and discuss fronts. *

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Chritechfied, H. J. (2004): General Climatology, Prentice Hall of Indian Private Limited, Lal, D.S, (2016): Climatology, 'harada Publishing House, Allahabad, ISBN: 81- 8620-4-26-1 New Delhi (4th Edition) Robinson, PJ, Sellers A.H (1987): Contemporary Climatology, Longman Scientific and Technical, England, ISBN: 0 582 02700 4 Singh, S (2015): Climatology, Trayag Pustak Bhawan, Allahabad.

Unit 4 * Structure 4..1 Intruduction 4.2 Objectives 4.3 Stability 4.4 Instability 4.5 Conclusion 4.6 Summary 4.7 Kew words 4.8 Model Questions 4.9 References 4.1 Intruduction The ascent of the air depends largely on the conditions of atmospheric stability and instability. Both of these condition affect the atmospheric conditions. It largely depends on the lapse rate and related issues. 4.2 Objectives i. To know the atmospheric stability. ii. To know the atmospheric instability. iii. To know the process of atmospheric stability. iv. To know the types and process of atmospheric instability. 4.3 Stability The ascent of the air depends largely on the conditions of atmospheric stability and instability. When the air remains in its original position and resists vertical movement, then the air has the same temperature as its surroundings, it is the stability. Airmass is most stable when colder and drier air underlines warmer air. Airmass in which a temperature inversion exists has a high degree of stability. Stability may occurs—

108 NSOU CC-GR-07 i) Air mass is cooled from below to a cold underlying surface, then the density of lower air is relatively increased and the stability increases. ii) When air is subsiding and spreading laterally producing high pressure, then the process of stabilistions occurs. Process: The environmental lapse rate (ELR) is less than dry adiabatic lapse rate (DALR) and saturated adiabatic lapse rate (SALR), then the absolute stability of weather occur. The air, when rising or falling, experience temperature change then, it results the same temperature as its surroundings, wheather become stable. 4.4 Instability When, the air becoming increasingly warmer than its surroundings, then the instability occur. When, the air displaced vertically, then it has a tendency to move upward a condition of instability prevalis. Instability prevails, taken the lapse rate is greater than adiabatie rate. Instability may be developed– i) When convergence takes place, the warm air rises. ii) When the air becomes lighter than its surroundings. iii) When, air is and forced to rise over some obstacles. Types and Process: i) Absolute Instability: In it, ELR is greater at every level than the DALR. ii) Conditional Instability: Humid air is forced to rise over mountain barrier or over colder wages of air, then conditional instability occur. Absolute Stability Height (Km) Height (Km) Temperturate (0 C) Fig 4.1 Stability Temperturate (0 C) Fig 4.2 Instability DALR Conditional Instability SALR Absalute Instability DALR SALR

109 NSOU CC-GR-07 iii) Potential Instability: When larger air masses undergo bodily lifting, then dry upper part will experience drop in temperature at DALR while the lower parts become saturated and cool at SALR. This different rate of colling of different parts alters the stable situation into unstable, in known as potential instability. 4.5 Conclusion The temperature changes occur when the air rises and falls. The ascent of the air will depend on the condition of atmospheric stability and instability. The dry and saturated adiabatic lapse rates are closely associated with these atmospheric condition. 4.6 Summary When the air remains in its original position and resists vertical movement, then the air has the same temperature as its surroundings, it is the stability. When, the air becoming increasingly warmer than its surroundings, then the instability occur. Fig. 4.3 and 4.4 : Stability and instability of the atmosphere. The lapse rate less than the dry adiabatic rate means stable air. When

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the lapse rate exceeds the dry adiabatic rate the air is unstable. 110			

NSOU CC-GR-07 4.7 Key words Stability, instability 4.8 Model Questions Short answer type: 1. What is atmospheric stability? 2. What is atmospheric instability? Long answer type: 1. Differentiate stability from instability of atmosphere. 2. Briefly explain the concepts of lapse rate. State the stability and instability of atmosphere. 4.9

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Unit 5 Circulation in the atmosphere: Planetary winds, Jet Stream Structure 5.1 Introduction 5.2 Objectives 5.3 General Wind Circulation: Controlling Factors 5.4 Planetary Wind Belts 5.5 Global atmospheric pressure belts and their controlling factors 5.6 Tri-cellular Meridional Circulation 5.7 Jet Stream 5.8 Conclusion 5.9 Summary 5.10 Key words 5.11 Model Questions 5.12 Referebce 5.1 Introduction Wind is a part of the energy system and most of the wind motion take place horizontally east-west and north-south while vertical motion is also important as it helps to formulate precipitation. The large scale wind motion is known as general wind circulation of the atmosphere. Most of the atmospheric circulation occurs due to imbalance in energy. The tri-cellular model of wind circulation describes the pattern of circulation from equatorial to polar region. It is closely related with the planetary wind belts and the distribution of global atmospheric pressure belts. In this context, the features of jet stream affect the wind circulation very interestingly and attract the keen interest of the geographers, meteorologist and climatologist. 5.2 Objectives i. To know the general wind circulation pattern. ii. To know the controlling factors of general wind circulation. iii. To know the planetary wind belts. iv. To know the global atmospheric pressure belts. v. To know the factors controlling atmospheric pressure.
112 NSOU CC-GR-07 vi. To know the tri-cellular meridional wind circulation. vii.To know about jet stream. 5.3 General Wind Circulation: Controlling Factors Introduction–

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Atmospheric Circulation is the large scale movement of air and together with ocean circulations by which thermal energy is redistributed on the earth surface. The global atmospheric circulation varies from year to year, but large scale structure of

wind or atmospheric circulation remains constant. Factors Controlling Wind Circulation: There are two types of forces on atmosphere to produce wind– 1) Driving force–It includes vertical forces such as gravity and pressure gradient force and the horizontal pressure gradient force. 2) Steering force–It arises as the motion of air begins. This includes coriolis force, frictional force and centripetal force. Various types of Drivins forces– 1) Gravity–The gravity is net effect of two forces when they work together. (i) The force of attraction between the earth and other object. (ii) When centrifugal force imparted to all objects because of spins of earth's axis, the two forces combined to produce the force of gravity, which accelarates a unit mass of any object downward at the rate of 9.8 meters/ seconds. The force of gravity always acts downward perpendicular to earth's horizontal surface. The gravity is more at pole than equator. 2) Pressure gradient force–A pressure gradient exists whenever there is a difference in air pressure from one place to other. In this regard, difference in pressure can be caused by contrast in air temperature or difference in water vapour concentration. Closely spaced isobar means air pressure change rapidly with distance and it is steep and strong and when the isobar are not close pressure gradient is weak. Thus when air has steep and strong pressure gradient in one side and weak on other cause imbalance and create high pressure and low pressure and thus wind blow due to difference in pressure gradient. Various types of Steering forces– 1) Coriolis force–This cause due to the rotation of earth on its axis and has effect is on every moving object. The coriolis force is zero (0) at the equator
113 NSOU CC-GR-07 and maximum at poles. All free moving objects including winds

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are deflected to the right path of motion in the northern hemisphere and left in southern hemisphere.

The

rate of curvature of moving air is directly related to velocity of wind and the latitude. Characteristics of coriolis force– 1) It always directed at right angles to the direction of airflow or moving air. Therefore, wind blowing right to northern hemisphere and left sourthern hemisphere. 2) It only affected wind direction not wind speed. 3) It is affected by the wind speed, the strong the wind, the greater is deflecting force. 4) It is strongest at pole and weak at equator. 2) Friction—It work opposite to pressure gradient to reduce wind velocity and subsequently the coriolis effect. In lower troposphere, the horizontal wind is strong as it contact with ground and blow against the object. The rougher the surfaces, the greather the frictional resistance. The atmospheric zone in which frictional resistance is essentially confined is called friction layer. On clear day, when earth is headed their is turbulent mixing of air in lower atmosphere some of the air near the surface sloved down by friction and mixed with the faster moving air above. Two effects are there: 1) air aloft slow down 2) surface air get speeded up Fig. 5.1 : The Coriolis Effect.
114 NSOU CC-GR-07 After sunset no turbulent mixing of air takes place and causes solar heading. The wind near the surface, thus die out after sunset and frictional effect seen at 2 or 3 km. 3) Centrifugal action of wind–It is caused by flow of winds around curved isobar. It tends to deffect the motion inward, toward the centre of rotation. 4) Buys Ballot's Law– The law is named after Christoph Hendrik Diedrik Buys Ballot (1817–1890). It show the relation between wind and horizonal pressure gradient. The movement of air mass from an area of high pressure to an area of low pressure is wind. Besides pressure, centain other forces like, coriolis force, the deviation due to the Earth's rotation, and a centrifugal forces come into play. What we see is a balance between these forces. Buys Ballot Law states that

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in the Northern Hemisphere, if a person stands with his back to the wind, the amospheric pressure is low to his left, high to his right. This is because wind travels anticlockwise around low pressure zones in the Northern Hemisphere and is reversed in the Southern Hemisphere, but the angle between the pressure gradient force and wind is not a right angle in low latitudes.

In a local 'dust devil' (ghurni) during summer, one sees wind rotating anti- clockwise around a low-pressure spot on the ground. It's not applicable in the equatorial region because of zero coriolis force. In Meteorology, this law acts as simple thumb rule for locating cyclone centres. Fig. 5.2 : Buys Bllot's law
115 NSOU CC-GR-07 Difference between geostrophic wind and gradient wind– Geostrophic wind Gradient wind Definition– Wind whoes It is a horizontal direction and speed wind flow in the are determind by same direction as balance of pressure gradient geostrophic wind. force and coriolis force. Isobar They blow parallel The wind blow along to the isobar and the curved isobar. isobars are straight lines. Low pressure In low pressure system, In low pressure. geostrophic wind move system, gradient at more speed than wind move at gradient wind. less speed than geostrophic wind. High pressure In high pressure In high pressure or in ridges geostrophic or in ridges wind move at gradient wind move lesser speed. at higher speed Velocity Velocity depend on Velocity depends. pressure gradient and pressure gradints, coriolise force. coriolise force as well as centripetal force and centrifugal force. 5.4 Planetary Wind Belts Introduction–Atmospheric circulation is largest movement of air, along with oceanic circulation of the thermal energy is redistributed on Earth surface. The circulation has both vertical and horizontal, components and mass between the high and low latitudes. The Planetary Wind Belts–

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The pattern of the movement of the planetary winds is called the general circulation of atmosphere. The general circulation

along with oceanic circulation intluence the earth's climate.
116 NSOU CC-GR-07 There are four wind belts that can be seen: 1) Inter Tropical Convergence Zone (ITCZ)–It is low pressure generally situated near the equator. ITCZ represent the convergence of two trade wind system. It's average location is 5 o S to 5 o N latitudes. Mostly there is vertical movement in the atmospher in this zone. The atmosphere is hot, oppressive, sticky. As the sailors found themselves calmed, it is became to known * 2) This belts are found roughly from 5 o to 30 o N and S of latitude. The trade winds originate because of pressure

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of the pressure gradient from the tropical belts of high pressure to equatorial belt of low pressure. In the Northern hemisphere, the wind are north easterly direction and are called and for southern hemisphere the wind move in south easterly direction and are called The

zone of trade winds is called the because it resemble the connective model use by –
In this zone we found horse latitude. As when the sailors take horse on the ship while going to Westindes. The usually stuck in these calm waters and for lighter up the ship they had to throw their horse into the water and to conserve drinking water for themselves and this led to the term horse Hadley. Fig. 5.3 : The general circulation of the atmosphere. 117 NSOU CC-GR-07 3) This belt is lies between 30 o and 60 o latitude in both hamispher. They originated from the high pressure area in horse latitudes and moues found poles. Under the effect of coriolis force they become the south westerlies in Northern hemisphere and North westerlies in sourthern hemisphere. As south hemisphere there is more ocean as a result westerlies blow with greater force in south hemisphere. These are associated with extra-tropical cyclones. It can found in westerlies.

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This movement is the reverse of airflow in the Hadley cell.

In southern hemisphere, as there is all water, sailore use expression as— 40 o –Roaring forties. 50 o –Furious fifties. 60 o –Screaming sixties. 4) It

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blow from the polar high pressure belts toward temperate low pressure belts.

This wind are observed from anticyclone in Siberian and Canada. They are found between 70 o N and 60 o S latitude. –The cold polar easterlies move towards equator and clash with warm westerlies and the zone of convergent is known as polar front. Polar cells have tendency to move northward and southward with the shifts of pressure belts. The upper air flow is westerly and surface flow is easterly. Fig. 5.4 : Planetary winds Polar cap Polar easterlies Polar front Prevailing southwesterlies Northeast trade winds Equitorial low (doldrums) Southeast trade winds Subtropical high (horse latitudes) Polar cap Polar easterlies Polar front Prevailing northwesterlies Subtropical high (horse latitudes) uper air circulation 118 NSOU CC-GR-07 Fig. 5.5 : Generalized distribution of air pressure Mechanism of General Circulation of Atmosphere Since the atmospheric circulation is due to imbalance in the energy it include the following facts– 1. We can observed wind direction throughout the depth of troposphere. 2. It maintain the heat balance of atmospher. The mechanism by which heat is transferd showed be taken into account. 3. There must be close balance between precipitation and amount of evaporation. There are area where precipitation is more such as equatorial region and areas here evaporation is more in desert region. 4. The circulation must take the earth's angular momentum. 5.5 Global atmospheric pressure belts Introduction–The unequal heating of earth and its atmosphere by the sun, because of revolution of earth on its titled axis causes difference in pressure and form the pressure belts. ! a) " ! At equator as the insolation receive by the earth is maximum as a result the air got heat and it rise up and form low pressure area at the surface. This zone shifted northword during summer and move southward during winter. b) # ! $! The warm air rises up at the equator and it bend down toward pole. Due to coriolis force, the air descends at 30 0 –35 o latitude and create sub tropical high pressure belt. This zone is characterized by anticyclonic condition and most of
119 NSOU CC-GR-07 the hot desert of the world are present. c) ! ! This belt is located at 60 o –65 o in both the latitude. The surface water spread outward from this zone due to rotation of earth and produce low pressure. This belts are more dominant in southern hemisphere due to the existence of more water. d) $ High pressure at the pole on both the hemisphere due to low temperature. As a result density of air increases.

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In northern hemisphere, the belt is called the north polar high pressure belt

and in southern hemisphere, the belt is called

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south polar high pressure belt. The wind from these belts blow toward sub polar low pressure belts. % & (

i) ' (– In January, as the sun move south-ward,

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the equatorial low pressure belt shifts a little south of

the mean equatorial position. Area of lowest pressure oceurs in South America, South Africa and Australia because land heated up faster than water. Subtropical high is over the southern oceans and is broken into three cells. There may be some evidence of low pressure over Antarctica. ! A well develop high pressure cell occurs in the interior part of Eurasia as land cools more rapidly than oceans. The temperature lower down in winter than surrounding seas. In northern hemispher, two cells develop over North Atlantic and North Pacific. Fig. 5.6 : World Pressure belg and Planetary winds 120 NSOU CC-GR-07 2) ' (In July, the equatorial low pressure belt shifts toward north of mean equatorial position, because of northward movement of sun. All pressure belts shift northward in July. The polar high disappeared from map due to warm up of Arctic Ocean in summer in Asia a lower pressure develop. ! Subtropical high seams to be strongly developed over ocean than over cold continents. The subpolar low is continuous belt at about 65 o S to 75 o S latitude. Fig. 5.7 : A schematic model of the general circultions of the atmosphere in plan. Fig. 5.8 : A schematic model of the generation circulation of the atmosphere (in Northern Hemisphere) in cross section showing the Hadley, Ferrel and Polar Cell.
121 NSOU CC-GR-07

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Factors Controlling Pressure Systems: There are two main causes, thermal and dynamic, for the pressure differences resulting in high and low pressure system.)* + An important factor while studying the pressure systems in temperature and its variations from equator to the poles, since a chain of events takes place due to heating and cooling of the earth's surface and its atmosphere. When air is heated, it expands and hence,

it's

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density decreases. This naturally leads to low pressure. On the contrary, cooling results in contraction. This increases the density and thus leads to high pressure. Formations of equatorial low and polar highs are examples of thermal lows and thermal highs respectively. ,* * + The formation of pressure belts may be explained by dynamic controls arising out of pressure gradient forces and rotation of the earth.

The warm equatorial air rise and cool and after reaching in the upper layers, it starts moving towards the pole. It further cools and begins to subside in a zone between 20 o and 35 o latitude. Two factors are responsible for the general subsidence of air in this belt: First, cooling of the air results in increased density, which accounts for its subsidence. Second, owing to the rotation of the earth, the poleward directed winds are deflected eastwards, which is also called the Coriolis force. The rate of deflection increases with the distance from the equator. -* * +

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In January, the equatorial low pressure belt shifts a little south of its mean equatorial position, due to the apparent southward movement of the sun. The lowest pressure occur on the land masses of South America, South Africa and Australia, because land masses become much hotter than the adjoining oceans. Sub-tropical high pressure belt of the southern hemisphere is broken over the continents and remains confined to the oceans only. It's development is maximum in the eastern parts of the oceans where the cool ocean currents are effective. In the northern hemisphere, a well-developed sub- tropical high pressure area extends over the continents. Finally, sub-polar low of the southern hemisphere extends as a trough whereas in the northern hemisphere, there are two cells of low pressure extending over the North Atlantic and the North Pacific. These are known as the Icelandic low and the Aleutian low respectively. 122 NSOU CC-GR-07 In July, the equatorial low pressure belt shifts towards the north due to the movement of the sun. This shift is maximum in Asia. The landmasses of the northern hemisphere become excessively hot and low pressure areas develop over them. The sub-tropical high pressure belt of the southern hemisphere extends continuously. In contrast, in the northern hemisphere, it is broken over the continents and remains confined to the North Atlantic and North Pacific Oceans. Sub-polar low is deep and continuous in the southern hemisphere, while in the northern hemisphere there is only a faint oceanic low. .* * / + The atmospheric pressure shows a definite rhythm when observed diurnally.

Insolation

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heating and terrestrial radiation are mainly responsible for diurnal variations in pressure. During the equinoxes, the maximum occurs at 10 A.M. and 10 P.M. and the minimum at 4 A.M. and 4 P.M. In the tropic, higher diurnal range occurs at places located at sea level and a lower range occurs at places located at higher altitudes. The continents experience a larger range during daytime and a smaller range during the night. The oceans and coasts have a large diurnal range. The irregularities in the diurnal range occur due to cyclones, anti-cyclones and other atmospheric disturbances. These irregularities are larger and more pronounced in mid-latitudes and less pronounced in high

latitdues. Characteristies of major global winds Latitudinal sone Sea level p r e s s u r e conditions Surfaces over which most disti- nctly developed Average direc- tion near to surface Average ve- locity near to surface Seasonal varitation Consistency of veloc- ity and direction Doldrums Equatorial–may be displaced 20 o from the Equator, particularly in the Northern Hemi- lsphere Generally low pressure with slack p r e s u r e gradients Over ocean surfaces as a discontinuous zone Highly variable Less than 3 ms -1 Contigulty of the doldrum zone varies, most extensively developined in March and April; disjoined in August Highly variable Equatorial Westelies Equatorial, extending to 28 o particulary over the Indian sub- continent Low, particularly monsoonal (summer) pressure conditions Primarily ocenic, but of major importance over land areas of West-Africa and India SW in Northern Hemisphere; NW in Southern Hemisphere Less than 6 ms -1 Best developed in the summer hemisphere Locality very consistent in speed and direction Trade winds 40 o to Equator, reaching greatest velocity 5 0 to 20 0 Subsiding air associated with subtropical anticyclone Core areas located in eastern parts of major oceasn but also blowing over subtropical and surface NE in Northern Hemispher; SE in Souther Hemisphere 5 to 8ms -1 Core areas most extensive in winter hemispheres but greatst velocities in summer Remarkcably consistent; core areas over 70% recorded win direction from east; over 50% in most other trade win areas
123 NSOU CC-GR-07 5.6 Tri-cellular Meridional Circulation The three cell model of the northern hemisphere or the meridional circulation is a model prepared by Palmen in 1951.

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The model makes it clear that there are two possible ways of transporting heat and momentum: (a) By circulation in vertical plane (

b) By horizontal circulation

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The three meridional circulation cells are– – Tropical cell (Hadley cell) – Polar front cell (Ferrel cell) – Sub polar

and polar cell (1) * This cell

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is also called Hadley Cell after G. Hadley who put forward his own explanation in 1735. The

circulation cell is located between the equator to 30° latitude. It rotate anticlockwise. Due to high rate of heating at equator, resulting the warm air moves up then cumulanimbus clouds with great vertical height form. The warm air moves from tropical cell to poleward direction. The poleward flow of air in this cell and this are not affected by surface friction. These air again blow towards the equator where they again heated. 2) This cell are also called Ferrel

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Cell. In this mid latitude cell, the surface air flow is directed toward the pole and becasue of coriolis force. The wind blow almost from west to east.

They move from pole ward to equator ward. These wind descent near horse latitudes. After decending the winds again blow poleward as surface westerlies and compute cell is form. It rotate clockwise. 3) This cell are located between 60 o latitude and the poles. The

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polar easterlies blow from polar high pressure area to mid latitude low pressure belt. The general direction of surface polar

wind become eastal, due to ceriolis force. The polar eastern winds move equator ward and cloud with warm westerlies in temperate regions and form polar front. The pole ward upper air decent at poles and the polar high pressure form polar cell.
124 NSOU CC-GR-07 5.7 Jet Stream Introduction–It is defined as fast moving air that is usually several thousand miles long and wide but relatively thin. They found in the upper atmosphere between troposphere and stratosphere. It was discovered during second world war. Properties of Jet Stream 1. The circulation of jet stream is from west to east but only tropical easterly jet stream moves from east to west. 2. On an average, jet stream measure

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thousands of kilometers in length, a few hundread kilometers in width and a few kilometers (2–4) in depth. 3. The circulation is observed between pole and 20 o latitudes in both the hemispheres. 4. Their circulation path is wavy and meandering. 5. There is seasonal charge in the wind velocity in jet stream. Wind velocity increase twice in summer season (480 km per hour). 6. Jet Stream narrow down during summer season because of their northward shifting. Types of Jet Streams– 1. Polar front Jet Stream–This is

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formed above the convergence zone of the surface polar cold airmass and tropical warm air mass.

These move in easterly direction but are irregular. 2. Subtropical Westerly Jet Stream–It move in upper tropesphere to the north of subtropical surface high pressure belt. The circulation is from west to east in more regular manner. 3. Tropical Easterly Jet Stream–This develop in upper troposphere above surface easterly trade winds over India and Africa. 4. Polar Night Jet Stream–This also known stratospheric subpolar jet streams. This develop in winter season. This jet stream become strong with high wind velocity during winter and low velocity during summer. 5.

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Local Jet Stream–This formed locally due to local thermal and dynamic condition and have limited local importance. 125

NSOU CC-GR-07 Importance of Jet Stream 1. Jet Stream cause horizontal convergence and divergence in upper troposphere. Convergence cause anticyclone and due to divergence air cyclone develop. 2. The vertical circulation of air in jet stream occurs in two ways. Cyclonic pattern is characterized by upward vertical air movement and anticyclonic patter is characterized by downward vertical air movement. This transfer anthropoganic pollutants. 3. The monsoon of South Asia is largely affected of controlled by Jet streams. 4. Sub-tropical westerly jet stream is responsible for one on set of monsoon. 5. Jet stream's location is used by meteorologist to help them in weather forecasting. They are responsible for pushing weather all over the world and control the behaviours of terrestrial atmosphere. Index Cycle of Jet Stream (Formation and Development of Jet Stream) : There are changes in the position of exent of jet stream from pole towards equator. The heavy jet stream is called Rossby waves. The period of transformation of straight Fig 5.9: Various types of Jet Stream.

126 NSOU CC-GR-07 path to weavy path is called index cycle. It has four stages:– (A) First Stage–The position of jet stream is near the poles and is separated by polar cell air mass in north and warm westerlies in the south. The westerlies in this stage have shifted towards higher latitudes where cyclonic activity take place. The circulation of jet stream is almost straight path from west to east. There is steep pressure gradient across this strong upper air westerly circulation and general high zonal index. (B) Second Stage–Grandully the amplitude of wave increase. The straight path of jet stream transformed into wavy path. The whole jet moves toward the equator. This stage is the begining of development of Rossby waves. (C) Third Stage–This stage is characterized be fully developed meanders cores of jet stream as the bending become sharp and amplitude increase there tropical air mass move north and cold polar air moves to south. Jet stream near

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equator and exchange of tropical and polar air masses take place on

large scale and temperature gradient is directed from east to west. (D) Fourth Stage–In this stage

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the giant size meanders of the jet streams are cut off from the main stream caused due to meridional circulation. In the upper atmosphere of higher latitudes, the tropical air masses are entrapped by the

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colder air. This is called the low zonal index of jet stream and the zonal character of

the

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upper level westerlies is no longer existence. They are fragment into number of cells.

Fig. 5.10 : Index cycle of Jet stream

127 NSOU CC-GR-07 5.8 Conclusion The general wind circulation pattern, tri-cellular model of it along with the controlling factors of wind circulation are very significant to understand the global scenario of planetary winds. Moreover, global atmospheric pressure belts and the salient features of jet stream help to understand the regional climatic conditions related to wind and pressure. 5.9 Summary The global

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atmospheric circulation varies from year to year, but large scale structure of

wind or atmospheric circulation remains constant. The equatorial region has zero coriolis force. The geostrophic wind blows parallel to the isobar. Globally there are four wind belts. In southern hemisphere, sailore use expression for the different latitudes as: 40 o - Roaring forties; 50 o -Furious fifties; 60 o -Screaming sixties. The three cell model of the northern hemisphere is prepared by Palmen in 1951.

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The three meridional circulation cells are: Tropical cell (Hadley cell); Polar front cell (Ferrel cell); Sub polar

and polar cell. The stronger flow of winds than normal in narrow cores are known as jet stream. The monsoon of South Asia is largely affected by jet streams. The jet stream is measured on an average,

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thousands of kilometers in length, a few hundread kilometers in width and a

few kilometers (2-4) in depth. 5.10 Key words Wind circulation, tri-cellular model, planetary winds, pressure belts, jet stream, coriolis force, Hadley cell, ferrel cell, polar cell, roaring forties, furious fifties, screaming sixties, horse latitude, geostrophic wind, doldrum, ITCZ 5.11 Model Questions Short answer type: 1. State the factors controlling general circulation of winds 2. What is geostrophic wind?

128 NSOU CC-GR-07 3. What is coriolis force? 4. What is Byes ballot law? 5. Differentiate geostrophic wind from gradient wind. 6. State the factors factors controlling pressure belts. Long answer type: 1. Explain the general pattern of distribution of planetary winds. 2. Give an account of the global pressure belts with diagram. 3. Discuss the relation between the global pressure belts and planetary winds. 4. Describe the tri-cellular (meridional) models of wind circulation. 5. Discuss the types and development of jet stream. 6. Highlights the properties and importance of jet stream. 5.12

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Unit 6 * Structure 6.1 Introduction 6.2 Objectives 6.3 Tropical Cyclone 6.4 Mid-Latitude Cyclone 6.5 Conclusion 6.6 Summary 6.7 Key words 6.8 Model Questions 6.9 References 6.1 Intruduction Henry Piddington first used the term 'cyclone' in 1840, as a derivation from the Greek word 'Kyklon' which means moving in a circle, like the 'coil of the snake'. In this portion, we came to know about two cyclones of two different regions. Cyclones lying between the tropics of capricorn and tropics of cancer are called tropical cyclones and cyclones observed in the temperate region uniformly are known as extratropical cyclones. 6.2 Objectives i. To know about tropical cyclones. ii. To know the features, favourable conditions of tropical cyclones. iii.To know the formation and structure of tropical cyclones. iv. To know about extratropical cyclones. v. To know the salient features of extratropical cyclones. vi.To know the formation and weather condition associated with extratropical cyclones. 6.3 Tropical Cyclone Introduction–Henry Piddington first used the term 'cyclone' in 1840, as a derivation from the Greek word 'Kyklon' which means moving in a circle, like the 'coil of the snake'. Cyclones developed in the regions lying between the tropics of capricorn and
130 NSOU CC-GR-07 cancer are called tropical cyclones which are not regular and uniform like extratropical or temperate cyclones. They vary in form, shape, size, velocity and weather conditions. Types of tropical cyclone—Generally they are divided into four major types– i) Tropical distrubance or easterly wave. ii) Tropical depression. iii) Tropical storm. iv) Hurricanes or Typhoons. On the basis of intensity they are divided into two principal types and four sub types— i) Weak cyclones: a) Tropical disturbance b) Tropical depressions ii) Strong and furious cyclones: a) Hurricanes and typhoons b) Tornadoes 1. Favourable conditions—The exact mechanism for the origin of tropical cyclones is still poorly understood. Sometimes, it is said that they have been occured due to development of a front like situation between land and sea wind. But more acceptable concept in this regard is it's thermal origin over warm tropical sea, development of which is related to the release of latent heat of condensation. The general conditions necessary for the origin and development of tropical cyclones can be summerized as follows:– i) There should be continuous supply of abundant warm and moist air. Tropical cyclones orignate over the warm tropical ocean where the surface temperature is above 27 o C during summer season. ii) Presence of higher value of coriolis force is rewired to give spiral motion to the inflow winds. Infact, coriolis force causes cyclonic circulation of air. That is why tropical cyclones are particularly absent in a belt of 5 o –8 o wide on both sides of the equator where coriolis force is minimum. Most of the cyclones are limited to a belt of 5 o –20 o Notth in the western parts of the oceans. iii) They are associated with Inter-Tropical Convergence (ITC) which extendes from 5 o to 30 o North latitudes during summer season. iv) Pre-existing weak tropical disturbances and intensity ultimately develop high intensive violent tropical cyclones. v) There should be anticyclonic circulation at the height of 9000–1500m above the surface distrubance. The upper air anticyclonic circulation sucks the air from the ocean surface above and thus the upward movement of air in
131 NSOU CC-GR-07 accelerated and low pressure centre at the surface is further intesified. vi) Tropical cyclones develop around small atmospheric vertices in the Inter- Tropical Convergence Zone (ITCZ). 2. Characteristics– i) Size– Tropical cyclones vary in size considerably. Their average diameter is from 80 km. to 300 km. But some of them may be having just 40 to 5 km. in diameter. ii) Velocity–They advance with varying velocities weak cyclones move at the speed of about 32 km per hour whille hurricanes attain the velocity of 180 km. per hour on more. iii) Vigorous–Tropical cyclones become more vigorous and move with very high velocity over the oceans, but become weak and feeble while moving over land areas and ultimately die out after reaching the interior portion of continents. iv) Pressure–The centre of the cyclone is characterised by extremely low pressure called 'eye' of the cyclone. v) Temperature variation–Like temperate cyclones, tropical cyclones are not characterized by temperature variations in their different parts as they do not have different fronts. vi) Rainfall cell–There are no different rainfall cells in the tropical cyclones as is the case of temperate cyclones and hence each part of the cyclones yields rainfall. Fig. 6.1: Tropical Cyclones as an energy system. Potentical energy Kinetic Energy Friction

132 NSOU CC-GR-07 vii) Flood deluge–Tropical cyclones are not always mobile. Sometimes, they become statinoary over a perticular place for several days and yield heavy rainfall causing flood deluge and environmental disaster. viii) Movement–Normally,

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they move from East to West under the influence of trade winds.			

These cyclones weaken when they enter subtropical region. ix) Time–Tropical cyclones are confined to a particular period of the year, mainly during summer season. x) Energy–Tropical cyclones derive their energy from the latent heat of condensation. 3. Natural hazard–Tropical cyclones become disasterous and natural hazard due to their high wind speed (180–400 km/hour), high tidal surges, high infall intensity, very low atmospheric pressure causing unusual rise in sea level and their presistence for several days cause several damages to the affected regions. 4. Regional Distribution–These clyclones are mostly develop over the occean surface between 5 o –15 o latitudes in both the hemisphere. There are 6 major regions of the tropical cyclones e.g.– 1. Tropical North Atlantic Ocean. 2. Western part of the tropical North Pacific Ocean. 3. Eastern part of the tropical North Pacific Ocean. 4. The Bay of Bengal and the Arabian Sea. 5. The South Indian Ocean. 6. The Western South Pacific Ocean. 5. Formation and Development/Life cycle: Pre-conditions: i) A continuous supply of abundant heat and moisture. ii) A suitable heat source, usually a large tropical water surface. iii) Low level convergence, turbulent vertical motion of air and strong anticyclonic circulation in upper troposphere. iv) High coriolis deflection to generate a cyclonic movement. v) Weak vertical wind shear. vi) Existence of weak tropical disturbance favouring intensification the storm etc. A) Formation stage: i) These phase develop over the sea with huge area. ii) It concentrating on the low pressure, wind from the high pressure area comes to the low pressure zone.
133 NSOU CC-GR-07 iii) The value of low pressure zone between 915 to 950 mb. B) Developing stage: i) The pressure radient fall and the wind velocity increases in this phase. ii) Wind rotate

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anticlockwise in the northern hemisphere and clockwise in the southern hemisphere. iii) The		

isobers line become rounded with the difference of 2–3 ml and closely located. iv) wind speed 25–40 km/hr colled depression. C) Mature stage: Divided into four parts– i) Eye of the cyclone (10-30 km. radius) ii) Wall of eye of cyelone (wind speed. 90km/hr) iii) Heavy rainfall with high wind velocity (80–150 km/hr) iv) Turbulence zone. v) Asymmetrical wind. d) Dissipating stage: i) Last stage of the phase. ii) It is the dacaying phase of cyclone. iii) Wind speed falls at 2–40 km./hr. 6. Structure: The horizontal structure of the cyclone, included fine parts– 1) The eye of the cyclone–(i) The eye is the centre of the storm, which is more or less circular with 5–50 km. diameter. The lowest pressure, the highest temperatures and the highest relative humidities of the storm are found within the eye. The air at the outward edge of the eye is dragged upward and outward by the surrounding air. ii) Eye wall–The eye is surrounded by a wall of cumulonimbus clouds known as eye wall, which is a more or less circular region of about 10-20 km wide. The cold air Polar front warm lite air cold air warm front warm air cold front Fig. 6.2 : Formation of Tropical Cyclone
134 NSOU CC-GR-07 strongest winds are found within the eye wall and it consists of an almost continuous ring of intense thunderstorm involving explosive cumulonimbus growth with violent vertical motion. As a result, the most intense rainfall occur in this region. 3) Spiral Band–Away from the eye wall there are two spiral bands which give the cyclone the appearance of galaxy from the space. These spiral bands are also called rainbands or feederbands. It contains many individual thunderstorm which produce heavy rainfall spiralling towards the centre in a cyclonic sense. 4) Annular Zone–The annular zone has suppressed cloudiness, high temperatures and low humidities. This is because of subsidence of air from aloft at the outer limits of the cyclone. Fig. 6.3: Tropical cyclones in plan (a); profile (b); and three dimension (c).

135 NSOU CC-GR-07 5) Outer connective band–The outer connective band occurs at the edge of the main cloudmass and consists of an outer fringe of deep connective cloud produced as a result of instability which is consequent upon convergence of subsident outflow. The vertical structure of the cyclone include three parts– i) Inflow layer–The inflow layer is the lowest layer extending upto 3 km. It is this layer which drives the storm and liberates latent heat. ii) Middle layer–Middle flow layer extending between 3 to 7 km. Thus, the main cyclonic circulation of the storm takes place in this region. The airflow is circular in form. iii) Outflow layer–The outflow layer is from 7 km. upward to the tropopause. The air motion is anti-cyclonic and helps in divergence of the air. 6.4 Mid-Latitude or Extra-tropical Cyclone Introduction–The term extra-tropical cyclones, temperate cyclones or depressions are inter changeably used to denote these moving cyclones in the mid-latitude zone. Extratropical cyclones arise through a process called cyclogenesis, in which cold and warm air masses interact in an unstable environment. Colder air to the north and warmer air to the south flow toward each other creating an area of low pressure between them. Location–Extra-tropical cyclones develop in the regions lying between 30 o and 65 o north and south latitudes in both the hemispheres near the Asian coast and the Atlantic, near Greenland and the North American coasts. Stroms affecting Europe typically originate to the east of North America or Greenland and subsequently move Eye of cyclone Wall of cyclone tail of cyclone Fig. 6.4: Structure of Tropical cyclone

136 NSOU CC-GR-07 eastward across Europe.

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It is in these latitude zones that the polar and tropical air masses meet and form		

what is known as the polar fronts. Characteristics– 1)

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Size and Shape The temperate cyclones are asymmetrical and shaped like an inverted 'V'. They stretch over 500 to 600 km. They may spread over 2500 km over North Americal (Polar Vortex). They have a height of 8 to 11 km. 2) Wind Velocity and Strength The wind strength is more in eastern and southern portions,			

more over

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North America compared to Europe. The wind velocity increases with the approach but decreases after the cyclone has passed. 3) Orientation and Movement Jet stream plays a major role in temperate cyclonogeneis. Jet streams also influence the path of temperate cyclones. Since these cyclones move with the westerlies (Jet Streams), they are oriented east-west. If the storm front is directed northward, the centre moves			

towards the north, High Cold front Warm front Warm sector Fig. 6.5 : Temperate cyclone of northern hemisphere

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but after two or three days, the pressure difference declines and the cyclone dissipates. When the storm front is directed southwards, the centre moves quite deep southwards-even up to the Mediterranean region and cause the Mediterranean cyclones or Western Disturbances (They are very important as they bring rains			

of

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North-West India–Punjab, Haryana). 4) Structure The north-western sector is the cold sector and the north-eastern sector is the warm sector (Because cold air masses in north and warm air masses in south push against each other and rotate anti-clockwise in northern hemisphere). Source Region–The most frequent temperate cyclone

areas are between 35 o - 65 o latitudes in both the hemisphere. Some favourable storm tracks are— i) After originating from noth Pacific of the north-east and eastern coasts of Asia move in easterly and north easterly directin towards the gulf of Alaska and ultimately merge with Aleutian Low and then follow southerly directin and reach as far south as Southern Californai. ii) Sierra Nevada Range, Eastern Colorado, East of CAnadian Rocky Mountains, Great Lakes region in North America. iii) Gulf of Mexico is also the chief centre of its origin. iv) North-west North Atlantic of the north-east coast of North America, from here cyclone enters the north western part of Europe. v) Area between Iceland and Barents Sea. 5) Stages of the life cycle of an extra-tropical cyclone: The four stages in the life cycle of an extra-tropical cyclone are: (1) the initial state, (2) the incipient stage, (3) the mature stage, and (4) the occlusion stage. i) The initial stage: In the initial stage the polar and the tropical air currents which are on the opposite sides of the polar front blow parallel to the isobars and the front is created. In the cold air mass to the north of the polar front flow air from east to west. In the warm air mass to the south of the front flow the air from west to east and the wave disturbance is produced the front is in perfect equilibrium. The wedge of cold air mass lies under the warm air. These is complete absence of wind shift. The weather is fine. However, along the slanting surface of discontinuity where the opposing air currents meet, there is a sudden change in the direction of wind. This is called wind-shear.
138 NSOU CC-GR-07 Fig. 6.6 : Cyclone model: upper drawing shows the idealized circulation of a mature cyclone; middle and lower drawings are vertical cross-sections along a-b and c-d respectively. ii) The incipient stage: In the second stage a wave has formed on the front. Cold air is turned in a southerly direction and warm air in a northerly direction. A wave like unstable front was created due to the penetration of warm and cold air masses into one another territory. This results in the readjustment in the
139 NSOU CC-GR-07 pressure field as a result of which the isobars become almost circular in shape. A cyclonic circulation is initiated around a low centre at the apex of the wave. The whole cyclonic vortex is carried along with the winds prevailing in the warm-air region at approximately the speed of the geostrophic component of the wind. It may be pointed out that the new depression developing at the crest of the wave is called the nascent cyclone. The process of the birth of a new cyclone is commonly called cyclogenesis. iii) The mature stage: In the third stage the intensity of cyclone increases. The curvature and amplitude of the wave also undergo a marked increase. The air in the warm sector starts flowing from the southwest towards the colder air flowing from the southeast. Now, the cyclone is fully developed. There are well marked warm and cold sectors. The warm air in this stage moves faster than the cold air. The direction of movement is perpendicular to the warm front. In fact, the warm air is moving into a region previously occupied by the cold air. In the rear of the cyclone cold polar air is under-running the air of the warm sector, thus a cold front is generated there. Throughout the cyclone, there is an ascending air along the entire surface of discontinuity. If the rising air mass is moist, there will be cloudiness and precipitation along the warm as well as cold fronts as shown by the shaded areas. The precipitaion released at the warm front is more widespread and steady, whereas the cold front precipitation is confined to a narrow zone. Since the position of the cold front advance faster than the warm front, the warm sector becomes progressively narrower. This is the beginning of occlusion. This particular phenomenon marks the maturity of the cyclone. iv) The occlusion stage: In the final stage the advancing cold front ultimately overtakes the warm front which results in the formation of an occluded front. Occlusion starts first near the apex of the wave where warm front is closest to the cold front. Gradually the process of occlusion comes down to the more open part of the two fronts. Thus, the warm sector is slowly pinched off and finally the two cold air masses mix across the front. This eliminates the occluded front. Now, the cyclone dies out. The life span of a single frontal cyclone is normally about five to seven days.

140 NSOU CC-GR-07 Fig. 6.7 : Stages in the life cycle of an extratropical cyclone (a) Initial state (b) Incipient state (c) Mature state (d) Occlusion state 6) Origin of Extra-tropical cyclones: i) Ploar front theory— This theory, as stated earlier, is also called the frontal theory or the wave theory of the origin of extra-tropical cyclones. It was developed by V. Bjerknes. This theory recognizes that the polar front, separating polar and tropical air masses, gives rise to cyclonic disturbances that intensify and move along the front and proceed through a somewhat predictable life cycle. Cyclones, according to Bjerknes, from along a front where polar and tropical air masses with contrasting physical properties (temperature and density) are moving parallel to it in opposite directions. However, it is to be pointed out that the middle latitudes are an area of convergence and it is here that unlike air masses such as the cold polar air and warm tropical or subtropical air generally meet. It may be noted that the polar front is not a permanent line. According to the polar front theory, as the cold polar air is deflected equator- ward and the warm tropical air pole-ward, a cyclone-forming wave is formed along the front. The wave thus formed and is divided into two parts:- The eastern part of the wave where the warm air advancing towards the east ascends over a wedge of cold air mass is called the warm front.
141 NSOU CC-GR-07 Fig 6.8 : Life cycle of a Mid latitude cyclone The western portion of the discontinuity, where cold polar air is replacing the warm air by under-running the warm and lighter tropical air mass, is the cold front. Now, the process of occlusion starts. Whether it is warm-front or cold-front type of occlusion, the warm-air sector is raised aloft, and cold air behind the cold front now meets the cold air in advance of the warm front. It is at this critical point that the cyclone is said to have reached maturity. It is noteworthy that when warm and cold fronts are combined into one a long backward-swinging front is formed. This is called an occluded front. ii) Baroclinic wave theory— This theory is based on the fact that cyclones of the extra-tropical regions may form even with out pre-existing front between on polar and tropical air masses. The most important feature is that it evolved through the use of mathematical techniques and numerical analysis of weather forcasting.
142 NSOU CC-GR-07 Fig 6.5 : .... Fig. 6.9: Stages of Extra-tropical cyclone: The Polar Front Theory (after Bjerknes) Baroclinicity state the stratification in the atmosphere in which surfaces of constant pressure interest surface of constant density. Barotrophy state the stratification in the atmosphere in which surface of constant pressure and constant density are parralel. According to baroclinic theory, cyclones and anticyclenes on the temparate region form, as a result of one the baroclinic stability. According to this theory, the north-south temperature gradient makes the middle- latitude upper air flow unstable. The air flow assumes wavy flow, which under special circumstances breaks into cyclones and anticyclones. Through these atmospheric disturbances, the greater heat exchange in the mid latitude region is made possible cyclones and anticyclones. According to this they are non-frontal on origin and may be taken to be a part and parcel later. Types: According to Humphreye's, it can be divided into– 1. Thermal cyclone: In it, the depression

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which are formed due to inequalities of temperature and barometric pressure. 2.		

Insolation cyclones: Caused by relatively warm land. In this case intense
143 NSOU CC-GR-07 insolation cause

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low pressure area and the shape of isobars become oval. The winds begins to move spirally and		

cyclones developed. 3. Migratory cyclones: Which

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are temporary in duration and whose origin is due to thermal convection. These are short lived. And during		

the short live, they

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are maintained by the latent heat released at the time of condensation. 7)

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Associated Weather The approach of a temperate cyclone is marked by fall in temperature, fall in the mercury level, wind shifts and a halo around the sun and the moon and a thin cover of cirrus clouds

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Rainfall stops and clear weather prevails until the cold front of an anticyclonic character arrives which causes a fall in temperature. After this clear weather is established. The temperate cyclones experience more rainfall when there is slower movement and a marked difference in rainfall and temperaute between the front and rear of the cyclone. These cyclones are generally accompanied by anticyclones. 6.5

Conclusion The weather of tropical region is largely effected by tropical disturbance, which may take a variety of forms. Among which the most important and common types are tropical cyclones and easterly waves. The tropical cyclone includes all cyclonic circulations origination over tropical water and strongly impacted on the weather of the region. The extratropical cyclone which is actually a mid latitude depression, plays a very significant role in transfer of energy from equator to poles. 6.6 Summary Tropical cyclones orignate over the warm tropical ocean where the surface temperature is above 27oC during summer season. They are associated with Inter-Tropical Convergence (ITC) which extendes from 5o to 30o North latitudes. Tropical cyclones known by diverse name in different regions of the world. Tropical cyclones have very high wind speed. Tropical cyclones have horizontal and vertical structures. The center of the tropical cyclones is known as Eye of cyclone. Extratropical cyclones arise through a process called cyclogenesis.

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The temperate cyclones are asymmetrical and shaped like an inverted 'V'.

The most frequent temperate cyclone areas are between 35o- 65o latitudes in both the hemisphere.
144 NSOU CC-GR-07 The polar front theory (also known as frontal theory or the wave theory earlier) that described the origin of extra-tropical cyclones was developed by V. Bjerknes. According to baroclinic theory, temparate cyclones form as a result of one the baroclinic stability. 6.7 Key words Tropical cyclones, Extratropical cyclones, Eye of cyclone, ITCZ, polar front theory, baroclinic wave theory, cyclogenesis, front 6.8 Model Questions Short answer type: 1. State about the structure of tropical cyclone. 2. What are the favourable conditions for tropical cyclone? 3. State about the Baroclinic wave theory and polar front theory of mid latitude cyclone. 4. What are the salient features of mid latitude cyclone? 5. What is anti-cyclone? 6. Differentiate cyclone from anti-cyclone. 7. Differentiate Warm front from Cold front. 8. What is Occluded front? 9. Distinguish between Frontogenesis and Frontolysis. 10. State about the regional distribution of tropical cyclone. 11. Classify tropical cyclones. Long answer type: 1. Explain the growth, origin and structure of tropical cyclone. 2. State the origin and development of the extra-tropical cyclone. 3. Distinguish between the tropical and extra-tropical cyclone. 6.9

81%	MATCHING BLOCK 212/265	W	

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Unit 7 Monsoon Circulation and Mechanism with reference to India Structure 7.1 Introduction 7.2 Objectives 7.3 Indian Monsoon 7.4 Circulation of Monsoon and relation with Jet Stream 7.5 Mechanism of Monsoon 7.6 Conclusion 7.7 Summary 7.8 Key words 7.9 Model Questions 7.10 References 7.1 Introduction In meteorology, monsoon signifies the directional shifting of winds from one season to other. The term Monsoon is arrived from a Arabic word 'Mowsim' which means 'season'. The monsoon climate is the characteristics of the whole India. Through the monsoon is dominated over India but its influence is observed in East-South Asia, owing to the greater size of the continent and consequently a greater seasonal extremes of temperature. East-South Asia is considered to be the classical monsoon region. The Indian monsoon has two branches, Arabian branch and Bay of Bengal branch. The origin of monsoon with special reference to India is very interesting and a matter of debate. Jet strem has a strong impact on the origin of monsoon.

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The sub-tropical jet stream plays a significant role in both

hindering the monsoon winds as well as in quick onset of monsoons. 7.2 Objectives i. To know about monsoon. ii. To know about Indian monsoon. iii. To learn about branches and features of the Indian monsoon. iv. To know about the relation of Indian monsoon with jet stream. v. To know about the theories of origin of Indian monsoon.

146 NSOU CC-GR-07 7.3 Indian Monsoon Introduction: The name monsoon is said to be derived from the Arabic word 'Mausim' meaning winds over the Arabian Sea which blow approximately 6 months from the North East and 6 months from the South East. As the word monsoon is commonly used in climatological literature, however it innoines not only a seasonal wind reversal but also one of the thermal origin arising from the differential heating of extensive land water surface. According to this move restricted point of view (monsoon are result of the earth's surface being non-homogeneous in character of such monsoon couldn't develop if the earth's surface were composed of either all land or all water. Characteristics: The main characteristics of the Indian summer monsoon are as follows– 1) The summer monsoon sets in over the extreme south of Indian peninsular on the 1st of June. The arrival of the monsoon is a gradual process with a period of transition, a spread over a week or more. 2) Subsequently the monsoon advances along

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West Bengal and Assam in North- East India. The Bay of Bengal

Branch is deflected by the orientation of the mountains into the Indo Gangetic plain of North India. 3) The normal duration of the monsoon varies from a 100–120 days. It begins to withdraw from India by mid September. 4) Over 70% of the India's annual rainfall is recorded is summer monsoon months. Much of the rainfall is caused by the maintain barriers but connective phenomena play an important role. 5) The variability of monsoon rain is highest over New India and Rajasthan. There are the areas which receives small amount of monsoon rain. 6) North-West India is an area of low barometric pressure. During the monsoon the region of low pressure coincides with the thermal high which gradually builds up over new india into the premonsoon months of May and June. 7) An extension of the seasonal low into the Indo Gangetic plain

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is known as the Monson through. The axis of the monsoon shows preiodic movements to the North and

to the South of the Indo-Gangetic plain. 8)

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Above the monsoon winds, the Indian subcontinents is dominated by an extensive anticyclonic circulation. The		

reversal of the wind field occurs at about 6 km. 9) Along the southern end of anticyclones a narrow belt of strong winds of about
147 NSOU CC-GR-07 16 km above sea level is encountered. This is well

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known as the easterly jet stream of the Tropics. For to the North of Himalayas the sub tropical jet		

blowing from the West to East. The aixs of the jet is located along the southern slopes of the Himalayas in winter but suddenly shifts Northwards with the advent of monsoon. 10) A region of high temperature is usually observed over tibet. This previdES the heat source and ascent for Hadley cell, subsequently the air spreads southwards wided by the upper tropospheric anticyclone over Tibet. Influence of Monsoon: Through the monsoon is dominated over India but its influence is observed in East- South Asia, owing to the greater size of the continent and consequently a greater seasonal extremes of temperature. East-South Asia is considered to be the classical monsoon region. According to the standard explanation of thermally induced monsoon, such a system of wind is simply a convectional system of gignatic scale. The chain of events is from temperture through pressure and winds to rainfall. In the high sun period the land surface becomes warmer than the surface of the surrounding seas and this thermal contrast tends to set up surface pressure difference in low centre over the land and high pressure over the adjacent areas. As a consequence the summer monsoon is a sea to land wind, the maritime air binging to the land on abundance of moisture cusing heavey rainfall. But there is some duobt, however weather the above described monsoon system of winds in its pure form, actually is a common occurance. And according to P.K. Das—'It is a restless of sea of motion, out there with great waves of disturbances'. The elements that make up the weather–wind, temperature air pressure and water vapour are in a state of constant flex. Every few km. upwards the wind blows in reverse direction. Air temperature and pressure and engaged in a sea- saw war for supremacy as nature strives to achieve a choatic balance. It is out of this chaos that the monsoon is born. The process begins when gently tilled earth rotate towards the summer solstice as a summer breaks over the Northern Hemisphere (which includes India). The landmass of the Asian continent heats up faster than the ocean. Giant low pressure areas or hotspots develop over Rajasthan at central India. The winds reverse direction dramatically and blows in carring rain bearing clouds. Meteorologists have discovered that if the crest of an upper air wind system moves southern, it imerits good monsoon. They also discover a dramatic burst of kinetic energy characterized by strong winds of the west coast just before the onset of monsoon. They further noticed an unusual cooling of Arabian sea by an ocean current (somale current) moving from E. Africa. The process seems simple enough but now as one meteorologist puts in 'we begin to oscillate'.

148 NSOU CC-GR-07 Meteorologist usually predict the course of monsoon by monitoring the temperature over Rajasthan and East coast during March. They have noticed that whenever it has been of few degrees above normal on these not spots. It indicates good monsoon. What keeps them guessing is that on many occasions the monsoon have failed deposite the temperature being favourable. They have now focussed their alternation on role of Tibetan Plateau on monsoonal rain. Traditionally the snow cover over the Himalayas is still monitered because it is believed that the greater it is, the poorer is the monsoon. But the Tibetan plateau begins as high as 5 km. above sea level acts an elevated over producing several atmospheric anamolis. Meteorologists believe that the Tibetian High belts due to many uexplained phenomenan. They knew the jet streams of the air are narrow on land and high speed wind into the upper atmosphere region, the criss-cross the country. Towards the May, the westerly jet streams that usually blows over the Himalayan slope moves northwards. This drag is said to be caused by the Tibetan High. As the Himalayan stream shifts towards the easterly jet stream over the southern peninsular and stay on till the monsoon weaves. While the rate of the jet stream including monsoon are still unchased. Meteorologists have been monitoring huge high pressure or anticyclone zones that from a few kms below them. The crest or ridge of the high pressure zone usually have over S. Goa. They have noticed that of the ridge moves slightly southwards towards Karnatak, it does not prove well for the monsoon. The reason that it appears as the high pressure zones act as a giant boulders of air that provents the low flowing south westerly monsoon from intersifying over the west coast. 7.4 Circulation of Monsoon and relation with Jet Stream Relation between Jet Streams and Monsoon: Jet streams have distinct peaks (ridges) and troughs. Ridges occur where the warm air mass pushes against the cold air mass. Troughs occur wheater cold air mass drops into warm air. The region on earth below the trough is at low pressure and the region below ridge is at high pressure. This condition occurs due to weakening of jet streams due to lesser temperature contrast between sub-tropics and temperature region. Troughs create due to upper level divergence which is associated with convergence at the surface, (low pressure–cyclonic conditions) and ridges create due to upper level convergence which is associated with divergence at
149 NSOU CC-GR-07 the surface (high pressure–cyclonic conditions). These ridges and troughs give rise to jet streaks which are also responsible for cyclonic and anticyclonic weather conditions at the surface. The winds leaving the jet stream are rapidly diverging, creating a lower pressure at the upper level (Tropopause) in the atmosphere. The air below rapidly replaces the upper outflowing winds. This in turn creates the low pressure at the surface. This surface low pressure creates conditions where the surrounding surface winds rush inwards. The coriolis effect creates the cyclonic rotation (cyclonic vortex) that is associated with depressions (low pressure cells). The winds entering the jet stream are rapidly converging because of the high preussure at the upper level (Tropopause) in the atmosphere. This convergence at upper troposphere leads to divergence (high pressure at the surface (anticyclonic condition). The Coriolis effect creates the anticyclonic rotation that is associated with clear weather. Influence of jet streams on Indian Monsoon: Indian Monsoon Mechanism–Role of Sub-tropical

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Jet Streams (STJ) Sub-Tropical Jet stream plays a significant role in both

hindering the monsoon winds as well as in quick onset of monsoons. Sub-Tropical Jet Stream Sub-Tropical

78%	MATCHING BLOCK 219/265	W

Jet stream is narrow band of fast moving air flowing from west to east [

Westerlies]. STJ in northern hemisphere flows between 25 o to 35 o North

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in the upper troposphere at a height of about 12–14 km. (

Here we will consider STJ only. Polar Jet has no influence on Indian monsoons).

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100%	MATCHING BLOCK 221/265	W

The wind speeds in a westerly jet stream are commonly 150 to 300

km per hour with extreme values reaching 400 km per hour.

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The burst of monsoons depends upon the upper air circulation which is dominated by

STJ, Seasonal Migration of Sub-Tropical Jet Stream,
In winter

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STJ flows along the southern slopes of the Himalayas but in summer it shifts northwards, rather dramatically and flows along the northern edge of Himalayas in early June and in late summer (July-August)

especially

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along the northern edge of the Tibetan Plateau. The periodic movement of the Jet stream is often

the
indicator of the onset (STJ shits to the north of Himalayas in a matter of days)

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and subsequent withdrawal (STJ returns back to its position-south of Himalayas) of the monsoon. 150

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Northward movement of the subtropical jet is the first indication of the onset of the monsoon over India.

Sub-Tropical Jet Stream (STJ) in Winter Westerly jet stream blows at a very high speed during winter over the sub-tropical zone. This jet stream is bifurcated by the Himalayan ranges and Tibetan Plateau. The two branches reunite off the east coast of China. The northern branch of this jet stream blows along the northern edge of the Tibetan Plateau.

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The southern branch blows to the south of the Himalayan ranges along 25 o north latitude.

A strong latitudinal thermal gradient (differences in temperature), along with other factors, is responsible for the development of southerly jet. Western Disturbances– Meteorologists believe that southern branch of jet stream exercises a significant influence on the winter in India. The upper jet is responsible for streering of the western depressions [Western Disturbances] from the mediterranean. Some of the depressions continue eastwards, redeveloping in the zone of jet Fig. 7.1 Winter monsoon (After Nieuwolt).

151 NSOU CC-GR-07 stream confluence about east cost of China. Winter rain and heat stroms in north-western plains and occasional heavy snowfall in hilly regions are cause disturbances. These are generally followed by cold waves in the whole of northern plains. The southern branch is stronger, with an average speed of about 240 km compared with 70 to 90 km per hour of the northern branch. Air subsiding beneath this upper westerly current gives dry blowing to the northerly winds from the subtropical anticyclone over northwestern India and Pakistan. Cause of absence of south-west monsoons during Winter: Reason 1: The winds that blow over India are mostly offshore—land to land or land to ocean—so they carry no moisture). Reason 2: During winter, the southern branch of STJ is strong and is to the south of Himalayas. The ridge of the Jet lies over north-western India and is associated with strong divergence of winds and creates a high pressure region sub-tropical high pressure belt) over entire north India. (This is how the mechanism of jet streams influence Indian Monsoons in winter season.) * There is already a strong high pressure over Tibet. [High Pressure due to STJ + High Pressure over Tibet = strong divergence = no rainfall]

With the beginning of summer in the month of March, the STJ (upper westerlies] starts their northward movement. The southerly branch of STJ remains positioned south of Tibet, although weakening in intensity.

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The weather over northern India becomes hot, dry and squally due to larger incoming solar radiation and hot winds like loo. Over India, the Equatorial Trough (ITCZ) pushes northwards with the weakening of the STJ [

upper westerlies]

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south of Tibet, but the burst of the monsoon does not take place until the upper-air circulation has switched to its summer pattern. By the end of May the southern jet breaks and later it is diverted to the north of Tibet Plateau and there is sudden burst of monsoons (the ridge moves northwards into Cental Asia = high pressure over north-west India moves northwards into Central Asia = way for south-west monsoon winds).

An Easterly jet emerges over peninsular India with the northward migration of STJ.

152 NSOU CC-GR-07 The upper air circulations are reversed with the emergence of Easterly jet [convergence in upper layers is replaced by divergence = divergence in lower layers is replaced with convergence = high pressure at lower layers is replaced by low pressure system].

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The easterly winds become very active in the upper troposphere and they are associated with westerly winds in the lower troposphere (south-west monsoon winds).

Western and eastern jets flow to the north and

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south of the Himalayas respectively. The eastern jet becomes powerful and is stationed at 15 o N latitude.

This results in more active south-west monsoon and heavy rainfall is caused. Cause of absnece of south-west monsoons in March-May (Summer): There is good sun's insolation from March-May but still there is no s-w monsoons. Reason: The ridge region of Southern branch of STJ creates strong divergence (high pressure) in north-west India. The deverging air blocks incoming winds and prevents strong convergence of winds along ITCZ. During the summer season in the Northern Hemisphere, low pressure areas develop at the ground surface near Peshawr (Pakistan) and north-west India due to intense heating of ground surface during April, May, and June. As long as the position of the upper air jet stream is maintained above the Figure: 7.2 Summer Monsoon
153 NSOU CC-GR-07 surface low pressure (to the south of Himalayas), the dynamic anti-cyclonic conditions persist over north-west India. The winds descending from the upper air high pressure [because of the ridge of STJ] obstructs the ascent of winds from the surface low pressure areas, with the result that the weather remains warm and dry. This is why the months of April and May are generally dry and rainless in spite of high temperatures (low pressure of land) and high evaporation. Branches of Monsoon: The Arabian Sea Branch: This branch of the south-west monsoon strikes the highlands of the Western Ghats at aolmost right angles. The windward slopes of the Western Ghats receive heavy orogenic precipitation. Although the western currents of the monsoon penetrate further into the Indian mainland and the intesity of rainfall goes on decreasing on the leeward side. While the windward slopes of the Western Ghats are the areas receiving the highest rainfall, the leeward slopes form a well-marked rain-shadow belt which is drought-prone. For instance, the average annual rainfall at Mumbai and Pune is 188 cm and 50 cm respectively, despite the fact that they are only 160 km apart. The most characteristic feature of the distribution of rainfall on the windward slope is that the amount of rains is hevier higher up the slopes. However, the heavy rains are concentrated in a narrow strip along the Western Ghats. After crossing the Western Ghats, the rain-bearing air current descend the eastern slopes where they get warmed up adiabetically. This result in a pronounced rain-shadow area. The higher the mountains, the larger is the rain-shadow effect. Towards the north, where the Western Ghats are not very high, the difference in the amount of rainfall between the windward and leeward side is rather negligible. Cause of no precipitation in Kutch and Western Rajasthan: There is no mountain barrier to tap the advancing winds. As the Aravallis have an almost north-south axis, they fail to block the passage of these monsoon currents (which rather blow parallel to the Aravallis and lift them). The monsoon currents heading towards Rajasthan are rather shallow and are superimposed by stable anti-cyclonic air. The hot and dry continental air masses from western Pakistan (Baluchistan) are drawn towards the thermal low developed in this region. These air masses check the ascent of air and absorb its moisture.
154 NSOU CC-GR-07 These conditions are unfavourable for precipitation in Kutch and western Rajasthan where desert conditions prevail. Some of the current from the Arabian Sea branch manage to proceed towards Chotonagpur plateau through the Narmada and Tapti gaps. These currents ultimately unite with the Bay of Bengal branch. Although a few air currents from the main Arabian Sea branch are diverted northward towards Kutch and the Thar desert, these currents continue upto Kashmir without causing rain anywhere on their way. In fact, an east-to-west line drawn near Karachi in Pakistan practically marks the limit of the monsoon rainfall. Bay of Bengal Branch: This branch is active in the region from Sri Lanka to Sumatra Island of the Indonesian archipelago. Like the Western Ghats of India in the case of the Arabian Sea branch, the windward slopes of the West Coast Mountains of Myanmar. (Arakan and Tenasserim mountains) get heavy rainfall when the main monson currents of this branch strike the Myanmarese coast.) Akyab on the west coast records 425 cm during the June-September period. As in case of the leeward sides of the Western Ghats in India, here too, the rain shadow effect is pronounced on the leeward side. A northern current of this branch strikes the Kashi hills in Meghalaya and causes very heavy rains. Mawsynram (near Cherrapunji), situated on the southern slopes of Khasi hills, has the distinction of recording the highest annual average precipitation in the old. This is because of its peculiar geographical location. Mawsynram if flanked on all sides by the Garo, Khasi and Jaintia hills except for a gap through which the rain-bearing winds enter and are forced to rise, thus yielding the heaviest rainfall. Shillong, a mere 40 km away on top of the Khasi hills, receives only about 140 cm of rainfall during June-September. Another current of the Bay of Bengal branch takes a left turn at the eastern end of the low pressure trough (roughly the Bengal delta). From here, it blows in a south-east to north-west direction along the orientation of the Himalayas. This current causes rainfall over the northern plains. The monsoon rainfall over the northern plains is assisted by west-moving monsoon or cyclonic depressions called 'westerly disturbances.' These are formed in the Bay of Bengal and move along the southern fringe of the northern plains causing copious rains there which are vital for the rice crop. The intensity of rainfall decreases from east to west and from north to south

155 NSOU CC-GR-07 in the northern plains. The decrease westwards is attributed to the increasing distance from the source of the moisture. The decrease in rainfall intensity from north to south, on the other hand, is due to increasing distance from the mountains which are responsible for lifting bird moisture-laden winds and causing orogenic rainfall in the plains, especially in the foothills. The two main branches of the monsoon winds follow different courses: The two main branches of the monsoon set out to fill the intense low pressure void created in the north-west of the subcontinent. The two branches meet at the Chhotanagpur Plateau. Of the total moisture carried by the two branches, only 20 per cent falls as precipitation. The Arabian Sea branch is more powerful of the two because of two reason—one, the size of the Arabian Sea is bigger and two, most of the Arabian Sea branch falls over India, while most of the Bay of Bengal branch goes to Myanmar, Malaysia and Thailand. Retreating or North-East Monsoon: Towards

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the end of September, the low pressure centre in the north-west begins to disintegrate and eventually shifts to the equatorial region.

The cyclonic conditions are replaced by anti-cyclonic ones. As a result, winds start blowing away from the northern region. Similar anti-cyclonic winds blow from the Tibetan highlands and beyond. This is also the time when the sun makes an apparent movement south of the equator. The ITCZ also moves equatorwards. Now the winds the dominate the subcontinental landscape are the ones which move from the north-east to the south-west. These conditions continue from October till mid-December and are known as the retreating monsoons or the north-east monsoons. By December end, the monsoons have completely withdrawn from India. The retreat of the monsoons is markedly gradual in contrast to the 'sudden burst' of the south-west monsoons. The retreating monsoons over the Bay of Bengal pick up moisture on their way which is dropped over eastern or coastal Orissa, Tamil Nadu and parts of Karnataka during October-November. This is the main season of rains over these areas as they almost lie in the rain-shadow area of the south-west monsoons. During October, easterly depressions occur at the head of Bay of Bengal which move southwards and in November get sucked into Orissa and Tamil Nadu coasts causing heavy rain—sometimes with destructive cyclonic winds in coastal and interior areas. The depressions weaken southwards and towards the interiors. 156 NSOU CC-GR-07 Winter Monsoon: The stable, dry anti-cylonic winds prevailing over the subcontinent after the retreat of the south-west monsoons are not capable of causing precipitation because they are free of moisture. Instead, these winds produce dry and fine weather. However, certain areas in the north get winter precipitation. The north-western parts of India—Punjab and Ganga plains—are invaded by shallow cyclonic disturbances moving from west to east and having their origin in the Mediterranean Sea. These are called 'Westerly Disturbances' which travel across West Asia and Afghanistan before they reach India. These disturbances come with cloudiness and rising temperature in the front and cold wind in the rear. These disturbance cause upto 5 cm rainfall in Punjab and Kashmir and up to 2.5 cm over the Uttar Pradesh plains. These showers are very good for the rabi crop, especially wheat and gram, and are very effective because of less runoff, less evaporation (because of low winter temperatures) and the fact that moisture from these showers is confined to the root area of the crops. 7.5 Mechanism of Monsoon Introduction—The term Monsoon is arrived from a Arabic word 'Mowsim' which means 'season'. The word monsoon is applied to such a circulation which reverses its direction every six months i.e. summer to winter and vice-versa. The term was first applied by Arab nevigators to explain winds over Arabian sea between Arab and India, which blow North-East and from South-West for six months from other six months. In meteorology, monsoon signifies the directional shifting of winds from one season to other. In summer, there is a warm and moist wind blowing from the ocean towards the land, while during the winter a cold and dry wind originating on land blows seaward. Monsoon circulation involves a change of 180 degrees in the direction of wind. (1) Classical concept of Monsoon Origin: This classical theory of Indian monsoon proposed and put forward by Admand Hally in 1686. He explained the origin of Indian monsoon which was earlier proposed by Arab Geographer Siddique Ali after experiencing the behavioural pattern of Asiatic wind system on his visit to India. According to the classical concept of Indian monsoon, monsoonal winds are land and sea breezes on a large scale which are produced and controlled by unequal and differential heating of contiguous of continental and oceanic areas of the Indian

157 NSOU CC-GR-07 subcontinent. Under this process, during the northern winter when sun rays fall vertically over tropic of Capricorn, the gigantic land mass of Asia cools rapidly than the sounding ocean generating a high pressure area over Asia while there is low pressure centre on the Indian ocean. As a result of this air pressure differential over land and ocean there is an out flow of air from high pressure to low pressure, consequently the surface winds started to flow from land to sea. This wind pattern is commonly known as north-east monsoon which is often dry due to lack of moisture and hence do not precipitate. On other side of this, the temperature and pressure conditions are reversed during the northern summer season on the occasion of summer solstice. In this time period sun rays fall vertical on tropic of cancer which passes through the middle of Indian subcontinent. Due to excess heating of huge land mass of Asia, a low pressure area develop over it. However, presence of the Himalayas bifurcate this low pressure areas into north-west Indian low and Baikal low. Conversely, high pressure centre is developed in the Indian Ocean due comparative low thermal conditions here. As a result of this winds started flowing from high pressure area over ocean to low pressure area over Indian subcontinent. This pattern of wind flow is popularly known as southwest monsoon in India and as simple monsoon througthou the world. Due to on shore nature of southwest monsoon it bears and produces rainfall wherever it is obstructed by various topographical barriers. (2) Traditional Convection Current Theory: It is well known fact that from a high pressure region the wind has an tendency to flow out and in a low pressure zone the wind has a tendency to flow in. Thus the weather pattern is influenced by the formation of high and low pressure cells. In winter, the north of the Himalayas becomes a centre of high pressure by the cooling of the surface. Wind blows outwards from the land, over which air is subsiding. Over India this air is cool and dry and flows through the entire stretch of the Gangetic plain, crossing the Bay of Bengal and when it had picked up enough moisture, it pours it down in the eastern coastal region. Fig. 7.3 The traditional view on the origin of Indian Monsoon H Summer L L L H L H H Winter
158 NSOU CC-GR-07 In summer, with the thermal shifting of the equator the whole scene changes. The high pressure vanishes and a low pressure centre is created in the north-western part of India. The trade winds while reaching to fill this low pressure zone cross the entire zone of Arabian sea and the Indian Ocean. This makes these winds moisture and thus they cause heavy downpour when they strike the Western Ghats and Himalayan ranges. This is by definition, the south-west monsoon. (3) Dynamic Concept of Indian Monsoon: This concept was proposed and presented by Flohn in 1951 which is based on dynamic origin of Indian monsoon that say monsoon is none other than and is only the seasonal migration of planetary winds and pressure belts following the position of sun in relation to earth. It opined that

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during summer solstice sun rays fall vertically over tropic of cancer, hence all wind and pressure belts of globe shift towards north. At this		

time the zone of inter tropical convergence (ITC or Doldrum) moves northwards and its northern boundary is extended upto 30 degree north that is south and southeast Asia. It is due to relatively larger changes of seasonal temperature and pressure conditions over the land in these areas which help in shifting of these belts. Due to this shifting major part of Indian subcontinent comes under impact of equatorial westerlies blowing in doldrum which are called southwest monsoon in India. Since ITC is associated with tropical disturbances which dominate the surface weather. On the other hand in winter planetary wind system and pressure belts move to southwards due southward movement of vertical sun rays. As a result of this northeast trade winds reestablished over the Indian subcontinent which are often dry and devoid of rain as they come from land. (4) Thermal Concept–It was Halley who propounded the thermal concept of the origin of monsoon. According to this theory, the monsoons are considered to be gigantic convectional systems produced by differential seasonal heating of continental and oceanic areas. The origin of Asiatic monsoon may be ascribed to the thermal difference between land and sea.

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During winter the landmass of Asia cools more rapidly than surrounding oceans		

creating a high pressure over land and low pressure over sea. So air travels from landmasses to oceans. Low Pressure High Pressure Summer Winter H L L L ... H H H Fig. 7.4 : Origin of monsoon [according to thermal concept]

159 NSOU CC-GR-07 During summer the landmass became more warm than the surrounding ocean creating a world of low pressure over landmass, so the surrounding cold air blow towards the sea. (5) Role of Jet Stream-Jet Strem has a strong impact on the origin of monsoon. In 1951, F. Fohn created this concept about the role of jet stream in the origin of monsoon. By the observation of the apparent speed of the sun, he confirmed the locational shift of the wind as jet stream. In norther hemisphere, during summer all the constant winds are shifted to the north and in winter they shifted back to the south. For this, in every year in the intermediate area between the zones of two constant winds there are arrival of Jet stream. In low latitudes seasonal change of direction in wind flow causes the arrival of jet streams. (6) Jeffry's concept-In different season, jet stream blow from different directions. According to the season, the direction of jet stream may change 102 o , Jeffery proposed a mathematical view or formula on the reversal flow of jet steams. According to him, air pressure decreases with the increasing height. Wind blows according to the slope of the air pressure. He expressed about the context of the changing direction of reasonal air that–'If the air blows from the west in the lower atmosphere, then the air will blow from the east above the height of 6 km.' (7) MONEX–The mechanism of Indian monsoon in south to be explained by the shifting by the inter-tropical convergence, the north ward movement of westerly jet stream and its replacemnet by easterly jet stream and the upper air ciculation over tibet. The World Meteorological Organisation (WMO) conducted monsoon experiment (MONEX) over the Arabian sea and the Bay of Bengal to observe the mysteries about the monsoon. Inspite of all these attempts, the working of the monsoon continue to be not fully understood. Criticism: (1) In low latitudes, where the jet streams are created, a scorcity in the Geostrophie balance can be noticed. But in Jeffery's concept there is no reference about this. (2) Mare importances are given to the differential temperature in Jeffery's concept. (3) The origin of the monsoon was not fully discovred. (4) Some the theories have a great contribution to discover the concept of monsoon but one the only can't able to describe the varieties of monsoon.

160 NSOU CC-GR-07 7.6 Conclusion The climate of India is known as monsson climate, which is stronghly impacted by the monsoon. The two branhes of Indian monsoon have individual salient features, which controls the distribution of rainfall all over the India. Moreover, the climatic conditions of India during summer is also influenced by the monsson. The Indian monsoon is strongly connected with jet stream. Thus, the vagaries of monsson impacted largely on the Indian climate and economy. 7.7 Summary The term Monsoon is arrived from a Arabic word 'Mowsim' which means 'season'. The Indian monsoon has two branches, Arabian branch and Bay of Bengal branch.The Arabian branch of the south-west monsoon strikes the highlands of the Western Ghats at aolmost right angles. A northern current of the is Bay of Bengal branch strikes the Kashi hills in Meghalaya and causes very heavy rains. Mawsynram (near Cherrapunji), situated on the Khasi hills, has the distinction of recording the highest annual average precipitation. Over 70% of the India's annual rainfall is recorded is summer monsoon months. These conditions continue from October till mid-December and are known as the retreating monsoons or the north-east monsoons. The north-western parts of India are invaded by shallow cyclonic disturbances moving from west to east and having their origin in the Mediterranean Sea, are known as 'Westerly Disturbances'. This classical theory of Indian monsoon proposed and put forward by Admand Hally in 1686. The dynamic concept of monsoon origin was proposed by Flohn in 1951. Jet strem has a strong impact on the origin of monsoon. Meteorologists believe that

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southern branch of jet stream exercises a significant influence on the winter in India. The sub-tropical jet stream plays a

significant role in both hindering the monsoon winds as well as in quick onset of monsoons. The World Meteorological Organisation (WMO) conducted monsoon experiment (MONEX) over the Arabian sea and the Bay of Bengal to observe the mysteries about the monsoon.

161 NSOU CC-GR-07 7.8 Key words Monsoon, Arabian branch, Bay of Bengal branch, Burst of monsoon, westerly Disturbances, origin of monsoon, WMO, MONEX, jet stream 7.9 Model Questions Short answer type: 1. What is burst of monsoon? 2. What is retreating monsoon? 3. What are the branches of Indian Monsoon? 4. State the influence of monsoon on Indian climate. 5. What is the classical concept of monsoon? Long answer type: 1. Discuss the salient features of Indian Monsoon. 2. Explain the monsoon circulation over the Indian subcontinent. 3. Explain the monsoon mechanism. 4. Explain how the mechanism of jet stream influences
Indian monsoon. 7.10

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Unit 8 Climatic Classification after Köppen and Thornthwaite Structure 8.1 Introduction 8.2 Objectives 8.3 Köppen's Climatic Classification 8.4 Thornthwaite's Climatic Classification 8.5 Conclusion 8.6 Summary 8.7 Key words 8.8 Model Questions 8.9 References 8.1 Introduction There is a infinite variety of climate is observed over the globe and climate of every place is slightly different in some aspect from each other. The climatic classification of the world climate helps us to understand the nature of such variations and distinctiveness. The homogeneous set of climatic conditions is operated in a certain climatic region; therefore to facilitate identification and description of that region, it is necessary to classify climate. Here we are going to know about such types of climatic classification as put forward by Koppen and Thornthwaite. 8.2 Objectives i. To know the climatic classification of Koppen. ii. To know the climatic classification of Thornthwaite. 8.3 Köppen's Climatic Classification Classification is a process basic to all sciences consisting of recognizing individuals with certain important characteristics in common and grouping them into the classes. One of the first and simplest classification of climate was derived from the ancient Greek who divided each hemisphere into three broad belts or zones:

163 NSOU CC-GR-07 1. Winterless tropical region where temperature is high throughout the year. 2. Polar region with low temperature. 3. The broad intermediate belt of temperature zone where seasonal contrast in temperatre is marked. Fig. 8.1 Climatic Classification This was very simple and generalized classification. Later the most popular and well accepted classification of climate was made by Köppen in 1918. He was a biologist and his classification was based on monthly and annual mean of temperature and precipitation. Köppen

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believed that the distribution of natural vegetation is the best expression of the totality of climate. 164

NSOU CC-GR-07 Köppen accepted Candolle's five fold classification of vegetation which recognizes the following divisions: 1. Megatherm: Which coincides with the tropical rainforest region. 2. Mesotherm: Which coincides with the mid-latitude temperate region. 3. Microtherm: Which coincides with the deciduous and steppe region. 4. Xerophytes: Which coincides with the semi-arid steppe and desert region. 5. Hekistotherms: Which is the vegetation of snow-bound steppe region. Koppen used English Letter Symbols to denote different climatic characteristics. Major divisions: A–Humid tropical climates B–Dry climates C–Warm temperate climates with mild winter D–Cold temperate climates with severe winter E–Polar climate H–Highlands climate Seasonal Distribution of Rainfall: For this Koppen gave four subdivisions–f–Wet all seasons m–Monsoon type, short dry seasons w–Dry winter s–Dry summer * Koppen divided into low and high latitudes H–Low latitudes K–High latitudes The main features of Köppen's climatic divisions are discussed below: KÖPPEN'S CLIMATIC CLASSIFICATON A B C D E H Af Am Aw As Bs Bw Cf Cs Df Ds Dw Et Ef Bsh Bsk Bwh Bwk

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165 NSOU CC-GR-07 MAJOR TYPES SUB TYPES CHARACTERISTICS Af Tropical Rainfall mainly experienced over the Amazon Basin, Zaire Basin and South East Asia Characterised by mean annual temperature of 27 o C and anuual average rainfall of 250 cms, luxuriant vegetation. A Aw Tropical Savanna which is a tropical grassland with scattered deciduous trees. Am Monsoon type characterised by alternate periods of rainfall and draught, seasonal reversal of winds. As Tropical climate with dry summer found along the eastern coast of Tamilnadu and Orissa. Bsh, Bsk Semi-arid and Steppe climate, are experienced in the deep interiors of landmasses, these regions received little rainfall of 30 cms. B Bwh Low latitude desert climate like Sahara. Bwk Mid latitude desert climate like Gobi. Cf Humid temperate climate, receives 100-140 cms of rainfall. C Cs Mediterranena climate with winter rainfall of 40-60 cms. Df Cool, East Coast climate between 45 o -65 o latitude. Ds Taiga climate which is experienced over the belts from Alaska to Newfoundland and Norway to Kamchetka peninsula. D Dw Continental type climate which is experienced in deep interiors of the continents between Taiga and the mid latitude desert. ET Tundra climate which is experienced over coastal fringes of the Arctic Ocean. This climate is found exclusively in the northern hemisphere. E Ef Ice Cap, there are the areas permanently covered with snow, average temperature of the warmest month below 0 o C. These conditions occur over the poles and the interiors of Greenland. Higlands climate is found over the Rockies, Andes, H – Alps and the Himalayas. Here altitude play an important role.
166 NSOU CC-GR-07 CLIMATIC CLASSIFICATION AFTER KÖEPPEN Advantages: 1. Köppen has used temperature and precipitation as the basis of his classification which can easily be measured. 2. Köppen's scheme uses letter symbols to denote various climatic characteristics, which is practical and convenient. 3. Here specific quantitative techniques has been used not based on mere abstraction. 4. His climatic divisions coincide with vegetational divisions. This aspect is quite appealing to geographers. 5. Köppen's scheme can be adapted and taught at any level. Limitation: 1. Other climatic elements such as wind pressure, cloundiness etc has not been considered by Köppen. 2. Köppen has not attempted to find out the causative factors of climatic characteristics. 3. Going by Köppen's classification, it is not possible to explain the existence of different vegetation types within the same climatic division. 8.4 Thornthwaite's Climatic Classification Indroduction: C. W. Thornthwaite, an American climotologist presented his scheme of climatic classification in 1931 and 1948. His scheme is complex and empirical in nature. Fig. 8.2 Climate Classification of Koppen
167 NSOU CC-GR-07 8.2.1 Classification of 1931 Climatic classification of Thronthwaite is based on– A. Effective Precipitation. B. Thermal efficiency. C. Seasonal distribution of rainfall. He considered evaporation to be an important element and proposed five Humidity Provinces based on Precipitation Effectiveness (P/E index), six Temperature Provinces based on Thermal Efficiency (T/E index), which is expressed as the positive departure of mean monthly temperature from the freezing point. Thornthwaite's Humidity Provinces: The annual precipitation index in given as– P/E index (Annaul) = Total Rainfall Total Evaporation The five Humidity provinces are given below– Humidity Vegetation P/E index Provinces Associated A – Wet Tropical Rainforest 128+ B – Humid Forest 64-27 C – Semi Humid Tropical Grassland 32-63 D – Semi-Arid Steppe 16-31 E – Arid Desert Below 16 Thornthwaite's Temperature Provinces: Again the annual T/E index is taken as the sum of twelve individual monthly T/E index ratios, and the monthly T/E index ratio is given as– T/E index ratio (Monthly) = (T-32) 4 Where, t = mean monthly temperature in degree farenhite. Thus the six temperature provinces are as follows– Humidity Provinces T/E Index A' – Tropcial 128 & Above B' – Masothermal 64 –127 C' – Microthermal 32–63 D' – Taiga 16–31 E' – Tundra 1–15 F' – Frost 0
168 NSOU CC-GR-07 Further sub-divisions are also possible based on seasonal distribution of rainfall

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r – rainfall in all seasons s – summer deficient in rainfall w – winter deficient in rainfall d – dry in all seasons

Criticism: 1.

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The concepts of precipitation effectiveness and thermal effectiveness were used for the first time by Thornthwaite, but they make the delimitation of boundaries difficult. 2. The

lack of climatic data, epecially on evaporation, is a serious handicap. 8.2.2.

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Classification of 1948 Thornthwaite's second classification is based on two variables: a. Potential Evapotranspiration (PE) b. Precipitation The

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potential evapotranspiration in expressed as the amount of moisture that will be transferred to atmosphere by evaporation of solid and liquid water and by transpiration from living tissues,

On the basis of it, he introduced the concept of Moisture Index: Moisture Index Humidity Province Thermal Province 100 & above Per Humid Megathemal 20 to 100 Humid Mesothermal 0 to 20 Moist Sub-humid Microthermal -33 to 0 Dry Sub-humid Tundra -67 to -34 Semi Arid Dry Forst -100 to -68 Arid – Criticism: 1.

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Because of inherent problem, mapping of Thornthwaite's divisions is not possible. 2. His scheme does not have a vegetational basis. Thus it is different from

Kö**
* * **
169 NSOU CC-GR-07 8.2.3. Comparative analysis of Köppen's and Thornthwaite's scheme: Similarities: 1. Both are based on empirical investigation and are genetic scheme. 2.

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Both have recognized climate-vegetation relationship. 3. Both have used letter symbols to represent climatic regions.

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Differences: 1. While Köppen had considered vegetation to be direct indicator of of climate, Thornthwaite's has given indirect recognition to the vegetational aspects. 2.

Köppen took into account

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the altitudinal aspect of climate by giving a seperate category of "Highlands Climate". Thornthwaite did not consider the altitudinal aspect. 8.5

Conclusion Köppen and Thornthwaite have classified the world climate on the basis of some selected criteria as per their own choice. Köppen has used temperature and precipitation as the basis of his classification which can easily be measured. This was very simple and generalized classification and thus and taught at any level. While, the climatic classification scheme of Thornthwaite is complex and empirical in nature. Both have used letter symbols to represent climatic regions. * * Köppen had considered vegetation to be direct indicator of of climate. Köppen has used temperature and precipitation as the basis of his classification. Thornthwaite had presented his climatic classification scheme in 1931 and 1948. Thornthwaite has given indirect recognition to the vegetational aspects. Thornthwaite considered evaporation to be an important element and proposed five Humidity Provinces based on Precipitation Effectiveness (P/E index), six Temperature Provinces based on Thermal Efficiency (T/E index). Both the classification are based on empirical investigation and are genetic scheme. Both the classification have recognized climate-vegetation relationship.

170 NSOU CC-GR-07 Koppen and Thornthwaite - both have used letter symbols to represent climatic regions. 8.7 Key words Köppen, Thornthwaite, PE index, TE index 8.8 Model Questions Short answer type: 1. Write short note on TE Index. 2. What is PE Index? 3. Criticise Köppen's climatic classification. 4. What are the merits of Köppen's climatic classification? Long answer type: 1. Classify climate of the world after Köppen highlighting its merits and demerits. 2. Critically discuss the Thornthwaite's climatic classification mentioning its merits and demerits. 3. Make a comparative analysis of the climatic classification of Koppen and Thornthwaite. 8.9

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Adiabatic Lapse rate 9.4 Adiabatic Lapse Rate 9.5 Warm Fronts Vs. Cold Fronts 9.6 Dry Adiabatic Lapse Rate Vs. Wet Adiabatic Lapse Rate 9.7

Tropical Cyclone Vs. Temperate Cyclone 9.8 Frontogenesis Vs. Frontolysis 9.9 Af Climate Vs. Aw Climate 9.10 Precipitation Effectiveness, Temperature Efficiency, Potential Evapo-transpiration 9.11 PE Index 9.12 Adiabatic Vs. Non-Adiabatic Process 9.13 Features of Frontogenesis 9.14 Features of Frontolysis 9.15 Ekman Spiral 9.16 Green house gases Vs. Pollutants 9.17 Local Winds 9.18 Katabatic Winds 9.19 El Nino Vs. La Nina 9.20 Southern Oscillation 9.21 Anticyclone-Origin and Characteristics 9.22 Anticyclone and Associated weather Phenomena 9.23 Types of Anticyclone 9.24 Stratosphere 9.25 Advection Fog Vs. Ground Fog 9.26 Impact of ENSO phenomena 9.27 Ozone Formation 9.28 Atmospheric Window
173 NSOU CC-GR-07 9.1 Frontal Fog Vs. Advection Fog Subject Frontal Fog Advection Fog Situation The fog developed due to The fog developed due to development of front, is called the development of advection frontal fog. of warm and cold air/wind. is called Advection fog. Distribution This fog is mostly found This fog is mostly found in the in the temperate region. tropical region and cold area. Causes of This fog is developed due to This fog is developed due to development collision of warm and cold air. advection or touch related activities of warm and cold air. Front Front is observed in this type Front is absent in this type of fog. of fog. Duration This frontal fog exist with The duration of time of advection long duration, more than fog is less than frontal fog. advection fog. Observed This fog may observed in with This fog may observed during Time the mid-latitude cyclone. morning time or winter climate. Ground level This fog may not be associated This fog is mostly associated with ground level. with ground level. Impact This fog leave its inpact on This fog leave its impact on the the weather of mid latitude weather in the tropical area area. and its amount is less than frontal fog. Association This fog is not associated with Dry and wet adiabatic lapse dry and wet adiabatic lapse rate. rate are closely associated with this fog. Development This fog is developed only with This fog may also developed the front develop due to the with the help or meeting of collision of warth and cold air. warm and cold ocean current.

174 NSOU CC-GR-07 9.2 Barotrophic wind Vs. Baroclinic wind Subject Barotrophic wind Baroclinic wind Definition When the isotherms and isobars When the wind blows cross are parallel in a cross section, the parallely situated isotherms then wind blows paralled of and isobars, this state of wind that, this state of wind is called is called Baroclinic wind. Barotrophic wind. Nature This is a stratification slate This a stratification state when in which the constant slope constant slope crossed the and density slope parallely density slope. situated with each other. Dependency This state is largly dependent This state is mainly dependent on the air pressure and density. on temperature. Airmass In this state, homogenous In this state, the airmass airmass exist. became heterogeneous. Condensation Condensation occur due to Condensation is not able to extraction of latent heat of occur in this state. of condensed air. Isobar and Isobars and isotherms are Isobars and isotherms Isotherm paralled to each other. are crossed each other Distribution The level between the The level between the cross parallely distributed wind is distributed about isobars and isotherms <100 km. is less distributed. Diagram Barotropic wind Baroclinic wind
175 NSOU CC-GR-07 9.3 Lapse Rate Introduction–Lapse rate is a rate of change in temperature observed which moving upward through the earth atmosphere. It can be positive– When temperature decrease with altitude It can be zero– When the temperateur is constant It can be negative–When temperature increase with altitude (inversion of temperature). Normal Lapse rate Adiabatic Lapse rate Definition It is also called environmental It involve changes due to rising Lapse rate. It is a rate at which and sinking of air. temperature decrease with elevation. Type It done not have any type -Dry adibatic lapse rate -Moist/Wet adibatic lapse rate Heat It is affected by radiation Heat does not enter or or heat. leave this system. Stabality Actual stability of air Actual stability of air is determind more as is less determind as compair to adibatic compair to normal lapse rate. lapse rate. Air saturation This rate is the rate when air It is the lapse rate that saturation is put into account. is affected by saturation of the atmosphere. Temperature Temperature decreases when Temperature decreases when the rate is not affected. air is either dry or moist. Other name Environment lapse rate. Wet–Saturated lapse rate Dry–Non saturated lapse rate Rate 6.5 o C per km. Wet: 4 o C per km. Dry: 10 o C per km. or 9.8 o C. per km. Zero It drop to zero at uper No such condition occur here. Temperature boundary, of tropopause. Diagram Temperature (0 o C) Km 10– 5– –10 –5 0 5 10 (Temperature (0 0 C) Air temperature below 0 0 C 5– SALR Attitude Thermal Belt Air temperature below 0 0 C Lapse Rate Attitude Km 10– Environmental lapse Rate –10 0 10
176 NSOU CC-GR-07 9.4 Adiabatic Lapse Rate It refers to the change in temperature with pressure. It involve rising and sinking of air. The air is moist when it is saturated by water vapour and dry when there is not much water vapour. Types of Adiabatic Lapse rate: (A) Dry Adiabatic Lapse rate–It's the rate of fall in temperature with altitude for a parcel of dry or unsaturated air which rise under adiabatic conditions. Unsaturated air has less than 100% relative humidity. (Saturated air–The air that can't hold any more moisture. Its stomach is full with moistere. Unsaturated air–It's stomach is not full and it can accommodate some more moisture) It is mainly associated with stable condition. The dry adiabatic lapse rate for the Earth's atmosphere equals 8 o C per kilometer. (B) Wet Adiabatic Lapse

88%	MATCHING BLOCK 247/265	W

rate–The rate of decrease of temperature of an ascending air beyond condensation level is lower due to addition of latent heat of condensation to the air.

The wet adiabatic rate is 3 o C–9 o C per kilometer. It is mostly saturated air. Condensation occur due to saturation of water vapour. 9.5 Warm Front Vs. Cold Front Subject Warm Front Cold Front Definition A warm front is defined as Cold front is that sloping a gently sloping frontal surface frontal surface along which in which there is active cold air becomes active movement of warm air over and aggressive and involves cold air. the warm air territory and being denser remain at the ground. Slope Between 1 : 100 to 1 : 200 Varics from 1 : 50 to 1 : 100 Relative Humitidy increases here. Humidity decreases here. humidity

177 NSOU CC-GR-07 Weather Heavy rainfall occur. Drizzle rainfall occur. Weather Clear weather followed Clouded sky followed by the Forecaste by the warm front. cold front. Temperature High temperature arround Low temperature along the the warm front was found. cold front was found. 9.6 Dry Adiabatic Lapse Rate Vs. Wet Adiabatic Lapse Rate The rate of change of temperature in an ascending or descending air mass through adiabatic process is called the adiabetic lapse rate. The adiabetic lapse rate is of two types– i) Dry adiabatic lapse rate ii) Wet adiabatic lapse rate Subject Dry adiabatic lapse rate Wet adiabatic lapse rate 1. Definition When the ascending or The rate of decrease of descending air parcel is dry temperature of an ascending unsaturated, it's temperature air beyond condensation level changes at a constant rate. The is lowered due to addition of dry adiabatic rate of change latent heat of condensation to in temperature with height is the air. This is called wet referred to as the dry adiabatic adiabatic lapse rate. lapse rate. or

78%	MATCHING BLOCK 248/265	W

The temperature of unsaturated ascending air decreases with increasing height at rate of 10 o C/km. This type of change of temperature of unsaturated ascending or descending air is called dry adiabatic

lapse rate 2. Rate Rate of 10 o C/km Rate of 3 o C–9 o C/km. 3. Nature of air Mostly unsaturated air Mostly saturated air 4. Condensation Condensation occur mostly due Condensation occur due to to the lapse rate. the saturation of water vapour.

178 NSOU CC-GR-07 9.7 Tropical Cyclone Vs. Temperate Cyclone Subject Tropical Cyclone Temperate Cyclone 1.Location Tropical cyclone occurs between They are found in temperate 5 o to 30 o latitude within tropics. region between 35 o and 65 o latitude. 2.Size Their diameter ranges between Their diameter ranges between (diameter) 80 and 300 km. 800 and 1500 km. 3.Velocity Average wind velocity ranges 30–50 km/hour is the wind of wind from 120 to 200 km. per hour. velocity range. 4.Movement From east to west. From west to east. 5.Influenced by Trade wind move along it. Westerlies move along it. 6.Size and They are circular and symmetrical They are elongated or oval in shape in shape. shape. 7.Time of They originate mostly in late They mostly orignate in observation summer or autumn. winter season. 8.Origin They are thermal by origin. They are of frontal by origin. 9.Formation They form over both of land They are strictly oceanic and sea and those ocean phenomena and form only in area where sea condition is surface temperature are at favourable. least 26 o –27 o C. 10. Energy Tropical cyclones derive their They derive their energy from energy from latent heat of airmass temperature contrsts. condensation released within the clouds. 11. Pressure Low pressure gradient. Steep pressure gradient. 12. Nature They are very destructive in They are less destructive and nature. They are accompained less violent. They bring rain with violent wind and heavy and cloudy weather and last for rainall. They (cyclone) last for a long period. some hours.

179 NSOU CC-GR-07 9.8 Frontogenesis Vs. Frontolysis Subject Frontogenesis Frontolysis 1.Definition The process of formation of The process of destruction front is known as frontogenesis. of front is known as frontolysis. 2.Process Genesis process. Depletion process. 3.Occurance First stage of temperate cyclone. Last stage of temperate cyclone. 4.Duration To proceed take more time. To proceed take less time. 5.Nature Creation of front. Destruction of front. 6.Rainfall Rainfall observe along No of rainfall is observed. frontogenesis. 7.Occlussion Occlusion occur. No. occlusion occur. 8.Stage Frontogenesis create first. Frontolysis formed later. of formation 9.Types There are two major types All the fronts are abolished. of front observed– a) warm front b) cold front 9.9 Af climate Vs. Aw climate Subject Af climate Aw climate 1.Climate Equatorial climate Savanna type of climate 2.Latitude Found between 10 o north and It found from 10 o to 30 o south latitude. north and south latitude. 3.Tempetatrue Temperature is less than 27 o C Monthly mean temperature (annual). is above 18 o C. 4.Rainfall Annual precipitation is upto Annual precipitation is upto 250 cm 100 cm. 100 cm. 5.Seasons There is no dry seasons. It include dry winter.

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180 NSOU CC-GR-07 6.Character -constant high temperature -high sun seasons -equal day length low sun dry period -evently distributed heavy -less rainfall precipitation -It has dry climate. 7.Controlling -The air masses -Shiting influence by high factors -Rising air along trade sun and ITCZ winds -low sun shifting 8.Geographic -Amazon Basin -Western Central America distribution -Congo river Basin -North East India etc. -Brazil coast etc. 9.10 Precipitation Effectiveness It refers to the amount of total precipitation which is available for the growth of vegetation. For obtaining this, Thornthwaite suggested to calculate precipitation effectiveness (P/E ratio) + precipitation effeciency index (P/E Index) P/E Ratio = 11.5 (r/t – 10) 10/9t (for cach month) (where r = mean monthly rainfall t = mean monthly temperature.) P/E Index = Total rainfall Totalevaporation = (r/t – 10) 10/9t (where n = month. r = mean monthly rainfall t = mean manthly temperature.) Thornthwaite proposed a P.E. ratio of a month and P.E. index which is the sum total of P-E ratio. On the bases of that he gave five humidity provinces–
181 NSOU CC-GR-07 Humidity Province Vegetation Type P/E index A Wet Rainforest 128 and above B Humid Forest 64-127 C Semi-humid Grassland 32-63 D Semi-arid Steepe 16–31 E Arid Desert >16 Temperature Efficiency–It is the sum of 12 individual monthly T/E Index ratio

90%	MATCHING BLOCK 252/265	SA	MGDSC - 2.1 - Climatology.pdf (D155224061)

Thermal Efficiency Ratio (T.E ratio) = (T 32) 4 - Thermal Efficiency Index (T/

E Index) = 12 n 1 (T 32) 4 - - å (where, T = Mean monthly temperature) * On the Basis of TE index six temperature provinces have been recognsied: * * A Tropical 128 and above

100%	MATCHING BLOCK 250/265	W

B Mesothermal 64–127 C Microthermal 32–63 D Taiga 16–31 E Tundra 1–15 F Frost 0

It represent the amount of moisture transfered to atmosphere by evaporation + transpiration from living tissue P/E = 1.6 ( ) | | ( ) a 10t I (where, I = Sum of months t = temperature, a = constant). – If refers to the moisture deflected or surplus. Moisture Index =

61%	MATCHING BLOCK 251/265	W

S D (100 60) PE - 182 NSOU CC-GR-07 (Where S = Monthly surplus of moisture D = Monthly deficit of moisture) * !"

This is the potential evapotranspiration in cm. # !" It is the annual water suplus in dry climate taken as percentage of annual PE. 9.11 PE Index Definition–Precipitation efficiency was obtained by relating measurments of potential evaporation to temperature and precipitation. $ 11.5 (r/t–10) 10/ t (for each month) (where r = mean monthly rainfall (inches) t = mean monthly tempeerature (o F).) $ It is calculated by the sum of 12 months ratios. It is the effectiveness of precipitation On the basis of P/E index five humidity provinces were difined. Provience

92%	MATCHING BLOCK 253/265	SA	MGDSC - 2.1 - Climatology.pdf (D155224061)

Vegetation P/E Index A (Wet) Rainforest 127+ B (Humid) Forest 64-127 C (Sub-humid) Grassland 32-63 D (Semi-arid) Steppe 16-31 E (Arid) Desert > 16

P/E
Index (Annual) = TotalRainfall TotalEvaporation = - ( ) – | | ( ) ∑ 10t 12 9 n 1 r 11.5 10 t (where, n = month) * % & ' (1)

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84%	MATCHING BLOCK 254/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

When the air rises, it expands. Thus heat available per unit volume is reduced and therefore the temperature is also reduced. (2) Temperture change which does not involve any subtraction of heat, and colling of air takes place only by ascent and expansion, is termed as 'adiabatic change.' 183 NSOU CC-GR-07 (3) The vertical displacement of the air is the major cause of adiabatic and katabatic temperautre changes. (4) Near the earth's surface, most process of change are non-adiabatic because horizontal movements

after produce mixing of air and modify its characterstics. ( ) *% & (1) Process

90%	MATCHING BLOCK 255/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

include cooling by radiation, conduction or mixing with colden air. The air may be cooled due to loss of heat by radiation. (2)

98%	MATCHING BLOCK 256/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

In case there is direct radiation from moist air, the cooling produces fog or clouds subject to presence of hygroscopic nuclei in the air. (3) Cooling by contact with a cold surface produces dew, frost or fog depending on other atmospheric conditions. (4)

But the effect of cooling produced by radiation, conduction and mixing is confined to a thin layer of atmosphere. (5)

86%	MATCHING BLOCK 257/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

The non-adiabetic processes of cooling produce only dew, fog or frost. They are incapable of producing a substaintial amount of precipitation. 9.13

Frontogenesis Definition–The mechanism and process of front development, is known as Frontogenesis. $ – T. Berjeron used the term Frotogenesis for the first time. It includes the process of regeneration. It is the creation of all together new fronts. It also mean the re-generation of decaying fronts already in existence. It

83%	MATCHING BLOCK 258/265	SA	climatology book.docx (D49940943)

is lively to occur when the wind blows in such a way that the isotherms became packed along the leading edge of the intruding air mass. During convergence,

due to movement of air mass, frontogenesis occur. By frotogenesis–

70%	MATCHING BLOCK 259/265	SA	UNIT 2 WEATHER PHENOMENON1_Final.docx (D68173473)

four types of fronts are generated, like– –Cold front –Warm front –Occluded front –Stationary front 184

NSOU CC-GR-07 9.14 Frontolysis Definition–It means the destruction or dying of a front. $ – It destroy fronts. Weaking or vanishing of existing fronts. This process is continued for sometime in order to existence and destroy fronts. Divergence of the wind is helpfull for frontolysis. It mostly occurs when fronts move into region on divergent air flow. It is mostly found in sub-tropical high pressure regions. When the air masses move away from each other, fronts may disipate. When temperature contrast between adjacent air masses diminises, this condition occur. 9.15 Ekman Spiral Definition–Ekman spiral is a structure of currents or winds near a horizontal boundary in which the flow and direction rotates as one moves away from the boundary.

' +, - . (1902), a Scandinavian physicist, developed a mathematical model of defection of surface ocean currents relative to wind direction caused by . / ' 1. According to Ekman, the surface water of the ocean, when set in motion by wind, is deflected to the right of the direction of the current-generating wind at almost 45 o angle in the norther hemisphere. 2. Surface water is deflected to the left of the wind direction in the southern hemisphere. 3. The speed of each successive lower layer of ocean water decreases in response to the downward decrease of frictional force of current generating wind. 4. The frictional force of wind becomes almost zero at the depth of 100 to 200 metres. 5. The winds sets the surface water of the ocean in motion through its friction with the surface of oceans caused by wind.

185 NSOU CC-GR-07 6. The resultant movement of surface water of the ocean does not follow the direction of wind but is deflected to right of the wind direction at the angle of 45 o . 7. Each successive lower layer of ocean water upto the depth of 100–200 meters moves forward. 8. Thus 'the Ekman spiral describes the speed and direction of flow of surface waters at various depths.' Direction of wind 45 o Direction of surface current Net water transport/ Ekman transport 90 o 45 o wind direction Super current Direction and velocity Figure : Ekman Spiral

186 NSOU CC-GR-07 9.16 Greenhouse gases vs. pollutants Greenhouse Gases Pollutant 1. Those gases which are responsible The elements which is responsible for green house effect. for environmental pollution. 2. Less effective on environment. More effective on environment. 3. The responsible gases are In most of the cases, the CO 2 , CO, N 2 O, O 3 , CFC, CH 4 . pollutants are CO 2 , CO. 4. These are responsible for global These are causing environment pollution as warming. well as degradation. 5. These are mainly associated with These are causing different environmental global warming and green pollution as well as environmental house effect. degradation on a large scale. 6. The effect is limited. These are widely spread and has a large scale impact on environment. * Meso scale winds are better known as local winds or regional winds. It can persist anywhere from several minutes to several days. It is mostly driven by temperature and pressure differences or by variation in topography. The main types of local winds are sea breezes and land breezes, Anabatic and katabatic winds. Due to difference in heating and cooling of earth surfaces can create several local and regonal winds. $ 0 1 1) 2 & 3 During the day time land become hot as campared to sea, hence sea breeze flow from sea to land.

187 NSOU CC-GR-07 Land Sea → → air decent Land Sea Sea Breeze Land Breeze Mountain breeze —Katabatic wind Anabatic wind Valley Figure: Katabatic wind Valley breeze Valley breeze 4 & 3 –During the night land become cooler than sea. Hence land breeze flow from land to sea. 2, & 3 & 3 –During

45%	MATCHING BLOCK 260/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

the day, the slope get heated and air move upslope to still the resulting gap. The air from the valley blows up to the valley are called & 3 . It is also known as % & 1 . & 3 –During the night, slope gets cooled and dense air desent into valley as mountain wind

or breeze.

100%	MATCHING BLOCK 261/265	SA	MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

The cool air of the high plateaus and ice fields draining into the valley is called 5 & 1 . 9.18 Katabatic Wind

It is a hot dry wind that blow down a mountain slope. When air over sloped terrain is cooled by conduction, it becames denser than near air and drains to lower level/when cool air is drain into the valley, then Katabatic wind generated. $ 1) The degree of cooling along the slope. 2) The roughness of the slope. 3) The steepness of the slope.

188 NSOU CC-GR-07 / ' 1. It is technical name for a 0 1 and it rush down or it move down the slope. 2. Commonly found blowing out from the large and elevated ice sheet of Antarctica and Greenland. 9.19 El Nino vs. La Nina Subject El Nino La Nina Meaning The little boy The little girl Interval 5-10 years 2-3 years Ocean current Warm Cold Location Peru, Chile coast Peru, Chile coast close to equator. Temperature Increase about 2-4 o C Decrease about 4 o C Impact –global warming –cooling of climate –change of wind movement –snowfall and pressure –rainfall and flood –effect on plant and animal –creation of cyclone –southern oscillation –increase of organism –effect on monsoon –effect on south-east pacific climate Year seen: 2000, 2002, 2007 1995, 1998, 2005 Figure: Pressure and circulation changes associated with El Nino
189 NSOU CC-GR-07 9.20 Southern Oscillation It
is a inter-annual

70%	MATCHING BLOCK 262/265	SA	BGEO21_21 Climatology and Oceanography_All Uni ... (D133844838)

fluctuation of atmospheric pressure over the tropical indo- pacific region. It is an atmospheric compenent of a single large-scale coupled interaction called the El

Nino. It is a oscillation in air pressure between the tropical eastern and western before oceans water. 2 6 It is measured by Southern Oscillation Index (SOI). It is a record of the monthly or seasonal fluctuation in the normalized surface air pressure. * 26 Positive Southern Oscillation Index. (a) Tahiti pressure is greater than port Darwin. (b) High pressure of East pacific and low over Indian Ocean. (c) Low rainfall over East Pacific and normal monsoon over Indian region.) 0 2 6 – (a) Port Darwin pressure is greater than Tahiti. (b) High pressure over Indian Ocean and low pressure of East pacific Figure: Circulation and precipitation associated with extreme phases of ENSO.
190 NSOU CC-GR-07 (c) Bad or low rainfall over Indian region. El Nino is associated with negative value of SOI. 9.21 Anticyclone Introduction–The term anticyclone was introduced by Galten in 1861. It is a circulation of wind around a central region of high atmospheric pressure. It

90%	MATCHING BLOCK 263/265	W

is clockwise in northern hemisphere and anti-clockwise in southern hemisphere. / 1.

It is a weather phenomenon that is a large scale circulation of winds, around a central region of high atmospheric pressure. 2. It moves clockwise in northern hemisphere and anti-clockwise in southern hemisphere. 3. The strongest anticyclones occur over snow covered portions of Asia and North America in the winter season. 4. Gradient wind speed is greater for an anticyclone. 5. No clouds are present as they tends to evaporate. 6. There is no precipitation occur and tend to become dry. 7. They are larger upto 3000 km across. January Shifting of isotherm Wind direction H. P. Low Pressure wind direction H.P L.P L. P. Northern hemispher L.P Southern hemispher Figure : Anticyclone H.P—High Pressure L.P–Low Pressure
191 NSOU CC-GR-07 6 0 The origin of anticyclones lies in upper air circulation in the oscillating westerlies. The Rossby waves and subsidence induced by density of the air. As the air cools, its density increases and it sinks forming high pressure zone. This is how anticyclone originate in polar and continental area. The Movement of Rossby waves change the forces. The result is the wind speed is greater than the ridgers of Rossby weaves. They compensated by convergence and divergence near the ground lead to anticyclone. Thus divergence take peace when convergence aloft. As long as Rossby waves is stable pressure area is stable. 9.22 Anticyclones and Associated weather Phenamena 1) / The core is high, as they are called cold core and have low temperature in their centres. As sea level a cold-core high weakeness with elevation and may change into high level to low. The spacing of isobar at the centre is low. Characteristic–Shallow anticyclone with circulation extend up to 23 km. Development–The cold core anticyclone develop over Arctic and Antarctic region in winter. Latitude–Cold core anticyclone form in high latitude. Origin–Due to radiation, cooling of land surface and chilling of the overlying atmosphere. Troposphere–It is cold and in tropopause it is low. Stratosphere–It is warm in stratospher. High High Warm Cold Warm

192 NSOU CC-GR-07 Intensity–It decrease with height. On occasions cold–Core highs move into warmer region of low latitude where they turn into deep warm core anticycle. - 1 Temperature–High temperature observe in the centre. Temperature gradually decrease from centre to outward. Isobar–The vertical spacing of isobar at the centre is relatively greater. At higher elevation, the isobar bulged out upward so, slope of isobar is steeper. Development–The anticyclone develop in south-east state of United State of America and South California during summer. Latitude–Warm core anticyclone form in low latitude. Troposphere–It is warm in troposphere, therefore the temperature in tropopause is high. Stratosphere–It is cold in stratosphere. Intensity–Increase with height. Origin–Convergence in upper tropospher. 7 . 0 This are warm anticyclonic cells that have broken away from the rossby waves, during high index and have establish themselves in higher latitude. It affect the normal westerly flow at all levels by diverting than and also block the eastured passage of depresion. The maximum frequency of blocking anticyclones occur over Alaska, Greenland, Australia, New Zealand etc. It has enormous effect on weather and climate and responsible for producing anomalous months and seasons. High High Cold Warm Cold

193 NSOU CC-GR-07 9.23 Types of Anticyclones 1. 2 & 0 Develope in subtropical region they are almost permanent high-pressure system positioned in subtropical high pressure belts. They are well develop over the oceans and have low pressure over continent. 2. / 0 These cold anticyclone from over continental surface in winter. The produced by radiational cooling of the earth is surface. 3. # 0 & & 1 This are weather system which are found between individual cyclone. They produce clear and fine weather after more turbulent cyclonic weather. 4. & . This are the last member of cyclone family which may move even in tropical region. 5. These anticyclones moves equator ward and it slows down. They transformed into subtropical warm anticyclones. 9.24 Stratosphere 1. 2 It is the second most lower layer of atmosphere. –12-50 km. $ / : 1. Lower portion of the layer is isothermal. 2. Temperature increases according to elevation increasement. 3. Upper part of this layer is known as stratopause. 4. Cirrus cloud found here. 5. No wheather phenomena is visible here. 6. It is divided into two part, lower stratosphere and upper stratosphere. 7. Thickness is highest at the poles. 8. Temperature increases above this layer of atmosphere. 9. Lower layer is toposphere. and upper layer is mesosphere. 10. It's a calm layer. 11. Jet planes are travel through this layer.

194 NSOU CC-GR-07 9.25 Advection Fog Vs. Ground Fog Subject Advection fog Ground fog 1. Definition It genrates when warm Fog formed by cooling moist air moves horizontally of land after sunset accross cooler surface. and clear sky. 2. Duration Can last for several days. Generally last for short duration. 3. Intensity Can range from thin to Varies with denser dense but dense fog likely over open condition cover larger area. area or near water bodies. 4. Coverage May be advected over It remains in ground of large area. a place. 5. Depth It varies with boundary layer It varies with depth of but deeper than radiational radiation inversion. fog. 6. Time It can form almost at any It can form late right time of day. or early morning. 7. Wind Occur with light or moderate Boundary layer low level wind. winds generally dynamic and adiatatic less than zero. process in negligible and winds generally blows 5 km in speed. * ENSO in El Nino and Southern Oscillation. It has both good and bad impact on the biosphere including human being. 1. El Nino affect the location of jet stream which produce winter weather pattern. 2. In Peruvian portion of the Atacama Desert, it bring copius rainfall associated with voilence storm. 3. It is associated with coral bleaching. 4. It reduces the upwelling of cold, nutrient rich water that sustains large fish population.

195 NSOU CC-GR-07 5. Agriculture of Australia, Indenosia, Africa etc. is effected due to El Nino. 6. Human health hazard can be related to ENSO as it increases famine, water population diseases such as malaria, dengu, cholera etc. 9.27 Ozone Formation Stratospheric Ozone is formed naturally by chemical reactions involving solar ultraviolet radiation and oxygen molecules which make up 21% of atmosphere. 2 $ 0 When short-wave length UV light from the sun hits a molecule of oxygen gas. Due to which the oxygen bond holding the atoms together break and create two oxygen atom. Pacific area Diagram Australia S. America S. Amer- ica Austratia El Nino P.O. Water movement Warm area Figure: El Nino and La Nina. A A A A A A La Nina

196 NSOU CC-GR-07 2 0 – Each of these highly reaction atoms combines with an oxygen molecules to produce an ozone molecules. These reaction occur continually whenever solar ultraviolet radiation is present in the stratospher. Some of the ozone are transported down to the troposphere. In Troposphere, ozone is produced by chemical reaction. It primarily involve hydrocarbon and nitrogen oxide gases as well as ozone itself and requir sunlight to complete. 9.28 Atmospheric Window It is that portion of eletromagnetic spectrum that can be transmitted through the atmosphere without absorption. The region where carbondioxide and water vapour is minimum than its absorption. Basically, from where the electromagnetic radiation from space can penetrate the earth atmosphere, is called atmospheric window. 1. It allow specific wave length like gamma rays. 2. Water vapour, ozone, carbon dioxide in the atmosphere is absents. So specific bands of EM spectrum can freely pass. 3. It help in remote sensing by taking atvantage of visible spectrum and non visible light. ________
197 NSOU CC-GR-07 Climatology Sample Questions Long answer type question : [10 Marks] *
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, - % *) % . # / 0 0 %) % # 1 % / % % ## % #(2 #* % #+ 3 4 5 #, % 2 . #- " % #* / 2 3 % # 3 % (6/ 36 7 36 (8 9 (# 2 8 ((
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. 8 (+ . (,) % : (-) % ; >
198 NSOU CC-GR-07 demerits. 38. Make a comparative analysis of the climatic classification of Koppen and Thornthwaite. Short answer type question: [5 Marks] 1. Albedo. 2. Characteristics of Troposphere/Stratosphere 3. Inversion of Temperature 4. Role of Green house gases 5. Evidences of global warming 6. Importance of Ozone/Ozonosphere 7. Solution of Ozone depletion. 8. Types of fog 9. Classification of clouds 10. Types of front 11. Characteristics of fronts 12. Conditions responsible for frontogenesis and frontolysis 13. Differentiate stability with instability of atmosphere. 14. Factors controlling general circulation of winds 15. Geostrophic wind 16. Coriolis force 17. Byes ballot law's 18. Geostrophic wind Vs. Gradient wind 19. Factors controlling pressure systems 20. Structure of tropical cyclone 21. Favourable conditions for tropical cyclone 22. Baroclinic wave theory and polar front theory of mid latitude cyclone 23. Features of mid latitude cyclone 24. Anti-cyclone 25. Cyclone Vs. anti-cyclone 26. Nor' wester 27. Warm front Vs. Cold front 28. Occluded front 29. Frontogenesis and Frontolysis 30. Regional distribution of tropical cyclone 31. Classification of tropical cyclone 32. Green House Gases 33. Ozone depletion 34. Effect of El-Nino 35. Effect of La-Nina 36. Human induced factors of global warming 37. Sunspot 38. Southern Oscillation Index (SOI) 39. Burst of monsoon
199 NSOU CC-GR-07 40. Retreating monsoon 41. Branches of Indian Monsoon 42. Influence of monsoon on Indian climate 43. Classical concept of monsoon 44. Differences and Brief Notes [5 Marks] 1. Frontal Fog Vs. Advection Fog 2. Barotrophic wind Vs. Baroclinic wind 3. Lapse Rate-Normal Vs.

50% **MATCHING BLOCK 264/265** W

Adiabatic Lapse rate 4. Adiabatic Lapse Rate 5. Warm Fronts Vs. Cold Fronts 6. Dry Adiabatic Lapse Rate Vs. Wet Adiabatic Lapse Rate 7.

Tropical Cyclone Vs. Temperate Cyclone 8. Frontogenesis Vs. Frontolysis 9. Af Climate Vs. Aw Climate 10. Precipitation Effectiveness, Temperature Efficiency, Potential** *
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200 NSOU CC-GR-07 Further Readings

80%	MATCHING BLOCK 265/265	W

Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)

Chritechfied, H. J. (2004): General Climatology, Prentice Hall of Indian Private Limited, New Delhi (4th Edition) Lal, D. S. (1985): Climatology, Chaitanya, Allahabad. Lenka, D. (1998): Climate, weather and crops in India, Kalyani Publishers, Ludhiana. Oliver, J. E. and Hodore, J. J. (2003), Climatology: An Atmospheric science, Pearson Education, Pvt. Ltd. Delhi (First Indian Edition). Singh, S. (2007): Climatology, Prayag Pustak Bhawan, Allahabad. Subrahmanyam, V. P. (ed./1983): General Climatology, Heritage Publishers, New Delhi. Thompson, R. D. (1997): Atmospheric Process and Systems, Routeledge, London. Trewartha, G. G. (1981): The Earth's Problem Climates, University of Wisconsim Press (2nd Edition).

Hit and source - focused comparison, Side by Side

Submitted text	As student entered the text in the submitted document.
Matching text	As the text appears in the source.

1/265 SUBMITTED TEXT 18 WORDS	69% MATCHING TEXT 18 WORDS
envelopes the earth's surface is called the atmosphere. The atmospherer is a mixture of many gases. In 10	envelopes the earth all round is called the atmosphere. 2.8.2.1 Composition The atmosphere is a mixture of many discrete gases, in

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2/265 SUBMITTED TEXT 11 WORDS	100% MATCHING TEXT 11 WORDS
addition, it contains huge numbers of solid and liquid particles,	addition, it contains huge numbers of solid and liquid particles,

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3/265 SUBMITTED TEXT 24 WORDS	94% MATCHING TEXT 24 WORDS
collectively called aerosols. Some of the gases may be regarded as permanents atmospheric components that remain in fixed proportions to the total gas volume. Other	collectively called aerosols. Some of the gases may be 7 regarded as permanent atmospheric components that remain in fixed proportions to the total gas volume. Other

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4/265 SUBMITTED TEXT 12 WORDS	100% MATCHING TEXT 12 WORDS
vary in quantity from place to place and from time to time.	vary in quantity from place to place and from time to time.

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5/265	SUBMITTED TEXT	51 WORDS	73%	MATCHING TEXT	51 WORDS

different components of the atmosphere have got their individual characteristics. These are– Gases: Of all the gases oxygen happens to be the most important as it is so essential to all life forms. No life is possible without it. It is capable of combining with all other element to form different components. It is

Different constituents of the atmosphere, it may be noted, have got their individual characteristics as briefly discussed below. Gases. Of all the gases oxygen happens to be the most important, for it is so essential to all life forms. All living organisms inhale oxygen. No life is possible without it. It is capable of combining with all other elements to form different compounds. It is

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6/265	SUBMITTED TEXT	34 WORDS	60%	MATCHING TEXT	34 WORDS

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SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

7/265	SUBMITTED TEXT	14 WORDS	75%	MATCHING TEXT	14 WORDS

mixture of gases contains huge numbers of solid and liquid particles collictively called aerosols,

mixture of many gases. In addition, it contains huge numbers of solid and liquid particles, collectively called aerosols.

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8/265	SUBMITTED TEXT	20 WORDS	57%	MATCHING TEXT	20 WORDS

Of all the gases Oxygen is the most important. All living organism inhale Oxygen. No life is possible without it.

Of all the gases oxygen happens to be the most important, for it is so essential to all life forms. All living organisms inhale oxygen. No life is possible without it.

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9/265	SUBMITTED TEXT	11 WORDS	95%	MATCHING TEXT	11 WORDS

main function in atmosphere is to regulate combustion by diluting Oxygen

main function in the atmosphere is to regulate combustion by diluting oxygen.

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Ouriginal by Turnitin

10/265	SUBMITTED TEXT	16 WORDS	68%	MATCHING TEXT	16 WORDS

green plants in the process of photosynthasis extract Carbondioxide from the atmosphere and utilized it. It

Green plants, in the process of photosynthesis, extract carbon dioxide from the atmosphere and utilize it. It

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11/265	SUBMITTED TEXT	21 WORDS	71%	MATCHING TEXT	21 WORDS

is a type of oxygen molecule form by three atoms. It is found in small quantity in upper atmosphere. It is

is a type of oxygen molecule formed of three atoms rather than two. It is found only in very small quantity in the upper atmosphere. It is

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12/265	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

is one of the most variable gases in the atmosphere, which

is one of the most variable gases in the atmosphere, which

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13/265	SUBMITTED TEXT	24 WORDS	54%	MATCHING TEXT	24 WORDS

In warm and wet tropics, it account for 4%, while in dry and cold area of desent and polar region may be less than 1%.

In the warm and wet tropics, it may account for four percent of the air by volume, while in the dry and cold areas of deserts and polar regions, it may be even less than

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14/265	SUBMITTED TEXT	23 WORDS	73%	MATCHING TEXT	23 WORDS

km above the surface. It act as a filter and absorbs the ultraviolet rays radiating from the sun and prevent them from reaching

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

15/265	SUBMITTED TEXT	17 WORDS	64%	MATCHING TEXT	17 WORDS

may orginate from different sources and includes sea salts, fine soil, smoke- soat, ash, pollen, dust and

may originate from different source and include: sea salts, fine soil, smoke-soot, ash, pollen, dust and

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Ouriginal by Turnitin

16/265	SUBMITTED TEXT	26 WORDS	79%	MATCHING TEXT	26 WORDS

absorbs part of insolation from the sun and preserues the earth radiated heat it thus act like a blanket allowing the earth neither to become too cold

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

17/265	SUBMITTED TEXT	12 WORDS	87%	MATCHING TEXT	12 WORDS

Dust particles are generally concentrated in the lower layers of the atmosphere

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

18/265	SUBMITTED TEXT	36 WORDS	94%	MATCHING TEXT	36 WORDS
Dust particles by the process of scattering contribute a varied colours of red and orange at sunrise and sunset. The blue colour of the sky is also due to selective scattering by dust particles.			Dust particles, by the process of scattering, contribute to the varied colours of red and orange at sunrise and sunset. The blue colour of the sky is also due to selective scattering by dust particles.		

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19/265	SUBMITTED TEXT	21 WORDS	100%	MATCHING TEXT	21 WORDS

higher concentration of dust particles is found in subtropical and temperate regions due to dry winds in camparison to equatorial and polar

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

20/265	SUBMITTED TEXT	23 WORDS	91%	MATCHING TEXT	23 WORDS
The duration of dawn and toilight as well as their intensity are all controlled by the presence of these solid particles in air. 1.4			The duration of dawn and twilight as well as their intensity are all controlled by the presence of these solid particles in the air. 1.5.1		

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21/265	SUBMITTED TEXT	21 WORDS	86%	MATCHING TEXT	21 WORDS
Atmosphere Introduction: Atmosphere consists of different layers with varying density and temperature. Density is highest near the surface of the earth and					

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

22/265	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS
Radio waves transmitted from the earth are reflected back to the earth by this layer.			Radio waves transmitted from the earth are reflected back to the earth by this layer.		

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23/265	SUBMITTED TEXT	14 WORDS	90%	MATCHING TEXT	14 WORDS
D-layer– It reflects low frequency radio waves but absorbs medium and high- frequency waves.			D-layer reflects low-frequency radio waves, but absorbs medium- and high-frequency waves.		

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24/265	SUBMITTED TEXT	49 WORDS	63%	MATCHING TEXT	49 WORDS
E-layer– This layer is also called kennelly-heaviside layer. It reflect the medium and high frequency radio waves. It is produced by ultraviolet photons from sun interacting with nitrogen and nitrogen moleque. Sporadict E-layer– This layer occurs under special circumstances. It is caused by meteors and by the same process that cause aurora			E-layer. The E-layer is also called the Kennelly-Heaviside layer. It reflects the medium-and high-frequency radio waves. It is much better defined than the D-layer. It produced by ultraviolet photons from the sun interacting with nitrogen and nitrogen molecules. This layer also does not exist at night. Sporadic E-layer. This layer occurs under special circumstances. It is believed that this sporadic layer is caused by meteors and by the same processes that cause aurora		

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25/265	SUBMITTED TEXT	72 WORDS	75%	MATCHING TEXT	72 WORDS

km. and extends roughly to a height of 8 km near poles and 18 km at the equator. Thikcness of troposphere is more in equator because heat is transported to a great height by strong concustion currents. This layer contain dust particles and water vapour. All changes in climate and weather take place in this layers. The temperature in this layer decreases at the rate of 1°C for every 165m of height.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

26/265	SUBMITTED TEXT	19 WORDS	65%	MATCHING TEXT	19 WORDS

The upper limit of mesosphere is known as mesospause. (iv) Thermosphere (Ionosphere)–It is located between 80 and 400 km. above mesopause.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

27/265	SUBMITTED TEXT	33 WORDS	70%	MATCHING TEXT	33 WORDS

it affects very high frequency radio waves. E 2 layers– This region is above E-layer. It produced by ultra violet photons acting upon oxygen molecules. Apper in day time and vanishes at the sunset.

It affects very high-frequency radio waves. E2-layer. This region is found above the E-layer and sporadic E-layer. It is produced by ultraviolet photons acting upon oxygen molecules. It appears in day time and vanishes at the sunset.

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28/265	SUBMITTED TEXT	29 WORDS	69%	MATCHING TEXT	29 WORDS

G-Layer– This layer is at 400 km. and above this layer existence came to be known as a result of the latest exploration carried into the upper part of the atmosphere. (

G-layer. This reflecting layer is found above the F2-layer. Its existence came to be known as a result of the latest exploration carried into the upper part of the atmosphere.

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29/265	SUBMITTED TEXT	27 WORDS	63%	MATCHING TEXT	27 WORDS

layer of the earth’s atmosphere which lies between 400 and 1000 km. The density of atmosphere is very low. The atmosphere in this region is rarefied that it

layer of the earth"s atmosphere is known as the exosphere which lies between 400 and 1000 kilometres. At such a great height the density of atoms in the atmosphere is extremely low. The atmosphere in this region is so rarefied that it

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30/265	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

In addition, it contains huge numbers of solid and liquid particles,

In addition, it contains huge numbers of solid and liquid particles,

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31/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS

References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)

REFERENCES Barry R.G. and Chorley R.J. 1982 “Atmosphere Weather and Climate” Methuen London Fourth Edition.

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

32/265	SUBMITTED TEXT	13 WORDS	76%	MATCHING TEXT	13 WORDS

the atmosphere consists of different layers with varying density and temperature which is

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

33/265	SUBMITTED TEXT	55 WORDS	58%	MATCHING TEXT	55 WORDS

area of the earth’s surface and they heat the minimum area but they received maximum solar energy. Oblique rays are spread over large area and therefore, the amount of solar energy receive per unit area decrease. Oblige rays have to pass through thicker portion of the atmosphere than vertical rays thus the oblique rays have to travel larger

area of the earth’s surface and they heat the minimum possible area and the energy received per unit area increases. Oblique rays are spread over larger area of the earth’s surface and hence the amount of energy received per unit area decreases. Oblique rays have to pass through thicker portion of the atmosphere than the vertical rays thus the oblique rays have to travels larger

W http://www.bdu.ac.in/cde/SLM/SLM_FULL/M.Sc%20Geogaraphy/Final/I%20Year/Major%20Course%20I%20Clima ...

34/265	SUBMITTED TEXT	14 WORDS	71%	MATCHING TEXT	14 WORDS

varies from place to place and season to season. Greater the length of the

varies from place to place and from season to season. Under normal conditions, the height of the

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

35/265	SUBMITTED TEXT	26 WORDS	75%	MATCHING TEXT	26 WORDS

within photosphere of the sun and surrounded by chromosphere. These dark areas are cool areas because they are characterized by 1500 0 C less temperature than the chromospheres

within photosphere of the sun and surrounded by chromospheres, are created in the solar surface. These dark areas are cool areas because they are characterized by 15000o c less temperature then the chromospheres

W http://www.bdu.ac.in/cde/SLM/SLM_FULL/M.Sc%20Geogaraphy/Final/I%20Year/Major%20Course%20I%20Clima ...

36/265	SUBMITTED TEXT	19 WORDS	73%	MATCHING TEXT	19 WORDS

Angle of incidence of sun rays: The earth is geoid shape therefore sun rays strike the surface at different

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

37/265	SUBMITTED TEXT	9 WORDS	100%	MATCHING TEXT	9 WORDS

The amount of insolation received on the earth's surface

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

38/265	SUBMITTED TEXT	39 WORDS	79%	MATCHING TEXT	39 WORDS

the insolation received at the top of the atmosphere is 100%. While passing through the atmosphere some amount of energy is reflected, scattered and absorbed. Roughly 35 units are reflected back to space before reaching the earth surface

the insolation received at the top of the atmosphere as 100 per while passing through the atmosphere some amount of energy is reflected, scattered and absorbed. Only the remaining part reaches earth surface. units are reflected back to space even before reaching the earth's surface.

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Ouriginal by Turnitin

39/265	SUBMITTED TEXT	15 WORDS	89%	MATCHING TEXT	15 WORDS
units are reflected back from the top of clouds, 2 units from snow and ice			units are reflected back from the top of the clouds and 2 units from the snow and ice-		

W https://www.sskunjpura.org/images/Topic_7_-_Composition_and_structure_of_atmosphere_1.pdf

40/265	SUBMITTED TEXT	21 WORDS	84%	MATCHING TEXT	21 WORDS
Thus the total radiation returning from the earth and the atmosphere is 17 + 48 = 65 which is the total			Thus, the total radiation returning from the earth and the atmosphere respectively is 17+48=65 units which balances the total		

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

41/265	SUBMITTED TEXT	15 WORDS	81%	MATCHING TEXT	15 WORDS
tropics should have been getting progressively hotter and poles pregressively cooler. But this is not so			tropics, therefore, should have been getting progressively hotter and the poles getting progressively cooler. But this is not so.		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

42/265	SUBMITTED TEXT	9 WORDS	100%	MATCHING TEXT	9 WORDS
The amount of solar radiation reaching the earth's surface					

SA climatology book.docx (D49940943)

43/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS
References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)			REFERENCES Barry R.G. and Chorley R.J. 1982 "Atmosphere Weather and Climate" Methuen London Fourth Edition.		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

44/265	SUBMITTED TEXT	35 WORDS	70%	MATCHING TEXT	35 WORDS
the lower the albedo, the more radiation from the sun that get absorbed by the planet and temperature will rise. If the albedo is higher and the earth is more reflective than more radiation is reflected to					

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

Ouriginal by Turnitin

45/265	SUBMITTED TEXT	39 WORDS	62%	MATCHING TEXT	39 WORDS

Temperature indicates the relative degree of heat of a substance. Heat is the energy which make them hot, while temperature measures the intensity of heat. There is a close relationship between heat and temperature as gain or loss of heat

Temperature indicates the relative degree of heat of a substance. Heat is the energy which make things or objects hot, while temperature measures the intensity of heat. Although quite distinct from each other, yet heat and temperature are closely related because gain or loss of heat

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

46/265	SUBMITTED TEXT	40 WORDS	57%	MATCHING TEXT	40 WORDS

Distribution of Temperature Introduction–Temperature indicates the relative degree of heat of a substance. Heat is the energy which make them hot, while temperature measures the intensity of heat. There is a close relationship between heat and temperature as gain or loss of heat

Distribution of Temperature Over the Earth's Surface Temperature indicates the relative degree of heat of a substance. Heat is the energy which make things or objects hot, while temperature measures the intensity of heat. Although quite distinct from each other, yet heat and temperature are closely related because gain or loss of heat

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

47/265	SUBMITTED TEXT	34 WORDS	66%	MATCHING TEXT	34 WORDS

Horizontal distribution of tempreature (ii) Vertical distribution of tempreature (i) Horizontal distribution of tempreature–Distribution of temperature across the latitudes over the surface of earth is called horizontal distribution. On map horizontal distribution is commonly shown by isotherms.

horizontal distribution of temperature (b) The vertical distribution of temperature. (a) Horizontal Distribution of Temperature Distribution of temperature across the latitudes over the surface of the earth is called horizontal distribution. The horizontal of Insolation and temperature is commonly shown by "Isotherms",

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

48/265	SUBMITTED TEXT	12 WORDS	90%	MATCHING TEXT	12 WORDS

Horizontal Distribution of Temperature 3.4 Vertical Distribution of Temperature 3.5 Inversion of Temperature 3.6

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

Ouriginal by Turnitin

49/265	SUBMITTED TEXT	20 WORDS	50%	MATCHING TEXT	20 WORDS

it also cools down faster than sea. Hence during day time temperature is relatively higher an land during day time and

It also cools down more rapidly than water during night. Hence, temperature is relatively higher on land during day-time and

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

50/265	SUBMITTED TEXT	40 WORDS	96%	MATCHING TEXT	40 WORDS

Relief and Altitude—Relief features such as mountains, plateaus and plains control the temperature by way of modifying its distribution. Mountain act as barriers against the movement of winds. The Himalayan ranges prevent cold winds of central Asia from entering India during winter. 4)

Relief and Altitude: Relief features such as mountains, plateaus and plains control the temperature by way of modifying its distribution. Mountains act as barriers against the movement of winds. The Himalayan ranges prevent cold winds of Central Asia from entering India, during winter.

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51/265	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

also affect temperature because they transport heat from one region to the other. The

also affect temperature because they transport heat from one region to the other. The

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

52/265	SUBMITTED TEXT	12 WORDS	92%	MATCHING TEXT	12 WORDS

same amount of insolation received by all the points located on same latitude.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

53/265	SUBMITTED TEXT	19 WORDS	86%	MATCHING TEXT	19 WORDS

The horizontal distribution of temperature over the global can be studied easily from the maps of January and July

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

54/265	SUBMITTED TEXT	54 WORDS	92%	MATCHING TEXT	54 WORDS

Horizontal distribution of temperature in January:- – In January, the sun shines vertically overhead near tropic of capricorn. Hence, it is summer in southern hemisphere and winter in northern hemisphere. – A high temperature is found over the landmasses mainly in 3 regions of southern hemisphere these regions are North-West Argentina, East and Central Africa and Central Australia.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

55/265	SUBMITTED TEXT	60 WORDS	84%	MATCHING TEXT	60 WORDS

isotherm of 30°C closes them. – In Northern hemisphere, landmasses are cooler than the ocean. As the air is warmer over the oceans than over landmasses in the northern region, the isotherms bend toward the north when they cross the oceans and to the south (equator) over the continents. – This can be clealry visible over the North Altantic Oceans. The presence of warm ocean

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

56/265	SUBMITTED TEXT	99 WORDS	84%	MATCHING TEXT	99 WORDS

Distribution of Temperature in July:- – In July, the Sun shines vertically overhead near the tropic of cancer. Hence, high temperature are found in the entire northern hemisphere. – The regions having high temperature including South Western USA, the Sahara, the Arabia, Iraq, Iran, Afghanistan, desert region of India and China. – However, lowest temperature (0°C) is also noticed in the northern hemisphere during summer in the central part of Greenland. – During summer, in the northern region, isotherms bend towards the equator while crosses occens and towards the poles while crossing landmasses isotherms are wide spaced over oceans while they are closely spaced over landmasses. 29

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

57/265	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS
Because of the preponderance of land in the northern hemisphere, the			Because of the preponderance of land in the northern hemisphere the		

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58/265	SUBMITTED TEXT	14 WORDS	78%	MATCHING TEXT	14 WORDS
In July the deviation of isotherms is not that much pronouced as in January.					

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

59/265	SUBMITTED TEXT	18 WORDS	97%	MATCHING TEXT	18 WORDS
On the continents of the northern hemisphere, the isotherms for the month of January bend sharply towards the					

SA climatology book.docx (D49940943)

60/265	SUBMITTED TEXT	20 WORDS	62%	MATCHING TEXT	20 WORDS
the apparent movement of the sun towards the tropic of cancer, all the isotherms are displaced slightly towards the North,					

SA climatology book.docx (D49940943)

61/265	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS
In July the thermal equator is displaced to the North of the equator.					

SA climatology book.docx (D49940943)

62/265	SUBMITTED TEXT 96 WORDS	91% MATCHING TEXT 96 WORDS

An inversion acts as a cap on the upward movement of air from the layers below. As a result, convection produced by the heating of air from below is limited to levels below the inversion. Diffusion of dust, smoke, and other air pollutants is likewise limited. In regions where a pronounced low-level inversion is present, convective clouds cannot grow high enough to produce showers. Visibility may be greatly reduced below the inversion due to the accumulation of dust and smoke particles. Because air near the base of an inversion tends to be cool, fog is frequently present there.

An inversion acts as a cap on the upward movement of air from the layers below. As a result, convection produced by the heating of air from below is limited to levels below the inversion. Diffusion of dust, smoke, and other air pollutants is likewise limited. In regions where a pronounced low-level inversion is present, convective clouds cannot grow high enough to produce showers and, at the same time, visibility may be greatly reduced below the inversion, even in the absence of clouds, by the accumulation of dust and smoke particles. Because air near the base of an inversion tends to be cool, fog is frequently present there.

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

63/265	SUBMITTED TEXT 44 WORDS	81% MATCHING TEXT 44 WORDS

Ideal Conditions For Temperature Inversion 1. Long nights, so that the outgoing radiation is greater than the incoming radiation. 34 NSOU CC-GR-07 2. Clear sky, which allow unobstructed escape of radiation. 3. Calm and stable air, so that there is no vertical mixing at lower levels.

Ideal Conditions for Formation of Temperature Inversion Long nights, so that the outgoing radiation is greater than the incoming radiation. B. Cloudless and Clear skies, which allow unobstructed escape of radiation. C. Calm and stable air, so that there is no vertical mixing at lower levels.

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

64/265	SUBMITTED TEXT 14 WORDS	89% MATCHING TEXT 14 WORDS

Temperature gradient in the interior and the eastern margins of the continents becomes weak.

SA climatology book.docx (D49940943)

65/265	SUBMITTED TEXT 27 WORDS	80% MATCHING TEXT 27 WORDS

The obseved rate of vertical decrease in temperature is called vertical temperature gradient or lapse rate. Lapse rate is not constant but varies with (1) height, (2) location

SA climatology book.docx (D49940943)

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66/265	SUBMITTED TEXT	23 WORDS	93%	MATCHING TEXT	23 WORDS

ground inversion develops when air is cooled by contact with a colder surface until it becomes cooler than the overlying atmosphere; this occur most

Ground Inversion: Develops when air is cooled by contact with a colder surface until it becomes cooler than the overlying atmosphere. This occurs most

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

67/265	SUBMITTED TEXT	27 WORDS	100%	MATCHING TEXT	27 WORDS

often on clear nights, when the ground cools off rapidly by radiation. If the temperature of surface air drops below its dew point, fog may result.

often on clear nights, when the ground cools off rapidly by radiation. If the temperature of surface air drops below its dew point, fog may result.

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

68/265	SUBMITTED TEXT	67 WORDS	99%	MATCHING TEXT	67 WORDS

subsidence inversion develops when a widespread layer of air descends. The layer is compressed and heated by the resulting increase in atmospheric pressure, and as a result the lapse rate of temperature is reduced. If the air mass sinks low enough, the air at higher altitudes becomes warmer than at lower altitudes, producing a temperature inversion. Subsidence inversions common over the northern continents in winter (

Subsidence Inversion: Develops when a widespread layer of air descends. The layer is compressed and heated by the resulting increase in atmospheric pressure, and as a result, the lapse rate of temperature is reduced. If the air mass sinks low enough, the air at higher altitudes becomes warmer than at lower altitudes, producing a temperature inversion. Subsidence inversions are common over the northern continents in winter

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69/265	SUBMITTED TEXT	18 WORDS	100%	MATCHING TEXT	18 WORDS

and over the subtropical oceans, these regions generally have subsiding air because they are located under large high-pressure

and over the subtropical oceans; these regions generally have subsiding air because they are located under large high- pressure

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

Ouriginal by Turnitin

70/265	SUBMITTED TEXT	107 WORDS	93%	MATCHING TEXT	107 WORDS

Sometimes, the temperature in the lower layers of air increases instead of decreasing with elevation. This happens commonly along a sloping surface. Here, the surface radiates heat back to space rapidly and cools down at a faster rate than the upper layers. As a result the lower cold layers get condensed and become heavy. The sloping surface underneath makes them move towards, the bottom where the cold layer settles down as a zone of low temperature while the upper layers are relatively warmer. This condition, opposite to normal vertical distribution of temperature, is known as Temperature Inversion. In other words, the vertical temperature gets inverted during temperature inversion.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

71/265	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

Submitted text	Matching text
A frontal inversion occurs when a cold air mass undercuts a warm air mass	A frontal inversion occurs when a cold air mass undercuts a warm air mass

W https://mu.ac.in/wp-content/uploads/2021/09/MA-GEOGRAPHY-SEM-I-P-102.pdf

72/265	SUBMITTED TEXT	47 WORDS	93%	MATCHING TEXT	47 WORDS

Submitted text	Matching text
and lifts it aloft. the front between the two qair masses then has warm air above and cold air below. This kind of inversion has considerable slope, whereas other inversions are nealry horizontal. In addition, humidity may be high, and clouds may be present immediately above it.	and lifts it aloft; the front between the two air masses then has warm air above and cold air below. This kind of inversion has considerable slope, whereas other inversions are nearly horizontal. In addition, humidity may be high, and clouds may be present immediately above it. (

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

73/265	SUBMITTED TEXT	19 WORDS	92%	MATCHING TEXT	19 WORDS

This temperature inversion is called upper suface temperature inversion because it takes place in the upper parts of the atmosphere. (

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

Ouriginal by Turnitin

74/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS

References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)

REFERENCES Barry R.G. and Chorley R.J. 1982 "Atmosphere Weather and Climate" Methuen London Fourth Edition.

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75/265	SUBMITTED TEXT	39 WORDS	72%	MATCHING TEXT	39 WORDS

There is a maxium concentration of ozone between 30 to 60 km. above the surface of the earth. Becasue of the concentration of ozone in this layer it is called ozonosphere. It's existance come to be known from the studies of meteors.

There is a maximum concentration of ozone between 30 to 60 kilometres above the surface of the earth. Because of the concentration of the ozone in this layer it is called the ozonosphere. Its existence came to be known from the studies of meteors.

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76/265	SUBMITTED TEXT	22 WORDS	84%	MATCHING TEXT	22 WORDS

There is a general agreement among the scientists that this warm layer is deu mainly to selective absorption of ultravioeet radiation by ozone. (

There is a general agreement among the scientists that this warm layer is due to mainly to selective absorption of ultraviolet radiation by ozone.

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

77/265	SUBMITTED TEXT	126 WORDS	78%	MATCHING TEXT	126 WORDS

In fact, the ozone layer acts as a filter for the ultraviolet rays of the sun. (C) According to scientists, the presence of ozone layer in atmosphere is a boon to humanity as it protects us from sunburn by absorbing larger percentage of the ultraviolet radiation. (D) The environmentalists are much concend that the emission of nitrogen oxide by large number of supersonic transport airplanes may lead to a deterioration of the ozone layer are also to a serious biological damage to people, animals and plants life. (E) In this layer the temperature increases with height at the rate of 5°c/km. The maximum temperature recorded in the ozonosphere is some what higher than that at the earth's surface. (F) It may be noted that because of the prepond erance of chemical processes, this sphere is sometimes called 'chemosphere'. (

In fact, the ozone layer acts as a filter for the ultraviolet rays of the sun. According to scientist, the presence of the ozone layer in atmosphere is a boon to humanity for it protects us from sunburn by absorbing a larger percentage of the ultraviolet radiation. The environmentalists are much concerned that the emission of nitrogen oxide by large number of supersonic transport air planes may lead to a deterioration of the ozone layer and also to a serious biological damage to people, animals and plant life. In this layer the temperature increases with height at the rate of 5oC/km. the maximum temperature recorded in the ozonosphere is somewhat higher than that at the earth"s surface. It may be noted that because of the preponderance of chemical processes, this sphere is sometimes called the chemosphere. 14 (

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78/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS

References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)

REFERENCES Barry R.G. and Chorley R.J. 1982 "Atmosphere Weather and Climate" Methuen London Fourth Edition.

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79/265	SUBMITTED TEXT	13 WORDS	88%	MATCHING TEXT	13 WORDS

This types of inversion is unstable and is destroyed as the weather changes.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

80/265	SUBMITTED TEXT	17 WORDS	68%	MATCHING TEXT	17 WORDS

The obseved rate of vertical decrease in temperature is called vertical temperature gradient or lapse rate.

SA climatology book.docx (D49940943)

81/265	SUBMITTED TEXT	26 WORDS	94%	MATCHING TEXT	26 WORDS

The transformation of water vapour into water is called condensation. Condensation is caused by the loss of heat (latent heat of condensation, opposite to latent heat of

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

82/265	SUBMITTED TEXT	76 WORDS	99%	MATCHING TEXT	76 WORDS

In free air, condensation results from cooling around very small particles termed as hygroscopic condensation nuclei. Particles of dust, smoke, pollen and salt from the ocean are particularly good nuclei because they absorb water. Condensation also takes place when the moist air comes in contact with some colder object and it may also take place when the temperature is close to the dew point. Condensation, therefore, depends upon the amount of cooling and the relative humidity of the air.

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83/265	SUBMITTED TEXT	16 WORDS	82%	MATCHING TEXT	16 WORDS

After condensation, the water vapour or the moisture in the atmosphere takes one of the followings forms—

After condensation the water vapour or the moisture in the atmosphere take one of the following forms-

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84/265	SUBMITTED TEXT	22 WORDS	100%	MATCHING TEXT	22 WORDS

Condensation The transformation of water vapour into water is called condensation. Condensation is caused by the loss of heat (

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

85/265	SUBMITTED TEXT	21 WORDS	85%	MATCHING TEXT	21 WORDS

of vaporization). When moist air is cooled, it may reach a level when its capcity to hold water vapour ceases.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

86/265	SUBMITTED TEXT	18 WORDS	76%	MATCHING TEXT	18 WORDS

place when the dew point is lower than the freezing point as well as higher than the freezing point.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

87/265	SUBMITTED TEXT	93 WORDS	95%	MATCHING TEXT	93 WORDS

When the air rises, it expands. Thus, heat available per unit volume is reduced and, therefore, the temperautre is also reduced. Such a temperature change which does not involve any subtraction of heat, and cooling of air takes place only by ascent and expansion, is termed 'adiabtic change'. The vertical displacement of the air is the major cause of adiabatic and katabatic (cold, dense air flowing down a slope) temperture changes. Near the earth's surface, most processes of change are non-adiabatic because horizontal movements often produce mixing of air and modify its characteristics. Non-Adiabatic Temperature Changes

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

88/265	SUBMITTED TEXT	25 WORDS	92%	MATCHING TEXT	25 WORDS

Non-adiabatic processes include cooling by radiaton, conduction or mixing with colder air. The air may be cooled due to loss of heat by radiation.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

89/265	SUBMITTED TEXT	42 WORDS	95%	MATCHING TEXT	42 WORDS

In case there is direct radiation from moist air, the cooling produces fog or clouds, subject to presence of hygroscopic unclei in the air. Cooling by contact with a cold surface produces dew, frost or fog depending on other atmospheric conditions.

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

90/265	SUBMITTED TEXT	21 WORDS	100%	MATCHING TEXT	21 WORDS

The non-adiabatic processes of cooling produce only dew, fog or frost. They are incapable of producing a substantial amount of precipitation. (1)

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

91/265	SUBMITTED TEXT	26 WORDS	91%	MATCHING TEXT	26 WORDS

Non-adiabatic processes: 1. Non-adiabatic processes include cooling by radiation, conduction or mixing with colder air. The air may be cooled due to loss of heat by radiation.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

92/265	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

Cooling by contact with a cold surface produces dew, frost or fog depending on other atmospheric conditions.

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93/265	SUBMITTED TEXT	20 WORDS	100%	MATCHING TEXT	20 WORDS

The non-adiabatic processes of cooling produce only dew, fog or frost. They are incapable of producing a substantial amount of precipitation. 4.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

94/265	SUBMITTED TEXT	20 WORDS	87%	MATCHING TEXT	20 WORDS
surface of the earth, they take various shapes. According to their height, expanse, density and transparency or opaqueness clouds are			surface of the earth, they take various shapes. According to their height, expanse density and transparence or opaquensess. Generally the clouds are		

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95/265	SUBMITTED TEXT	18 WORDS	78%	MATCHING TEXT	18 WORDS
clouds are generally formed either due to loss of heat or the mixing of air masses with different temperatures.			clouds are generally formed either due to loss of heat because of radiation or due to the mixing of air masses at different temperature.		

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96/265	SUBMITTED TEXT	41 WORDS	84%	MATCHING TEXT	41 WORDS
the surface of the earth. These are extremely dense and opaque to the rays of the sun. Sometimes, the clouds are so low that they seem to touch the ground. Nimbus clouds are shapeless masses of thick vapour.			the surface of the earth. These are extremely dense and opaque to the rays of the sun. Sometimes these are so low that they seem to touch the ground. They are shapeless masses of thick vapour		

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97/265	SUBMITTED TEXT	15 WORDS	89%	MATCHING TEXT	15 WORDS

Advection fog occurs when moist air passes over a cool surface and is cooled.

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98/265	SUBMITTED TEXT	23 WORDS	81%	MATCHING TEXT	23 WORDS

A combination of these four basis types can give rise to the following types of clouds: 1. High clouds–cirrus, cirrostratus, cirrocumulus; 2. Middle clouds–altostratus

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

99/265	SUBMITTED TEXT	31 WORDS	90%	MATCHING TEXT	31 WORDS

The air on being heated, becames light and rises up in convection currents. As it rises, it expands and loses heat and consequently condensation takes place and cumulous clouds are formed.

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

100/265	SUBMITTED TEXT	16 WORDS	80%	MATCHING TEXT	16 WORDS

Precipitation is a product of the condensation of atmospheric water vapour that falls under gravity. The

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101/265	SUBMITTED TEXT	28 WORDS	70%	MATCHING TEXT	28 WORDS

When the saturated air mass comes across a mountain, if force to ascend and as it rise it expands, the temperature falls and the moisture is condensed.

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

102/265	SUBMITTED TEXT	26 WORDS	74%	MATCHING TEXT	26 WORDS
There is a continuous increase in precipitation on the windward slope upto a certain height beyond which starts diminishing. This is called inversion of rainfall.				There is a continuous increase in precipitation on the windward side up to a certain height beyond which the rainfall starts decreasing. This is called the inversion of rainfall. (	

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103/265	SUBMITTED TEXT	21 WORDS	63%	MATCHING TEXT	21 WORDS
south-west monsoon gives copious rainfall on wind ward slope of western ghats, whereas on leeward side there are extensive rain shadow			south-west monsoon causes heavy rains on the windward slope of Western Ghats, whereas on the leeward side there are extensive rain shadow		

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

104/265	SUBMITTED TEXT	34 WORDS	94%	MATCHING TEXT	34 WORDS
The chief characteristic of this sort of rain is that windward side receive greater rainfall. After giving rain on the windward side, when these winds reach the other slope, they descend and their temperature					

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

105/265	SUBMITTED TEXT	18 WORDS	92%	MATCHING TEXT	18 WORDS
occurs when deep and extensive air masses are made to converge and move upward so that their adiabatic cooling			occurs when deep and extensive air masses are made to converge and move upwards so that their adiabatic cooling		

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

106/265	SUBMITTED TEXT	30 WORDS	65%	MATCHING TEXT	30 WORDS
air with differing temperature and moisture content meet at an angle, the warm and moist air will be forced to rise over the heavier air. In addition, when air masses from different			air masses with different temperature and moisture content meet at a certain angle, Climatology 33 the warm and moist air is forced to rise over the heavier cold air mass. (ii) When air masses from different		

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

107/265	SUBMITTED TEXT	13 WORDS	76%	MATCHING TEXT	13 WORDS
Frontal precipitation occurs when the warm and moit air gradually rises above the			Frontal precipitation occurs when the warm and moist air gradually rises over the		

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

108/265	SUBMITTED TEXT	26 WORDS	86%	MATCHING TEXT	26 WORDS

capacity to take moisture increases and hense these leeward slopes remain rainless and dry. The area situated on the leeward side, which get less rainfall

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109/265	SUBMITTED TEXT	14 WORDS	85%	MATCHING TEXT	14 WORDS

Drizzle is very light rain. It is stronger than most but less than shower.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

110/265	SUBMITTED TEXT	21 WORDS	90%	MATCHING TEXT	21 WORDS

They arise from low stratocumulus clouds they evaporate even before reaching the ground due to their minute size. Drizzle can be

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

111/265	SUBMITTED TEXT	13 WORDS	82%	MATCHING TEXT	13 WORDS

Sleet don't freeze into solid mass except when it combines with freezing rain. (5)

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112/265	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

they are highly damaging to crops, tearing leaves apart and reducing their value.

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113/265	SUBMITTED TEXT	12 WORDS	76%	MATCHING TEXT	12 WORDS

formed from super-cooled droplet that slowly freeze and result in clear ice. (6)

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114/265	SUBMITTED TEXT	14 WORDS	89%	MATCHING TEXT	14 WORDS

falls which the sun shines. It occurs when the winds bearing rain together with

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

115/265	SUBMITTED TEXT	18 WORDS	69%	MATCHING TEXT	18 WORDS

C. (iii) When water remains in liquid state below 0°c, it is referred to as super-cooled. The super-cooled water

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116/265	SUBMITTED TEXT	18 WORDS	66%	MATCHING TEXT	18 WORDS

are spares in the atmosphere. Thus, when the ascending air currents rise well above the freezing level, some

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117/265	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

water droplets will be changed into ice and through sublimation, water vapour will enter into solid state.

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118/265	SUBMITTED TEXT	25 WORDS	88%	MATCHING TEXT	25 WORDS

if a single ice crystal is introduced into a cloud of super cooled water droplets, the entire cloud rapidly changes over to an all-ice cloud.

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119/265	SUBMITTED TEXT	14 WORDS	76%	MATCHING TEXT	14 WORDS

when air is saturated with respect to water, it is supersaturated with respect to ice. (

SA climatology book.docx (D49940943)

120/265	SUBMITTED TEXT	15 WORDS	96%	MATCHING TEXT	15 WORDS
Condensation depends upon the amount of cooling and the relative humidity of the air.			Condensation, therefore, depends upon the amount of cooling and the relative humidity of the air.		

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

121/265	SUBMITTED TEXT	47 WORDS	90%	MATCHING TEXT	47 WORDS
The growth of ice crystals is rapid enough to generate crystals large enough to fall. While falling from the cloud, the ice crystals grow by intercepting cloud droplets that freeze upon them. (iv) Sometimes, these falling ice crystals are broken up into fragments which again become freezing nuclei for other					

SA climatology book.docx (D49940943)

122/265	SUBMITTED TEXT	16 WORDS	82%	MATCHING TEXT	16 WORDS
After condensation, the water vapour or the moisture in the atmosphere takes one of the followings forms-			After condensation the water vapour or the moisture in the atmosphere take one of the following forms-		

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123/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS
References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition).			REFERENCES Barry R.G. and Chorley R.J. 1982 “Atmosphere Weather and Climate” Methuen London Fourth Edition.		

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124/265	SUBMITTED TEXT	45 WORDS	33%	MATCHING TEXT	45 WORDS
Air Mass 2.4 Classification of Air mass 2.5 Origin of Air mass 2.6 Conclusion 2.7 Summary 2.8 Key words 2.9 Model Questions 2.10 References 2.1 Introduction Air mass is defined as an extensive portion of the atmosphere whose physical properties, especially temperature, moisture content and lapse rate are homogeneous horizontally and vertically for hundreds of			Air Mass 2. Source Regions of Air Mass 3. Classification. Meaning of Air Mass: “An air mass may be defined as a large body of whose physical properties, especially temperature, moisture content, and lapse rate, are or less uniform horizontally for hundreds of		

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125/265	SUBMITTED TEXT	32 WORDS	48%	MATCHING TEXT	32 WORDS

of air mass. 2.3 Air Mass Air mass is defined as an extensive portion of the atmosphere whose physical properties, especially temperature, moisture content and lapse rate are homogeneous horizontally and vertically for hundreds of

of Air Mass 3. Classification. Meaning of Air Mass: "An air mass may be defined as a large body of whose physical properties, especially temperature, moisture content, and lapse rate, are or less uniform horizontally for hundreds of

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126/265	SUBMITTED TEXT	20 WORDS	76%	MATCHING TEXT	20 WORDS

place when the dew point is lower than the freezing point as well as higher than the freezing point.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

127/265	SUBMITTED TEXT	10 WORDS	95%	MATCHING TEXT	10 WORDS

of Air Mass Air masses are classified on the basis of–

of the air mass. Air masses are classified on the basis of

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128/265	SUBMITTED TEXT	131 WORDS	84%	MATCHING TEXT	131 WORDS

Trewartha has classified air masses on the basis of their geographical locations into two broad categories, viz-i) Polar air mass (P) which originates in polar areas. Artic air masses are also included in this category. ii) Tropical air mass (T), which originates in tropical areas. Equatorial air masses are also included in this category. These two air masses have been further divided into two types on the basis of the nature of the surface of their source region, i.e. land or water. a) continental air mass indicated by a small letter c. b) maritime air mass indicated by a small letter m. It may be pointed out that a continental air mass gets modified and is transformed into maritime type while passing through ocean surface but maritime airmass is seldom transformed into continental type while passing through land surface. Based on

Trewartha has classified air masses on the basis of their geographical locations into two broad categories viz.: (i) Polar air mass (P), which originates in polar areas. Arctic air masses are also included in this category.(ii) Tropical air mass (T), which originates in tropical areas. Equatorial air masses are also included in this category. These two air masses have been further divided into two types on the basis of the nature of the surface of the source regions (oceanic areas) e.g.: (a) Continental air indicated by a small letter c), and (b) Maritime air masses (indicated by a small letter m).It may be pointed out that a continental air masʃ gets modified and is transformed into maritime type while passing through ocean surface but maritime air mass is seldom transformed into continental type while passing through land surface. Based on

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129/265	SUBMITTED TEXT	43 WORDS	83%	MATCHING TEXT	43 WORDS

above facts air masses are classified into the following four principal types according to their geographical locations– i) Continental Polar air mass (cP) ii) Maritime Polar air mass (mP) iii) Continental Tropical air mass (cT) iv) Maritime Tropical air mass (mT) 2) Thermodynamic Classification–Theromodynamic modification of an air mass

above facts air masses are classified into the following four principal types according to their geographical locations: (i) Continental polar air mass (cP). (ii) Maritime polar air mass (mP). (iii) Continental tropical air mass (cT). (iv) Maritime tropical air mass (m t).(2) Thermodynamic Modifications and Classification of Air Masses: Thermodynamic modification of an air mass

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130/265	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

Cold air masses originate in the polar and arctic regions.

Cold air masses originate in the polar and arctic regions.

W https://www.geographynotes.com/climatology-2/air-masses-meaning-and-classification-climatology-ge ...

131/265	SUBMITTED TEXT	12 WORDS	76%	MATCHING TEXT	12 WORDS

Warm air masses generally originate in the subtropical regions characterised by anticyclone conditions.

Warm air masses generally originate in the subtropical regions characterized by anticyclonic conditions.

W https://www.geographynotes.com/climatology-2/air-masses-meaning-and-classification-climatology-ge ...

132/265	SUBMITTED TEXT	18 WORDS	84%	MATCHING TEXT	18 WORDS

There are two approaches to the classification of air masses, e.g.– 1) Geographical classification and 2) Thermodynamic classification 1) Geographical Classification–

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

133/265	SUBMITTED TEXT	13 WORDS	76%	MATCHING TEXT	13 WORDS

subtropical high pressure land areas. They have high temperature and low moisture content.

Subtropical high pressure land areas • High temperature and low moisture content. •

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

134/265	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

found in the upper parts of these air masses in their source

found in the upper parts of these air masses in their source

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

135/265	SUBMITTED TEXT	33 WORDS	79%	MATCHING TEXT	33 WORDS

Continental Polar Cold Stable Air Mass (cPks) b) Continental Polar Cold Unstable Air Mass (cPku) c) Continental Polar Warm Stable Air Mass (cPws) d) Continental Polar Warm Instable Air Mass (cPwu) ii) Maritime Polar Air Masses (mP)–

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

136/265	SUBMITTED TEXT	37 WORDS	70%	MATCHING TEXT	37 WORDS

Maritime Polar cold stable Air Mass (mPks) b) Maritime Polar cold unstable Air Mass (mPku) c) Maritime Polar warm stable Air Mass (mPws) d) Maritime Polar warm unstable Air Mass (mPws) 87 NSOU CC-GR-07 iii) Continental Tropical Air Masses (cT)–

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

137/265	SUBMITTED TEXT	31 WORDS	57%	MATCHING TEXT	31 WORDS

Continental Tropical cold unstable Air Mass (cTku) b) Continental Tropical cold stable Air Mass (cTks) c) Continental Tropical warm unstable Air Mass (cTwu) d) Continental Tropical warm stable Air Mass (cTws) iv) Maritime Tropical

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

Ouriginal by Turnitin

138/265 SUBMITTED TEXT 74 WORDS	91% MATCHING TEXT 74 WORDS
In meteorology, an air mass is volume of air defined by its temperature and water vapour content. Air masses cover many hundreds or thousands of square miles, and adapt to the characteristics of the surface below them. They are classified according to latitute and their continental or maritime source regions. Colder air masses are termed polar or arctic, while warmer air masses are termed tropical. Continental and superior air masses are dry while maritime and monsoon air masses are moist.	In meteorology, an air mass is a volume of air defined by its temperature and water vapor content. Air masses cover many hundreds or thousands of miles, and adapt to the characteristics of the surface below them. They are classified according to and their continental or maritime source regions. Colder air masses are termed polar or arctic, while warmer air masses are deemed tropical. Continental and superior air masses are dry while maritime and monsoon air masses are moist.

W https://en.wikipedia.org/wiki/Air_mass

139/265 SUBMITTED TEXT 16 WORDS	100% MATCHING TEXT 16 WORDS
Air masses are commonly classified according to four basic source regions with respect to latitude. 91	Air masses are commonly classified according to four basic source regions with respect to latitude.

W https://www.britannica.com/science/air-mass

140/265 SUBMITTED TEXT 166 WORDS	98% MATCHING TEXT 166 WORDS
usually forms during the cold period of the year over extensive land areas such as central Asia and northern Canada. It is likely to be stable and is characteristically free of condensation forms. When heated or moistened from the ground with strong turbulence, this type of air mass develops limited convective stratocumulus cloud forms with scattered light rain or snow showers. In summer strong continental heating rapidly modifies the coolness and dryness of the CP air mass as it moves to lower latitudes. Daytime generation of cumulus clouds in the rule, but the upper-level stability of the air mass is usually such as to prevent rain showers. * * air masses develop over the polar areas of both the Northern and the Southern hemispheres. They generally contain considerably more moisture than the cP air masses. As they move inland in middle and high latitudes, heavy precipitation may occur when the air is forced to ascend mountain slopes or is caught up in cyclonic activity.	usually forms during the cold period of the year over extensive land areas such as central Asia and northern Canada. It is likely to be stable and is characteristically free of condensation forms. When heated or moistened from the ground with strong turbulence, this type of air mass develops limited convective stratocumulus cloud forms with scattered light rain or snow showers. In summer strong continental heating rapidly modifies the coolness and dryness of the cP air mass as it moves to lower latitudes. Daytime generation of cumulus clouds is the rule, but the upper-level stability of the air mass is usually such as to prevent rain showers. develop over the polar areas of both the Northern and the Southern hemispheres. They generally contain considerably more moisture than the cP air masses. As they move inland in middle and high latitudes, heavy precipitation may occur when the air is forced to ascend mountain slopes or is caught up in cyclonic activity (

W https://www.britannica.com/science/air-mass

141/265	SUBMITTED TEXT	190 WORDS	95%	MATCHING TEXT	190 WORDS

air mass originates in arid or desert regions in the middle or lower latitudes, principally during the summer season. It is strongly heated in general, but its moisture content is so low that the intense dry convection normally fails to reach the condensation level. Of all the air masses, the cT is the most arid, and it sustains the belt of subtropical deserts worldwide. is the most important moisture-bearing and rain- producing air mass throughout the year. In winter, it moves poleward and is cooled by the ground surface. Consequently, it is characterized by fog or low stratus or stratocumulus clouds, with drizzle and poor visibiliy. A steep lapse rate aloft in regions of cyclonic activity ensures the occurrence of heavy frontal and convective rains. In summer, the characteristics of the mT air mass over the oceans and in zones of cyclonic acitivity are basicaly the same as in winter. Over warm continental areas, however, the air mass is strongly heated so that, instead of fog and low startus clouds, widely scattered and locally heavy afternoon thunderstorms occur.

air mass originates in arid or desert regions in the middle or lower latitudes, principally during the summer season. It is strongly heated in general, but its moisture content is so low that the intense dry convection normally fails to reach the condensation level. Of all the air masses, the cT is the most arid, and it sustains the belt of subtropical deserts worldwide. The maritime Tropical (mT) is the most important moisture-bearing and rain-producing air mass throughout the year. In winter it moves poleward and is cooled by the ground surface. Consequently, it is characterized by fog or low stratus or stratocumulus clouds, with drizzle and poor visibility. A steep lapse rate aloft in regions of cyclonic activity ensures the occurrence of heavy frontal and convective rains. In summer the characteristics of the mT air mass over the oceans and in zones of cyclonic activity are basically the same as in winter. Over warm continental areas, however, the air mass is strongly heated so that, instead of fog and low stratus clouds, widely scattered and locally heavy afternoon thunderstorms occur.

W https://www.britannica.com/science/air-mass

142/265	SUBMITTED TEXT	41 WORDS	63%	MATCHING TEXT	41 WORDS

The principal source regions of the earth may be classified according to the nature of surface (land or water) and the latitude of the region. Thus, the source regions are classified as under: The Article source regions are located in the high latitudes,

The principal source regions of the earth may be classified according to the nature of the surface (land or water) and latitude of the region. Classification of Air MassesClassification of Air Masses Thus the source regions are classified as under: • Surface • Continental • Maritime • Latitude • Arctic (located in the high latitudes) •

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

143/265	SUBMITTED TEXT	18 WORDS	75%	MATCHING TEXT	18 WORDS

located around the equator between the trade winds of the northern 92 NSOU CC-GR-07 and southern hemispheres. The

located around the equator between the trade winds of the northern and hemispheres) The

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

Ouriginal by Turnitin

144/265	SUBMITTED TEXT 55 WORDS	100% MATCHING TEXT 55 WORDS
	moves out to oceanic surface, it is modified into cPW air mass with haze, fog and low stratus clouds. # *	moves out to oceanic surface, it is modified into cPW air mass with haze, fog and low stratus clouds. •

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

145/265	SUBMITTED TEXT 28 WORDS	80% MATCHING TEXT 28 WORDS
	Maritime Tropical cold stable Air Mass (mTks) b) Maritime Tropical cold unstable Air Mass (mTku) c) Maritime Tropical warm stable Air Mass (mTws) d) Maritime Tropical warm unstable Air Mass (	

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

146/265	SUBMITTED TEXT 13 WORDS	88% MATCHING TEXT 13 WORDS
	cool and moist in the lower parts, but dry aloft. A temperature inversion	Cool and moist in the lower parts, but dry aloft • Temperature inversion

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

147/265	SUBMITTED TEXT 59 WORDS	97% MATCHING TEXT 59 WORDS
	well distributed to high levels. When these air masses are lifted over fronts or high mountains, they produce heavy precipitation. & "	well distributed up to high levels. • When these air masses are lifted over fronts or high mountains, they produce heavy Precipitation •

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

148/265	SUBMITTED TEXT 20 WORDS	82% MATCHING TEXT 20 WORDS
	the two air masses into two types on the basis of the nature of the surface of their source regions	

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

149/265	SUBMITTED TEXT 12 WORDS	100% MATCHING TEXT 12 WORDS
	great semi- permanent highs of the tropical oceans including the Caribbean Sea.	great semi permanent highs of the tropical oceans including the Caribbean Sea.

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

Ouriginal by Turnitin

150/265	SUBMITTED TEXT	13 WORDS	76%	MATCHING TEXT	13 WORDS

subtropical high pressure land areas. They have high temperatures and low moisture content.

Subtropical high pressure land areas • High temperature and low moisture content. •

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

151/265	SUBMITTED TEXT	40 WORDS	86%	MATCHING TEXT	40 WORDS

both in winter and summer. In summer they are very hot. Subsidence and stability are found in the upper parts of these air masses in their source regions. When cT air is found aloft over warm, moist air at the surface,

both dry in winter and summer. • In summer they are very hot • Subsidence and stability found in the upper parts of these air masses in their source regions. • If cT air mass is aloft over warm moist air at the surface,

W https://www.insightsonindia.com/world-geography/physical-geography-of-the-world/climatology/air-m ...

152/265	SUBMITTED TEXT	27 WORDS	75%	MATCHING TEXT	27 WORDS

of their source regions. Trewartha has classified air masses on the basis of their geographical locations into two broad categories, - Polar air mass (P) &

of the source regions. Trewartha has classified air masses on the basis of their geographical locations into two broad categories viz.: (i) Polar air mass (P),

W https://www.geographynotes.com/climatology-2/air-masses-meaning-and-classification-climatology-ge ...

153/265	SUBMITTED TEXT	75 WORDS	90%	MATCHING TEXT	75 WORDS

is volume of air defined by its temperature and water vapour content. Air masses cover many hundreds or thousands of square miles, and adapt to the characteristics of the surface below them. They are classified according to latitute and their continental or maritime source regions. Colder air masses are termed polar or arctic, while warmer air masses are termed tropical. Continental and superior air masses are dry while maritime and monsoon air masses are moist. 2.7 Summary Air masses

SA Compensation_Meteorology_2_Arke (002).docx (D27484722)

154/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS

References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition).

REFERENCES Barry R.G. and Chorley R.J. 1982 "Atmosphere Weather and Climate" Methuen London Fourth Edition.

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

Ouriginal by Turnitin

155/265	SUBMITTED TEXT	25 WORDS	38%	MATCHING TEXT	25 WORDS

uncommon (unusual) in tropical and polar regions. 97 NSOU CC-GR-07 Front is three-dimensional boundary zone formed between two converging air masses with different physical properties (

uncommon phenomena in the Equatorial, Tropical and Polar Regions. 113 4.4.1 Definition of Front: It is a three dimensional (3-D) boundary zone, also called as a frontal zone or frontal surface which is formed between two converging air masses that have different physical properties,

W https://mu.ac.in/wp-content/uploads/2021/09/MA-GEOGRAPHY-SEM-I-P-102.pdf

156/265	SUBMITTED TEXT	30 WORDS	95%	MATCHING TEXT	30 WORDS

Colder air masses are termed polar or arctic, while warmer air masses are termed tropical. Continental and superior air masses are dry while maritime and monsoon air masses are moist. 2.8

SA Compensation_Meteorology_2_Arke (002).docx (D27484722)

157/265	SUBMITTED TEXT	21 WORDS	78%	MATCHING TEXT	21 WORDS

Cold front occlusion. It occurs when the cold air chich overtakes the warm air is colder than the retreating cold air.

SA UNIT 2 WEATHER PHENOMENON1_Final.docx (D68173473)

158/265	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

the retreating cold air mass is colder than the advancing cold air mass.

SA UNIT 2 WEATHER PHENOMENON1_Final.docx (D68173473)

159/265	SUBMITTED TEXT	42 WORDS	100%	MATCHING TEXT	42 WORDS

Frontogenesis is likely to occur when the wind blows in such a way that the isotherms become packed along the leading edge of the intruding air mass. Convergence of the wind toward a point or contraction toward a line augments the process of frontogenesis. 4)

SA climatology book.docx (D49940943)

160/265	SUBMITTED TEXT	30 WORDS	71%	MATCHING TEXT	30 WORDS

the dissipation of a front, occurswhen either the temperature difference between the two– a) air masses disappears or the wind carries the air b) particles of the air mass away from each other.

SA climatology book.docx (D49940943)

161/265	SUBMITTED TEXT	26 WORDS	82%	MATCHING TEXT	26 WORDS

Frontolytical processes are most effective in thelower layers of the atmosphere since surface heating and turbulent mixing are the most intense of then on conservative influences on temperature.

SA climatology book.docx (D49940943)

162/265	SUBMITTED TEXT	12 WORDS	83%	MATCHING TEXT	12 WORDS

The process of formation of front is frontogenisis. Infact the process of

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

163/265	SUBMITTED TEXT	18 WORDS	63%	MATCHING TEXT	18 WORDS

air. If convergence of wind towards a point or contraction towards a line arguments the process of frontogenesis,

SA climatology book.docx (D49940943)

164/265	SUBMITTED TEXT	36 WORDS	38%	MATCHING TEXT	36 WORDS

Cold front is that sloping frontal surface along which cold air becomes active and aggressive and invades the warm air territory and being denser 105 NSOU CC-GR-07 remain at the ground but forcibly uplifts the warm

SA UNIT 2 WEATHER PHENOMENON1_Final.docx (D68173473)

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165/265	SUBMITTED TEXT	17 WORDS	80%	MATCHING TEXT	17 WORDS

Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)

Barry R.G. and Chorley R.J. 1982 “Atmosphere Weather and Climate” Methuen London Fourth Edition.

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166/265	SUBMITTED TEXT	16 WORDS	65%	MATCHING TEXT	16 WORDS

The cold front moves faster than the warm front with the result the warm sector is

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

167/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS

References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)

REFERENCES Barry R.G. and Chorley R.J. 1982 “Atmosphere Weather and Climate” Methuen London Fourth Edition.

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168/265	SUBMITTED TEXT	13 WORDS	87%	MATCHING TEXT	13 WORDS

the lapse rate exceeds the dry adiabatic rate the air is unstable. 110

SA climatology book.docx (D49940943)

169/265	SUBMITTED TEXT	36 WORDS	81%	MATCHING TEXT	36 WORDS

Atmospheric Circulation is the large scale movement of air and together with ocean circulations by which thermal energy is redistributed on the earth surface. The global atmospheric circulation varies from year to year, but large scale structure of

SA EGE 311 CLIMATOLOGY.docx (D120363587)

170/265	SUBMITTED TEXT	16 WORDS	67%	MATCHING TEXT	16 WORDS

are deflected to the right path of motion in the northern hemisphere and left in southern hemisphere.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

171/265	SUBMITTED TEXT	78 WORDS	57%	MATCHING TEXT	78 WORDS
of the pressure gradient from the tropical belts of high pressure to equatorial belt of low pressure. In the Northern hemisphere, the wind are north easterly direction and are called and for southern hemisphere the wind move in south easterly direction and are called The			of the pressure gradient from the subtropical belts of high pressure to the equatorial belt of low pressure. In the northern hemisphere the prevailing winds are north-easterly and are called the north – east trades. In the southern hemisphere the prevailing winds moving equatorward are south-easterly and are the		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

172/265	SUBMITTED TEXT	62 WORDS	80%	MATCHING TEXT	62 WORDS
in the Northern Hemisphere, if a person stands with his back to the wind, the amospheric pressure is low to his left, high to his right. This is because wind travels anticlockwise around low pressure zones in the Northern Hemisphere and is reversed in the Southern Hemisphere, but the angle between the pressure gradient force and wind is not a right angle in low latitudes.					

SA Compensation_Meteorology_2_Arke (002).docx (D27484722)

173/265	SUBMITTED TEXT	12 WORDS	83%	MATCHING TEXT	12 WORDS
blow from the polar high pressure belts toward temperate low pressure belts.			blow from the polar high pressure belts towards the temperate low pressure belts.		

W http://www.bdu.ac.in/cde/SLM/SLM_FULL/M.Sc%20Geogaraphy/Final/I%20Year/Major%20Course%20I%20Clima ...

174/265	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS
In northern hemisphere, the belt is called the north polar high pressure belt			In northern hemisphere the belt is called the North polar high pressure belt		

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

175/265	SUBMITTED TEXT	19 WORDS	97%	MATCHING TEXT	19 WORDS
The pattern of the movement of the planetary winds is called the general circulation of atmosphere. The general circulation					

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

176/265	SUBMITTED TEXT	41 WORDS	73%	MATCHING TEXT	41 WORDS

south polar high pressure belt. The wind from these belts blow toward sub polar low pressure belts. % & (

South polar high pressure belt in the southern hemisphere. Winds from these belts blow towards sub-polar low pressure belts.

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

177/265	SUBMITTED TEXT	10 WORDS	95%	MATCHING TEXT	10 WORDS

This movement is the reverse of airflow in the Hadley cell.

SA EGE 311 CLIMATOLOGY.docx (D120363587)

178/265	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

the equatorial low pressure belt shifts a little south of

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

179/265	SUBMITTED TEXT	72 WORDS	91%	MATCHING TEXT	72 WORDS

density decreases. This naturally leads to low pressure. On the contrary, cooling results in contraction. This increases the density and thus leads to high pressure. Formations of equatorial low and polar highs are examples of thermal lows and thermal highs respectively. ,* * + The formation of pressure belts may be explained by dynamic controls arising out of pressure gradient forces and rotation of the earth.

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

180/265	SUBMITTED TEXT	20 WORDS	97%	MATCHING TEXT	20 WORDS

The model makes it clear that there are two possible ways of transporting heat and momentum: (a) By circulation in vertical plane (

The model makes It clear that there are two possible ways of transporting heat and momentum: (a) by circulation in the vertical plane

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

181/265	SUBMITTED TEXT	18 WORDS	64%	MATCHING TEXT	18 WORDS
The three meridional circulation cells are– – Tropical cell (Hadley cell) – Polar front cell (Ferrel cell) – Sub polar			The following meridional circulation cells are discussed Tropical cell (also called Hadley cell). (2) Polar front cell (also called Ferrel cell). (3) Polar		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

182/265	SUBMITTED TEXT	16 WORDS	96%	MATCHING TEXT	16 WORDS
is also called Hadley Cell after G. Hadley who put forward his own explanation in 1735. The			is also called Hadley cell after G. Hadley who put forward his own explanation in 1735 for the		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

183/265	SUBMITTED TEXT	261 WORDS	89%	MATCHING TEXT	261 WORDS

In January, the equatorial low pressure belt shifts a little south of its mean equatorial position, due to the apparent southward movement of the sun. The lowest pressure occur on the land masses of South America, South Africa and Australia, because land masses become much hotter than the adjoining oceans. Sub-tropical high pressure belt of the southern hemisphere is broken over the continents and remains confined to the oceans only. It's development is maximum in the eastern parts of the oceans where the cool ocean currents are effective. In the northern hemisphere, a well-developed sub- tropical high pressure area extends over the continents. Finally, sub-polar low of the southern hemisphere extends as a trough whereas in the northern hemisphere, there are two cells of low pressure extending over the North Atlantic and the North Pacific. These are known as the Icelandic low and the Aleutian low respectively. 122 NSOU CC-GR-07 In July, the equatorial low pressure belt shifts towards the north due to the movement of the sun. This shift is maximum in Asia. The landmasses of the northern hemisphere become excessively hot and low pressure areas develop over them. The sub-tropical high pressure belt of the southern hemisphere extends continuously. In contrast, in the northern hemisphere, it is broken over the continents and remains confined to the North Atlantic and North Pacific Oceans. Sub-polar low is deep and continuous in the southern hemisphere, while in the northern hemisphere there is only a faint oceanic low. .* * / + The atmospheric pressure shows a definite rhythm when observed diurnally.

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

184/265	SUBMITTED TEXT	27 WORDS	60%	MATCHING TEXT	27 WORDS

Submitted text	Matching text
Cell. In this mid latitude cell, the surface air flow is directed toward the pole and becasue of coriolis force. The wind blow almost from west to east.	cell. In this mis-latitudes cell the surface airflow is directed towards the pole, and because of the Coriolis force the winds blow almost from west to east.

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185/265	SUBMITTED TEXT	20 WORDS	77%	MATCHING TEXT	20 WORDS

polar easterlies blow from polar high pressure area to mid latitude low pressure belt. The general direction of surface polar

polar easterlies, blow from polar high pressure areas to sub-polar or mid-latitude low pressure belts. The general direction of surface polar

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

186/265	SUBMITTED TEXT	76 WORDS	93%	MATCHING TEXT	76 WORDS

Factors Controlling Pressure Systems: There are two main causes, thermal and dynamic, for the pressure differences resulting in high and low pressure system.)* + An important factor while studying the pressure systems in temperature and its variations from equator to the poles, since a chain of events takes place due to heating and cooling of the earth's surface and its atmosphere. When air is heated, it expands and hence,

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

187/265	SUBMITTED TEXT	16 WORDS	87%	MATCHING TEXT	16 WORDS

formed above the convergence zone of the surface polar cold airmass and tropical warm air mass.

formed above the convergence zone of the surface polar cold air mass and tropical warm air mass.

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

188/265	SUBMITTED TEXT	18 WORDS	63%	MATCHING TEXT	18 WORDS

Local Jet Stream–This formed locally due to local thermal and dynamic condition and have limited local importance. 125

Local Jet Streams They are formed due to local thermal and dynamic conditions and have limited local importance.

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

Ouriginal by Turnitin

189/265	SUBMITTED TEXT	102 WORDS	94%	MATCHING TEXT	102 WORDS

heating and terrestrial radiation are mainly responsible for diurnal variations in pressure. During the equinoxes, the maximum occurs at 10 A.M. and 10 P.M. and the minimum at 4 A.M. and 4 P.M. In the tropic, higher diurnal range occurs at places located at sea level and a lower range occurs at places located at higher altitudes. The continents experience a larger range during daytime and a smaller range during the night. The oceans and coasts have a large diurnal range. The irregularities in the diurnal range occur due to cyclones, anti-cyclones and other atmospheric disturbances. These irregularities are larger and more pronounced in mid-latitudes and less pronounced in high

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

190/265	SUBMITTED TEXT	12 WORDS	83%	MATCHING TEXT	12 WORDS
equator and exchange of tropical and polar air masses take place on			equator and the exchange of tropical and polar air masses takes place on		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

191/265	SUBMITTED TEXT	15 WORDS	90%	MATCHING TEXT	15 WORDS
the giant size meanders of the jet streams are cut off from the main stream			the giant size meanders of the jet are cut off from the main stream.		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

192/265	SUBMITTED TEXT	13 WORDS	80%	MATCHING TEXT	13 WORDS

thousands of kilometers in length, a few hundread kilometers in width and a

SA UNIT 2 WEATHER PHENOMENON1_Final.docx (D68173473)

193/265	SUBMITTED TEXT	17 WORDS	88%	MATCHING TEXT	17 WORDS
colder air. This is called the low zonal index of jet stream and the zonal character of			colder air. This is called the low zonal index of the jet stream. The zonal character of		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

Ouriginal by Turnitin

194/265	SUBMITTED TEXT	13 WORDS	82%	MATCHING TEXT	13 WORDS

upper level westerlies is no longer existence. They are fragment into number of cells.

upper – level westerlies is no longer in existence. They are fragmented into a number of cells. 2.6.2

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

195/265	SUBMITTED TEXT	17 WORDS	64%	MATCHING TEXT	17 WORDS

The three meridional circulation cells are: Tropical cell (Hadley cell); Polar front cell (Ferrel cell); Sub polar

The following meridional circulation cells are discussed separately: (1) Tropical cell (also called Hadley cell). (2) Polar front cell (also called Ferrel cell). (3) Polar

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196/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS

References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)

REFERENCES Barry R.G. and Chorley R.J. 1982 "Atmosphere Weather and Climate" Methuen London Fourth Edition.

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197/265	SUBMITTED TEXT	12 WORDS	95%	MATCHING TEXT	12 WORDS

atmospheric circulation varies from year to year, but large scale structure of

SA EGE 311 CLIMATOLOGY.docx (D120363587)

198/265	SUBMITTED TEXT	12 WORDS	88%	MATCHING TEXT	12 WORDS

anticlockwise in the northern hemisphere and clockwise in the southern hemisphere. iii) The

anticlockwise in the northern hemisphere and clockwise in the southern hemisphere. The

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199/265	SUBMITTED TEXT	16 WORDS	90%	MATCHING TEXT	16 WORDS

It is in these latitude zones that the polar and tropical air masses meet and form

It is in these latitude zones the polar and tropical air masses meet and form

W http://www.bdu.ac.in/cde/SLM/SLM_FULL/M.Sc%20Geogaraphy/Final/I%20Year/Major%20Course%20I%20Clima ...

Ouriginal by Turnitin

200/265	SUBMITTED TEXT	13 WORDS	80%	MATCHING TEXT	13 WORDS

thousands of kilometers in length, a few hundread kilometers in width and a

SA UNIT 2 WEATHER PHENOMENON1_Final.docx (D68173473)

201/265	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

they move from East to West under the influence of trade winds.

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

202/265	SUBMITTED TEXT	61 WORDS	97%	MATCHING TEXT	61 WORDS

Size and Shape The temperate cyclones are asymmetrical and shaped like an inverted 'V'. They stretch over 500 to 600 km. They may spread over 2500 km over North Americal (Polar Vortex). They have a height of 8 to 11 km. 2) Wind Velocity and Strength The wind strength is more in eastern and southern portions,

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

203/265	SUBMITTED TEXT	66 WORDS	85%	MATCHING TEXT	66 WORDS

North America compared to Europe. The wind velocity increases with the approach but decreases after the cyclone has passed. 3) Orientation and Movement Jet stream plays a major role in temperate cyclonogeneis. Jet streams also influence the path of temperate cyclones. Since these cyclones move with the westerlies (Jet Streams), they are oriented east-west. If the storm front is directed northward, the centre moves

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

204/265	SUBMITTED TEXT	11 WORDS	95%	MATCHING TEXT	11 WORDS
which are formed due to inequalities of temperature and barometric pressure. 2.				which are formed due to the inequalities of temperature and barometric pressure.	

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205/265	SUBMITTED TEXT	17 WORDS	73%	MATCHING TEXT	17 WORDS
low pressure area and the shape of isobars become oval. The winds begins to move spirally and			low pressure area is formed and the shape of the isobars becomes oval. The winds begin to move spirally and		

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206/265	SUBMITTED TEXT	18 WORDS	80%	MATCHING TEXT	18 WORDS
are temporary in duration and whose origin is due to thermal convection. These are short lived. And during			are most temporary in duration and their origin is due to thermal convection. They are short-lived and during		

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207/265	SUBMITTED TEXT	46 WORDS	86%	MATCHING TEXT	46 WORDS
but after two or three days, the pressure difference declines and the cyclone dissipates. When the storm front is directed southwards, the centre moves quite deep southwards-even up to the Mediterranean region and cause the Mediterranean cyclones or Western Disturbances (They are very important as they bring rains					

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

208/265	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS
are maintained by the latent heat released at the time of condensation. 7)			are maintained by the latent heat released at the time of condensation. 4.5.8		

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

209/265	SUBMITTED TEXT	46 WORDS	84%	MATCHING TEXT	46 WORDS
North-West India–Punjab, Haryana). 4) Structure The north-western sector is the cold sector and the north-eastern sector is the warm sector (Because cold air masses in north and warm air masses in south push against each other and rotate anti-clockwise in northern hemisphere). Source Region–The most frequent temperate cyclone					

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

210/265	SUBMITTED TEXT	38 WORDS	93%	MATCHING TEXT	38 WORDS

Associated Weather The approach of a temperate cyclone is marked by fall in temperature, fall in the mercury level, wind shifts and a halo around the sun and the moon and a thin cover of cirrus clouds

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

211/265	SUBMITTED TEXT	59 WORDS	91%	MATCHING TEXT	59 WORDS

Rainfall stops and clear weather prevails until the cold front of an anticyclonic character arrives which causes a fall in temperature. After this clear weather is established. The temperate cyclones experience more rainfall when there is slower movement and a marked difference in rainfall and temperaute between the front and rear of the cyclone. These cyclones are generally accompanied by anticyclones. 6.5

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

212/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS
References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)				REFERENCES Barry R.G. and Chorley R.J. 1982 "Atmosphere Weather and Climate" Methuen London Fourth Edition.	

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213/265	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

The temperate cyclones are asymmetrical and shaped like an inverted 'V'.

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

214/265	SUBMITTED TEXT	12 WORDS	83%	MATCHING TEXT	12 WORDS
West Bengal and Assam in North- East India. The Bay of Bengal				West Bengal and Assam in the north-east from the Bay of Bengal;	

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215/265	SUBMITTED TEXT	17 WORDS	72%	MATCHING TEXT	17 WORDS

is known as the Monson through. The axis of the monsoon shows preiodic movements to the North and

is known as the monsoon trough. The axis of the monsoon trough shows periodic movements to the north and

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216/265	SUBMITTED TEXT	15 WORDS	73%	MATCHING TEXT	15 WORDS

Above the monsoon winds, the Indian subcontinents is dominated by an extensive anticyclonic circulation. The

Above the monsoon winds, the Indian sub-continent is dominated by an extensive anticyclone circulation (of the

W https://studyres.com/doc/14277383/--madhya-pradesh-bhoj-open-university

217/265	SUBMITTED TEXT	18 WORDS	60%	MATCHING TEXT	18 WORDS

known as the easterly jet stream of the Tropics. For to the North of Himalayas the sub tropical jet

known as the Easterly Jet Stream of the tropics. ●● The periodic movements of the sub-tropical jet

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

218/265	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

The sub-tropical jet stream plays a significant role in both

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

219/265	SUBMITTED TEXT	14 WORDS	78%	MATCHING TEXT	14 WORDS

Jet stream is narrow band of fast moving air flowing from west to east [

Jet stream is a band of fast moving air from west to east

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

220/265	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

in the upper troposphere at a height of about 12–14 km. (

in the upper troposphere at a height of about 12 km. (

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

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221/265	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

The wind speeds in a westerly jet stream are commonly 150 to 300

The wind speeds in a westerly jet stream are commonly 150 to 300

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

222/265	SUBMITTED TEXT	14 WORDS	84%	MATCHING TEXT	14 WORDS

Jet Streams (STJ) Sub-Tropical Jet stream plays a significant role in both

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

223/265	SUBMITTED TEXT	18 WORDS	73%	MATCHING TEXT	18 WORDS

along the northern edge of the Tibetan Plateau. The periodic movement of the Jet stream is often

along the northern edge of the Tibet Plateau. The periodic movements of the Jet stream are often

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

224/265	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

The burst of monsoons depends upon the upper air circulation which is dominated by

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

225/265	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

Northward movement of the subtropical jet is the first indication of the onset of the monsoon over India.

northward movement of the subtropical jet is the first indication of the onset of the monsoon over India. ••

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

226/265	SUBMITTED TEXT	32 WORDS	77%	MATCHING TEXT	32 WORDS

STJ flows along the southern slopes of the Himalayas but in summer it shifts northwards, rather dramatically and flows along the northern edge of Himalayas in early June and in late summer (July-August)

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

227/265	SUBMITTED TEXT	14 WORDS	90%	MATCHING TEXT	14 WORDS

and subsequent withdrawal (STJ returns back to its position-south of Himalayas) of the monsoon. 150

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

228/265	SUBMITTED TEXT	17 WORDS	90%	MATCHING TEXT	17 WORDS

The southern branch blows to the south of the Himalayan ranges along 25 o north latitude.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

229/265	SUBMITTED TEXT	35 WORDS	94%	MATCHING TEXT	35 WORDS

The weather over northern India becomes hot, dry and squally due to larger incoming solar radiation and hot winds like loo. Over India, the Equatorial Trough (ITCZ) pushes northwards with the weakening of the STJ [

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

230/265	SUBMITTED TEXT	71 WORDS	88%	MATCHING TEXT	71 WORDS

south of Tibet, but the burst of the monsoon does not take place until the upper-air circulation has switched to its summer pattern. By the end of May the southern jet breaks and later it is diverted to the north of Tibet Plateau and there is sudden burst of monsoons (the ridge moves northwards into Cental Asia = high pressure over north-west India moves northwards into Central Asia = way for south-west monsoon winds).

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

231/265	SUBMITTED TEXT	24 WORDS	94%	MATCHING TEXT	24 WORDS

The easterly winds become very active in the upper troposphere and they are associated with westerly winds in the lower troposphere (south-west monsoon winds).

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

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232/265	SUBMITTED TEXT	24 WORDS	72%	MATCHING TEXT	24 WORDS

during summer solstice sun rays fall vertically over tropic of cancer, hence all wind and pressure belts of globe shift towards north. At this

During summer solstice sun's rays are vertical over the Tropic of Cancer. Therefore, all wind and pressure belts of the globe shift towards the north. At this

W https://www.uniqueshiksha.com/online_foundation/Study_Material/Geography.pdf

233/265	SUBMITTED TEXT	19 WORDS	91%	MATCHING TEXT	19 WORDS

south of the Himalayas respectively. The eastern jet becomes powerful and is stationed at 15 o N latitude.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

234/265	SUBMITTED TEXT	21 WORDS	50%	MATCHING TEXT	21 WORDS

the end of September, the low pressure centre in the north-west begins to disintegrate and eventually shifts to the equatorial region.

SA UNIT 2 WEATHER PHENOMENON1_Final.docx (D68173473)

235/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS

References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)

REFERENCES Barry R.G. and Chorley R.J. 1982 "Atmosphere Weather and Climate" Methuen London Fourth Edition.

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236/265	SUBMITTED TEXT	17 WORDS	90%	MATCHING TEXT	17 WORDS

believed that the distribution of natural vegetation is the best expression of the totality of climate. 164

believed that the distribution of natural vegetation was the best expression of the totality of climate.

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237/265	SUBMITTED TEXT	12 WORDS	95%	MATCHING TEXT	12 WORDS

During winter the landmass of Asia cools more rapidly than surrounding oceans

SA climatology book.docx (D49940943)

238/265	SUBMITTED TEXT	21 WORDS	59%	MATCHING TEXT	21 WORDS

southern branch of jet stream exercises a significant influence on the winter in India. The sub-tropical jet stream plays a

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

239/265	SUBMITTED TEXT	21 WORDS	52%	MATCHING TEXT	21 WORDS

r – rainfall in all seasons s – summer deficient in rainfall w – winter deficient in rainfall d – dry in all seasons

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

240/265	SUBMITTED TEXT	24 WORDS	92%	MATCHING TEXT	24 WORDS

The concepts of precipitation effectiveness and thermal effectiveness were used for the first time by Thornthwaite, but they make the delimitation of boundaries difficult. 2. The

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

241/265	SUBMITTED TEXT	24 WORDS	92%	MATCHING TEXT	24 WORDS

Because of inherent problem, mapping of Thornthwaite's divisions is not possible. 2. His scheme does not have a vegetational basis. Thus it is different from

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

242/265	SUBMITTED TEXT	27 WORDS	91%	MATCHING TEXT	27 WORDS

potential evapotranspiration in expressed as the amount of moisture that will be transferred to atmosphere by evaporation of solid and liquid water and by transpiration from living tissues,

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

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243/265	SUBMITTED TEXT	14 WORDS	93%	MATCHING TEXT	14 WORDS

Both have recognized climate-vegetation relationship. 3. Both have used letter symbols to represent climatic regions.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

244/265	SUBMITTED TEXT	22 WORDS	80%	MATCHING TEXT	22 WORDS

Differences: 1. While Köppen had considered vegetation to be direct indicator of of climate, Thornthwaite's has given indirect recognition to the vegetational aspects. 2.

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

245/265	SUBMITTED TEXT	19 WORDS	81%	MATCHING TEXT	19 WORDS

Submitted text	Matching text
References Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)	REFERENCES Barry R.G. and Chorley R.J. 1982 "Atmosphere Weather and Climate" Methuen London Fourth Edition.

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246/265	SUBMITTED TEXT	21 WORDS	50%	MATCHING TEXT	21 WORDS

Submitted text	Matching text
Adiabatic Lapse rate 9.4 Adiabatic Lapse Rate 9.5 Warm Fronts Vs. Cold Fronts 9.6 Dry Adiabatic Lapse Rate Vs. Wet Adiabatic Lapse Rate 9.7	adiabatic lapse rate. the adiabatic lapse rate can be explained in terms of dry adiabatic lapse rate and wet adiabatic lapse rate.

W https://mu.ac.in/wp-content/uploads/2021/09/MA-GEOGRAPHY-SEM-I-P-102.pdf

247/265	SUBMITTED TEXT	26 WORDS	88%	MATCHING TEXT	26 WORDS

Submitted text	Matching text
rate–The rate of decrease of temperature of an ascending air beyond condensation level is lower due to addition of latent heat of condensation to the air.	rate. The rate of decrease of temperature of an ascending air beyond condensation level is lowered due to addition of latent heat of condensation of the air.

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248/265	SUBMITTED TEXT	27 WORDS	78%	MATCHING TEXT	27 WORDS

The temperature of unsaturated ascending air decreases with increasing height at rate of 10 o C/km. This type of change of temperature of unsaturated ascending or descending air is called dry adiabatic

The temperature of unsaturated ascending air decrease with increasing height at the rate of 5.50 F per 1000 feet or 100 C per 1000 m. This type of change of temperature of unsaturated ascending or descending air is called dry adiabatic

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249/265	SUBMITTED TEXT	19 WORDS	92%	MATCHING TEXT	19 WORDS

the altitudinal aspect of climate by giving a seperate category of "Highlands Climate". Thornthwaite did not consider the altitudinal aspect. 8.5

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

250/265	SUBMITTED TEXT	37 WORDS	100%	MATCHING TEXT	37 WORDS

B Mesothermal 64–127 C Microthermal 32–63 D Taiga 16–31 E Tundra 1–15 F Frost 0

B′ – Mesothermal 3 32-63 C′ – Microthermal 4 16-31 D′ – Taiga 5 1.15 E′ – Tundra 6 0 F′- Frost

W https://mu.ac.in/wp-content/uploads/2021/09/MA-GEOGRAPHY-SEM-I-P-102.pdf

251/265	SUBMITTED TEXT	42 WORDS	61%	MATCHING TEXT	42 WORDS

S D (100 60) PE - 182 NSOU CC-GR-07 (Where S = Monthly surplus of moisture D = Monthly deficit of moisture) * !"

s –60D)/PE Im = monthly moisture index S = monthly surplus of moisture D = monthly deficit of moisture

W http://www.bdu.ac.in/cde/SLM/SLM_FULL/M.Sc%20Geogaraphy/Final/I%20Year/Major%20Course%20I%20Clima ...

252/265	SUBMITTED TEXT	10 WORDS	90%	MATCHING TEXT	10 WORDS

Thermal Efficiency Ratio (T.E ratio) = (T 32) 4 - Thermal Efficiency Index (T/

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

253/265	SUBMITTED TEXT	19 WORDS	92%	MATCHING TEXT	19 WORDS

Vegetation P/E Index A (Wet) Rainforest 127+ B (Humid) Forest 64-127 C (Sub-humid) Grassland 32-63 D (Semi-arid) Steppe 16-31 E (Arid) Desert > 16

SA MGDSC - 2.1 - Climatology.pdf (D155224061)

254/265	SUBMITTED TEXT	77 WORDS	84%	MATCHING TEXT	77 WORDS

When the air rises, it expands. Thus heat available per unit volume is reduced and therefore the temperature is also reduced. (2) Temperture change which does not involve any subtraction of heat, and colling of air takes place only by ascent and expansion, is termed as 'adiabatic change.' 183 NSOU CC-GR-07 (3) The vertical displacement of the air is the major cause of adiabatic and katabatic temperautre changes. (4) Near the earth's surface, most process of change are non-adiabatic because horizontal movements

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

255/265	SUBMITTED TEXT	22 WORDS	90%	MATCHING TEXT	22 WORDS

include cooling by radiation, conduction or mixing with colden air. The air may be cooled due to loss of heat by radiation. (2)

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

256/265	SUBMITTED TEXT	40 WORDS	98%	MATCHING TEXT	40 WORDS

In case there is direct radiation from moist air, the cooling produces fog or clouds subject to presence of hygroscopic nuclei in the air. (3) Cooling by contact with a cold surface produces dew, frost or fog depending on other atmospheric conditions. (4)

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

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257/265	SUBMITTED TEXT	22 WORDS	86%	MATCHING TEXT	22 WORDS

The non-adiabetic processes of cooling produce only dew, fog or frost. They are incapable of producing a substaintial amount of precipitation. 9.13

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

258/265	SUBMITTED TEXT	29 WORDS	83%	MATCHING TEXT	29 WORDS

is lively to occur when the wind blows in such a way that the isotherms became packed along the leading edge of the intruding air mass. During convergence,

SA climatology book.docx (D49940943)

259/265	SUBMITTED TEXT	13 WORDS	70%	MATCHING TEXT	13 WORDS

four types of fronts are generated, like– –Cold front –Warm front –Occluded front –Stationary front 184

SA UNIT 2 WEATHER PHENOMENON1_Final.docx (D68173473)

260/265	SUBMITTED TEXT	76 WORDS	45%	MATCHING TEXT	76 WORDS

the day, the slope get heated and air move upslope to still the resulting gap. The air from the valley blows up to the valley are called & 3 . It is also known as % & 1 . & 3 –During the night, slope gets cooled and dense air desent into valley as mountain wind

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

261/265	SUBMITTED TEXT	27 WORDS	100%	MATCHING TEXT	27 WORDS

The cool air of the high plateaus and ice fields draining into the valley is called 5 & 1 . 9.18 Katabatic Wind

SA MGEO21_12 Climatology and Hydrology_All Units.pdf (D128539984)

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262/265	SUBMITTED TEXT	22 WORDS	70%	MATCHING TEXT	22 WORDS

fluctuation of atmospheric pressure over the tropical indo- pacific region. It is an atmospheric compenent of a single large-scale coupled interaction called the El

SA BGEO21_21 Climatology and Oceanography_All Unit.pdf (D133844838)

263/265	SUBMITTED TEXT	23 WORDS	90%	MATCHING TEXT	23 WORDS
is clockwise in northern hemisphere and anti-clockwise in southern hemisphere. / 1.			is clockwise in the northern hemisphere and anti-clockwise in the southern hemisphere.		

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264/265	SUBMITTED TEXT	21 WORDS	50%	MATCHING TEXT	21 WORDS
Adiabatic Lapse rate 4. Adiabatic Lapse Rate 5. Warm Fronts Vs. Cold Fronts 6. Dry Adiabatic Lapse Rate Vs. Wet Adiabatic Lapse Rate 7.			adiabatic lapse rate. the adiabatic lapse rate can be explained in terms of dry adiabatic lapse rate and wet adiabatic lapse rate.		

W https://mu.ac.in/wp-content/uploads/2021/09/MA-GEOGRAPHY-SEM-I-P-102.pdf

265/265	SUBMITTED TEXT	17 WORDS	80%	MATCHING TEXT	17 WORDS
Barry, R. G. and Chorley, R. J. (1998): Atmosphere, weather and climate, Routeledge, London (7th Edition)			Barry R.G. and Chorley R.J. 1982 “Atmosphere Weather and Climate” Methuen London Fourth Edition.		

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SA	**MGEOS_13 Environmental Geography_ All Units.docx** Document MGEOS_13 Environmental Geography_ All Units.docx (D123720082)	41
W	URL: https://pdfcoffee.com/download/environmental-studies-tutorial-pdf-free.html Fetched: 11/5/2021 12:17:21 PM	3
SA	**Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and National Legal Framework sunil-sutar sharada-gaikwad - Sunil Sutar.docx** Document Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and National Legal Framework sunil-sutar sharada-gaikwad - Sunil Sutar.docx (D128549500)	10
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PREFACE In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. core, generic, discipline specific elective, ability and skill enhancement for graduate students of all programmes at Honours level. This brings in the semester pattern which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. I am happy to note that the university has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade "A". UGC (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for U.G. programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Material (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English/Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor

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deterministic approach 1.4.2 Teleological approach 1.4.3 Possibilistic approach 1.4.4 Economic deterministic approach 1.4.5 Ecological approach 1.4.6

Geographical Approach 1.5 Summary and Conclusion 1.6 Reference 1.0 Objective Getting an overall idea of the environment and the various approaches to environmental studies. 1.1 Introduction The study of environment is an interdisciplinary field that systematically studies human interaction with the environment in the interests of solving complex problems. It broadly includes the natural environment, human-made environment, and the relationship between them. C.C. Park, in 1980, referred to environment as a

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sum total of conditions which surrounded humans at a given point in space and time.

The field deals with the basic principles of ecology and environmental science as well as associated subjects such as ethics, policy, politics, law, economics, philosophy,
NSOU ? CC-GR-08 8 environmental sociology and environmental justice, planning, pollution control and natural resource management. 1.2 Concept of Environmental Studies Environmental study basically involves the study of total environment of the earth as a living planet having both physical and biotic components. The field of study encompasses the life layer of the earth in lithospheric, hydrospheric and atmospheric components, which supports all types of life. This life supporting layer is known as bio-sphere. It is characterized by the operation of several physical and biological processes, mutual interaction and interdependence of abiotic and biotic components of the bio-spheric ecosystem. The production and consumption of ecological resources, various positive and negative responses of interactions between different components of the environment result into stability or instability of the bio- spheric ecosystem at different levels (local, regional and global). This study also explains environmental degradation and pollution arising out of increasing pressure of economic and technological activities of humans on the environment. Renewed efforts have been undertaken by humans to stabilize the disturbed ecosystem, to conserve and mange the ecological resources and to ameliorate environmental degradation and pollution through different pollution control and abatement programmes. There are certain basic principles, which govern different aspects of environmental studies such as natural processes, both physical and biological in the life supporting layer (biosphere) and relationships between humans and environment. It is an integrated functional unit of the biotic and abiotic components of the environment, (Singh, S 2008). Environmental geography provides analytical tools to assess the impact of anthropogenic activities on earth and address environmental issues and their possible solutions. It starts with the following propositions and assumptions. 1. Ecosystem is a fundamental unit for the study of environment. 2. Ecosystem is shaped by the endogenic and exogenic forces. 3. There is a continuous creation, maintenance, destruction and recreation of surface materials of the earth.

NSOU ? CC-GR-08 9 4. The earth's physical and biological processes operate in a cyclic manner. 5. Natural environmental system is governed by homeostatic or 'inbuilt self- regulating' mechanism. 6. There is a reciprocal relationship between the abiotic and biotic components of the natural environment. 7. The energy flow and circulation of nutrients in the ecosystem maintain life on the planet earth. 8. There are temporal and spatial variations in biotic and abiotic components in an ecosystem. 9. The diversity and complexity of the ecosystem enhance and maintaints stability. Thus the subject of Environmental Geography

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can be perceived and evaluated in a variety of ways and approaches.

The following principles and concepts of environmental study may be identified. 1. Ecosystem is the fundamental ecological unit that includes both the non- living (abiotic) and living (biotic) components of the earth. The earth is the only known planet having different kinds of life forms in a complex sets of interrelationships between the physical and biological components. Various linkages between the physical and the biological components at different levels maintain the bio-spheric ecosystem. 2. The bio-spheric ecosystem is governed by discernible processes. The physical and biological processes operate through a set of cycles as well as a set of sub-cycles. In fact, the endogenetic and exogenetic processes create different types of habitats on the earth surface for living organisms, on the one hand, and sometimes destroy the habitats, on the other hand. The driving force of the endogenetic processes comes from within the earth. Endogenetic forces create different types of relief features of various magnitudes on the earth's surface. Exogenetic forces are engaged ina continuous process of denudation of surface irregularities caused by endogenetic processes. 3. Various physical, chemical and biological processes are continuously engaged in the creation, maintenance, destruction and recreation of surface
NSOU ? CC-GR-08 10 materials of the earth's surface (both organic and inorganic). These materials initially uncontaminated became contaminated and are seldom available for human use because either they are dispersed to such locations which may not be reached by humans for fairly long period of time, otherwise they become so deformed and contaminated that they are not reusable. Sometimes, some renewable natural resources are so contaminated that they become non-renewable. 4. Physical and biological processes operate according to the law of uniformitarianism. The idea developed byJames Hutton along with Charles Lyell worked on two basic principles, (1) earth has always changed in uniform ways and (2) the present is thekey to the past. The very nature of the operation of the physical processes remains almost the same throughout the geologic history of earth though their frequency and magnitude may vary. So, the biological processes, which operate today might have operated in the past though with varying degree of relationships between biological communities and physical or natural environment and between organisms. 5. Natural environmental system is governed by homeostatic mechanism. Physical and biological processes of the natural environmental system operate in such a way that any change in any part of the environment at any place in a specific time period is suitably compensated by a negative feedback mechanism in a natural condition. Thus the natural environmental system has 'in-built self-regulating mechanism' known as homeostatic mechanism through which any change in the natural ecosystem is counter- balanced by responses of the system to the change and eventually, ecosystem stability or environmental equilibrium is restored. Sometimes this situation also leads to the evolution of new species. (Singh, S, 2008) 6. There is a reciprocal relationship between abiotic and biotic components of the environment. The physical processes create suitable habitats for biological communities on the one hand, biological communities (including humans) modify the environment, on the other hand. In fact, life continuest modify and alter atmospheric, lithospheric and oceanic components of the biosphere since the very beginning of life on earth.

NSOU ? CC-GR-08 11 7. The energy flow and circulation of nutrients in the ecosystem help in the sustenance of life on earth. Ecosystems are open systems characterised by continuous input of energy (solar radiation) and matter (nutrients) and output of energy and matter and they tend to be in relatively stable equilibrium unless there is disturbance in one or more controlling factors. The circulation of elements or matter or nutrients in the ecosystem is made possible through energy flow. So energy flow is the main driving force of materials (nutrients) circulation in various biotic components of the ecosystem. 8. There are temporal and spatial variations in species. Darwin's theory of evolution of species states that there is a progressive evolution of species through the processes of natural selection and adaptation to environmental condition that lead to a gradual modification and diversification of species over a long period of time. 9. Ecosystem diversity and complexity enhance and maintain ecological stability. The stability of ecosystem refers to a balance between the production and consumption of each element of the ecosystem. It means a balance between input and output of energy and normal functioning of different biogeochemical cycles and the stable condition of concentration of all elements. 1.3 Scope of Environmental Studies The interface of air, water and land, forming life supporting layer, known as biosphere, is the broadest geo-ecosystem that is the spatial unit for the study of environmental science. Thus the prime concern of environmental study is to study the components of natural environment, separately and together, their linkages at various levels through environmental (physical) and biological processes and human responses to environment. The scope of the study of environmental geography may be grouped into 9 major subfields: 1. The geo-ecosystem or simply ecosystem as a study unit.

NSOU ? CC-GR-08 12 2. The functioning of ecosystem including circulation of energy and matter and ecosystem productivity. 3. Temporal changes in ecosystem: Evolution of plants and animals, and ecological succession. 4. Spatial ecological changes, distribution and dispersal of plants and animals. 5. Global environmental problems. 6. Environmental hazards and disasters. 7. Human and environmental processes. 8. Environmental degradation and pollution. 9. Environmental management. 1.4 Approaches of Environmental Studies An approach is a way of planning and procedure of getting closer towards some assumptions. The study of relationships between human and environment is a focal theme in the study of environmental geography. But the facets of humman-

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environment relationship change through time with the development of human society and the dimension of environment. Thus the

human

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environment relationships can be perceived and evaluated in a variety of ways and approaches. 1.4.1 Environmental deterministic approach

pays more attention to the complete control of physical environment on human and their activities.

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All aspects of human life viz. physical, social, economic, political, ethical and aesthetic etc. are dominantly controlled by physical environment.

Although this deterministic or environmentalists approach blossomed in the writings of E.C. Semple (1910) in the second decade of the 20th century, its seeds were already sown
in the second half of the nineteenth century. In fact, the publication of the book 'The Origin of Species' of

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Charles Darwin in 1859 laid the foundation stone of the concept of environmental influences on humans and other

organisms. The concept of environmentalism reached the highest point in1910 when American geographer E.C Semple published her book 'Influences of Geographic Environment'. According to Semple, "man is the

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product of the earth's surface. This means not merely that he is a child of the earth, dust of her dust, but the earth has mothered him,

NSOU ? CC-GR-08 13 fed him, set him tasks, directed the thoughts,

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confronted him with difficulties that have strengthened his body and sharpened his wits, given him his problems of irrigation and navigation and at same time whispered hints for their

solutions" (E.C. Semple, 1910) The deterministic approach was fully organized on a scientific plane by E. Huntington. His books 'Civilisation and Climate' (1915), 'The Human and Habitat' (1927), 'Season of Birth' (1938) etc. clearly demonstrate the influences of physical environment on humans. 1.4.2 Teleological approach The

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teleological approach is based on religious faith of man being superior to nature and all other creatures. This

approach of man-environment relationship led to excessive and rapid rate of exploitation of natural resources in North America and Western Europe as well as in other parts of the world which were their colonies. A host of scientists and environmentalists have held this religious tradition responsible for present-day ecological crisis. This approach of man towards nature and environment stimulated Europeans to spread all over the world in search of unexplored land and resources. Consequently, numerous colonies were established in all the inhabited continents. After 1750, there began a race for rapacious exploitation of natural resources and widespread industrialization in Europe and America. The process continued for the last three centuries and created most of the present-day environmental problems. (Husain, M, 2002). 1.4.3 Possibilistic approach The

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possibilistic approach to the study of man-environment relationships emerged through the criticism of environmental determinism and overtone of teleological approach. Right from the inception of the school of environmental determinism there was dissenting voice raised by those who believed that 'no doubt physical environment influences man and his activities but there is ample scope for man to change the environment so much so that it becomes suitable for man and his society'.

Husain, M (2002). This concept of possibilism was founded by French historian Lucien Febvre. The environment sets certain constraints or limitations, but humans have the commanding power over the environment within certain limit. NSOU ? CC-GR-08 14 Two French geographers, Vidal de la Blache and Jeans Bruhnes, and American geographers Isiah Bowman and Carl Sauer founded the school of possibilism which is based on the philosophy of possibilism in nature at every stage in a given space and time as remarked by

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Febvre, 'There are no necessities, but everywhere possibilities and man as a master of these possibilities is the judge of their use', (

Husain, M, 2002). 1.4.4

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Economic deterministic approach This approach is based on the basic ideology of

the man'

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s mastery over environment and continued economic and industrial expansion through the application of modern technologies.

Economic determinism is based on two assumptions, (i) positive correlation between population of a given region and the level of economic development and activity in that region, (ii) the interactions of people, resources and society being governed by universal economic principles. This approach believes in man's ability to solve environmental problems arising out of continued economic growth and industrial expansion.

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It may be pointed out that this concept of economic determinism led to rapacious exploitation of natural resources in the western developed countries and thus created most of the environmental and ecological problems of global dimensions. 1.4.5 Ecological approach Ecological approach to the study of man-environment relationships is based on the basic principles of ecology which is the study of mutual interactions between organisms and physical environment, on the one hand and interactions among the organisms, on the other hand in a given ecosystem. Thus, man is considered as an integral part of environment. '

The relationship of man with the natural environment should be symbiotic and not exploitative nor suppressive' (C.C. Park 1980). This school recognizes man, being most skilled and intelligent, as the leader of all biota of the earth. This approach further lays emphasis

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on wise and restrained use of natural resources, application of appropriate environmental management programmes, policies and strategies keeping in view

the ecological principles so that already depleted natural resources are replenished (wherever possible), degraded environment is set right and ecological balance is maintained. The ecological approach lays emphasis on rational

NSOU ? CC-GR-08 15 exploitation of resources and optimum utilization through recycling of resources, (Singh, S, 2008) 1.4.6 Geographical Approach The Geographic approach refers to using geographic science supported by Geographical Informartion System (GIS) as a frame work for understanding our world and applying geographic knowledge to solve problems and guide human behaviour. This science provides humans with awareness, predictions and systematic information for planning and decision making. The understanding of the relationships between land use change, hydrology, flooding, biodiversity, etc. helps society become more conscious and a ware of the interrelatedness of our world and how our cumulative behaviour is affecting the evolution of the planet. Today GIS is extending the power of geography by providing digital tools that abstract and organize geospatial data, model geographic processes, and visualize these data and models with advanced computer techniques to solve a host of problems. For example, the use of GIS is valuable to select the route for a new highway. It will consider all the physical and human factors for its layout and the design: the environment, existing land use, terrain, and social impacts, as well as engineering constraints and costs. 1.5 Summary and Conclusion Environmental study considers all the aspects of environment. It not only discusses about the composition and components of the environment, but also deals with its quality, problems and solution. It evaluates various environmental systems and different approaches related to it.

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The complex physical, chemical and biotic factors such as climate, soil and living things that act			

on organisms and ecological communities, and ultimately, determine its form and survival. So, environmental study is that broad branch of science that tries to cover all the occurrencesof the environment under one canopy. 1.6 Reference 1. Association for Environmental Studies and Sciences 2. http://www.nec.com/en/global/eco/

NSOU ? CC-GR-08 16 3. http://www.environment-agency.gov.uk/ Environment Agency 4 http://www.smu.ca /academics/school-of-the-environment.html 5. https://www.google.com 6. Husain, M (2002), Human Geography, Rawat Publications, New Delhi 7. Rana, S.V.S, Essentials of Ecology and Environmental Science, Prentice Hall of India, New Delhi 8. Singh, S (2008), Environmental Geography, PrayagPustak Bhawan 9. Wikipedia

NSOU ? CC-GR-08 17 Unit 2 ? Perception of Enviroment in Different Stages of Civilization Structure 2.0 Objective 2.1 Introduction 2.2 Concept of Civilization 2.3 Concept of Environment 2.4 Civilization and the Environment 2.5 Changing perception of environment 2.6 In the context of geography, we can identify the following perception of the environment: 2.7 Impact of Civilization on Environment 2.8 Rethinking about Civilization 2.9 Summary and Conclusion 2.10 References 2.0 Objective • To help the learners understand the changing perception of environment through the different stages of civilization. 2.1 Introduction Environment plays a very significant role in human civilization. Trees, plants, creepers, water, river, air, etc. and different kinds of animals play a vital role towards human civilization. The survival of human being is perhaps impossible, even for a single moment, without nature or natural environment. The human being flourish in its lap and at the end take eternal rest therein. Any kind of intolerance and carelessness towards nature and natural elements may bring destruction to human civilization. So, the newly emerging concepts, like the concept of Environmental

NSOU ? CC-GR-08 18 Awareness has moved into the mainstream of public life as a major national and international concern intending to make aware about the role of nature in human life. 2.2 Concept of Civilization Civilization is the process by which a society advances with its social and cultural attributes. A civilization in any complex society is characterized by urban development, social stratification imposed by the cultural elite, symbolic systems of communication (for example, writing systems), and a perceived separation from and domination over the natural environment. Civilizations are intimately associated with other socio-politico-economic characteristics, including centralization, domestication of both humans and other organisms, specialization of labour, culturally ingrained ideologies of progress and supremacism, monumental architecture, taxation, societal dependence upon farming and expansionism. Historically, civilization has often been understood as a larger and "more advanced" culture, in contrast to smaller primitive cultures. Similarly, some scholars have described civilization as being necessarily multicultural. In this broad sense, a civilization contrasts with non-centralized tribal societies, including the cultures of nomadic pastoralists, Neolithic societies or hunter- gatherers, but sometimes it also contrasts with the cultures found within thecivilizations themselves. In brief it refers to the process of a society developing into a centralized, urbanized, stratified structure. Civilizations are organized in densely populated settlements divided into hierarchical social classes with a ruling elite and subordinate urban and rural populations, which engage in intensive agriculture, mining, small-scalemanufacture and trade. It concentrates power, extending human control over the rest of nature, including other human beings. Civilization, as its etymology suggests, is a concept originally linked to towns and cities. The earliest emergence of civilizations is generally associated with the final stages of the Neolithic revolution, culminating in the relatively rapid process of urban revolution and state formation, a political development associated with the appearance of a governing elite. 2.3 Concept of Environment Now a day everyone is concerned about the protection and preservation of environment. Global summits are being held regularly to discuss environmental
NSOU ? CC-GR-08 19 issues. During the last hundred years, the mutual relationship among environment, social organization and culture has been discussed in sociology, anthropology and geography showing increasing importance of environment. In fact

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life is tied with the environment. Social sciences have borrowed the concept of ecology from biology. As a branch of biology, ecology is the study of the relationship between living beings and their environment. Sociology has been greatly influenced by biology. Sociology also studies the relationship between man and environment through ecology. Field of study of human ecology in sociology is centered around man and his environment. The credit of beginning the study of human ecology in the field of sociology goes to Park and Burgess.

There exists a close relationship between man and environment. On the one hand man is born in environment and establishes harmony with environment, on the other hand man tires to control his environment and change it according to his requirements. Hence it requires an understanding of the environment of which man is a part.

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Environment The term environment has been derived from a French word "Environia" means to surround. It refers to both abiotic (physical or non-living) and biotic (living) environment. The word environment means surroundings, in which organisms live. Environment and the organisms are two dynamic and complex component of nature. Environment regulates the life of the organisms including human beings.

Human beings interact with the environment more vigorously than other living beings. Ordinarily environment refers to the materials and forces that surrounds the living organism. Environment is

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the sum total of conditions that surrounds us at a given point of time and space.

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It is comprised of the interacting systems of physical, biological and cultural elements which are interlinked both individually and collectively.

Environment is the sum total of conditions

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in which an organism has to survive or maintain its life process. It

influences the growth and development of living forms. It consists of atmosphere, hydrosphere, lithosphere and biosphere.
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environment as anything surrounding an object and exerting a direct influence on it while E. J. Ross explains environment as an external force which influences

human being.
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Components of Environment: Environment mainly consists of atmosphere, hydrosphere, lithosphere and biosphere. But it can also be divided into other types such as (a) Micro environment and (b) Macro

environmentas well

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as (c) Physical and (d) biotic environment. Micro environment refers to the local surrounding of the organism. Macro environment refers to all the physical and biotic conditions that surround the organism externally. Physical environment refers to all abiotic factors like temperature, light, rainfall, soil, minerals etc. It comprises of atmosphere, lithosphere and hydrosphere. Biotic environment includes all biotic factors or living forms like plants, animals, micro-organisms. 2.4

Civilization and the Environment Anthropomorphic climate change, its associated consequences, and the delicate state of the natural world more generally are at the forefront of the new and emerging threats to civilization. In fact, the nature of humankind's largely exploitative relationship with the wider natural world in general is being called into question and is forcing some of us to seriously rethink that relationship. Rousseau characterized the relationship between human beings and the natural world as one marked by harmony and beneficence. But the history of civilization has in large part been about humankind's capacity to conquer nature: conquer the wild frontier, tame the animal world, and civilize the barbaric and savage peoples of our own species. As V. Gordon Childe (1948) explains, "progress" and "scientific discoveries promised a boundless advance in man's control over Nature." This attitude toward nature and natural resources has long predominated in European and Western thinking in particular. John Locke (1965), for instance, in his discussion of the Americas, Amerindians, and property rights, wrote, "Land that is left wholly to Nature, that hath no improvement of Pasturage, Tillage, or Planting, is called, as indeed it is, wast [waste]." The land was there to be improved and exploited in order to accommodate a greater number of people than the Amerindians were inclined to, and if they were not going to make appropriate use of it, then the British were entitled to take it—in fact, it was their duty to do so. As outlined above in relation to progress, a significant aspect of civilization revolves around evolving or developing, whether from a state of nature, savagery, or barbarism, toward urbanized, scientific, technological civilization. A NSOU ? CC-GR-08 21 large part of this evolutionary process concerns society's capacity to control nature and exploit its resources. This is illustrated by Adam Smith in 1869. He outlines four distinct stages of human social development. The first stage is "nations of hunters, the lowest and rudest state of society," his prime example being the "native tribes of North America." The second stage is "nations of shepherds, a more advanced state of society," such as that of the Tatars and the Arabs. But such peoples still have "no fixed habitation" for any significant length of time, as they move about on the "whim" of their livestock and with the seasons in the endless search for feed. The third stage is that of agriculture, which "even in its rudest and lowest state, supposes a settlement [and] some sort of fixed habitation." The fourth and most advanced stage is that of civilized, urbanized, commercial society, an efficient and effective exploiter of nature. The higher the level of civilization, the greater will be the exploitation of nature; the greater the exploitation of nature, the more civilization will progress. But this relationship cannot go on forever. Natural resource extraction and exploitation is not a bottomless pit, but rather is finite and can only support so many people for so long. There are severe consequences associated with the processes of civilization, modernization, urbanization, and all that goes with them. The cycle of extracting more stuff from the ground, processing more stuff, building more stuff, producing more stuff, owning more stuff, throwing away more stuff, and buying more new stuff to replace it is proving unsustainable on such a large scale. The consequences of such excess, in the forms of environmental degradation and climate change, are many and varied; they include melting polar ice caps and rising sea levels, variations in air and sea temperatures, extended periods of drought in some parts of the world while others experience increased rainfall and flooding, and increasing frequency of extreme weather phenomena, to name just a few. These environmental changes in turn impact our capacity to continue to inhabit certain parts of Earth and our ability to continue to utilize and exploit resources as we have done for centuries. These diverse changes and threats are often interrelated; one realm of security or insecurity can have a direct and dramatic impact on another, generating a kind of vicious cycle of insecurity. For instance, scarcity of and competition for essential resources such as land, food, water, and energy are potential catalysts for violent conflict. The period 2007–2008 witnessed violent food riots in as many as thirty countries around the globe. If the dire predictions are correct, then this is just the tip of the iceberg.

NSOU ? CC-GR-08 22 2.5 Changing perception of environment Environmental perception has commonly been defined as awareness of the environment. American Psychologist William H. Ittelson (1973) described environmental perception as a multi-dimensional phenomenon, as a transactional process between the person and the environment. He analysed the dimensions of environmental experience into four major categories: the environment as external object, as representation of self, as embodiment of value and as arena for action. The environment refers to anything external to the perceiver which influences the perception process. There is a close relationship between environmental situation and environmental perception. The significant information are: • Environments have no fixed or given boundaries to space and time. • Environments provide information through all the senses. • Environments include peripheral as well as central information. • Environments include more information than can adequately be handled. • Environments are experienced through action. • Environments have symbolic meaning. Environmental experience always takes on the systematic quality of a coherent and predictable value. • Environmental perception involves activity on our part in terms of Environmental Perception and Cognition of exploring the environment to determinewhat needs it meets. • Environmental perception is likely to consider the person -environment relationship from a holistic system or transactional perspective. We commonly think of perception of the environment as a passive process. People just sit back and absorb data from the environment. Under this way of thinking, culture acts as a distortion. There is one right way to think about the environment, but culture can bias or distortour understanding. We can call this belief in one correct perception of the environment objectivism. A better way of thinking about environmental perception is that perception is active. People seek out information about their environment based on what they need to know for their current projects

NSOU ? CC-GR-08 23 or interests. In this way of thinking, culture acts as a guide or roadmap. Some people have taken this theory of activeperception as justification for being a relativist. Relativism is the opposite of objectivism. Pragmatism provides an alternative to either objectivism orrelativism. Pragmatism says that we should judge perceptions of the environment according to how useful they are for people in getting along with their lives. But no one perception necessarily works best for every situation. However, there may be multiple ways of perceiving it, each of which may bemore or less useful for a given person's projects and interests. To understand how different people come to different perceptions of the environment, we can use the framework of Grid-Group Cultural Theory(GGCT). GGCT was developed by anthropologist Mary Douglas, who noticed that many groups — from the Lele tribe of Congo to environmentalists in the United States — followed a fewsimilar patterns of social organization and environmental perception. She and her followerssystematized these similarities into a scheme of four basic worldviews: Individualism,Fatalism, Hierarchy, and Egalitarianism (Thompson et al 1990), (Douglas and Ney 1998). Individualism is a worldview based on freedom for individuals to compete for wealth and status. Individualists believe that as long as no artificial restraints are placed on anyone, then the marketplace will allow the best and most deserving to rise to the top. People who fall behind have only themselves to blame. Individualists tend to see the environment as resilient and robust. Nature will take care of itself and bounce back from whatever people do to it. Therefore, people can be free to exploit it in order to get ahead — there is no need for any restrictions on freedom in order to promote conservation. Fatalism is a worldview based on dealing with luck. Fatalists do not feel in control of their own fortunes. Both social and environmental forces are unpredictable and uncontrollable. From a fatalist perspective, all that you can do is to enjoy your good luck while it lasts, and hunker down and try to survive when your luck turns bad. Any attempt to make long-term plans or to achieve social change is a waste of effort.

NSOU ? CC-GR-08 24 Hierarchy is a culture based on the promotion of order. Hierarchs seek a society in which everyone knows their place in the overall scheme of things, and people are ranked in order of holiness, expertise, seniority, or some other organizing principle. In this system, people lower on the chain have a duty to obey, while those in positions of authority have a duty to look out for the best interests of all of the people below them. Hierarchs see the world as having definite limits to how people can legitimately interact with it. It's fine to use resources, but only up to a certain limit. It is necessary to have experts, such as priests or scientists, who can determine where these limits lie, and then create and enforce rules so that nobody transgresses them. Egalitarianism is a culture based on equality and solidarity. Egalitarians aim to live by a creed of sharing and brotherhood/sisterhood, in which no one person has authority or power over any other. The egalitarian way of life depends on shared commitment by all members — everyone has to go "all in" for the good of the group. Egalitarians tend to see the environment as extremely fragile. Fears of a catastrophic collapse – whether it be Armageddon or nuclear meltdown — help to keep up people's enthusiasm for focusing on the good of the group and avoiding any search for individual advancement. To illustrate how these worldviews work in practice, we can consider applying them to the issue of climate change. An individualist would tend to be sceptical that climate change is occurring. A hierarch would focus on ways to regulate and control climate change. Hierarchs would want to scientifically determine the critical threshold at which climate change becomes irreversible and catastrophic — is it 450 parts per million of carbon dioxide in the atmosphere? 350 parts per million? Once this is determined, rules can be made that will ensure that nobody transgresses the threshold. This might come in the form, for example, of emissions permits that restrict the total emissions to under a certain amount. A hierarch's biggest fear is disorder — the anarchy of the market in which people have no respect for the rules that ought to limit their behavior. An egalitarian sees climate change as confirmation that the environment is fundamentally fragile. Improper behavior aimed at aggrandizing the individual or society has put us out of balance with nature, and now we are getting our
NSOU ? CC-GR-08 25 comeuppance. The egalitarian solution lies in adopting a simple way of life. Any interference with nature's balance is potentially dangerous, so we should be aiming to move quickly to a zero-carbon society rather than permitting some acceptable amount of emissions. 2.6 In the context of geography, we can identify the following perception of the environment • Deterministic view: Put forward by a number of geographers like Humboldt, Ritter, Ratzel, Huntington, Semple and many others, this school views environment as the supreme power which affects and moulds every aspect of human life. The environment dictates how people will live, what they will eat and wear, even their rites, rituals and religious belief. • Possibilistic view: Put forward by Paul Vidal de la Blache, this viewpoint says that environment presents a number of choices in front of human groups. The choice that the group will make will depend on cultural factors like the actions of their forefathers and religious and cultural beliefs and practices. Hence, the choice may not always be the easiest or the most logical alternative offered by the environment. Overall, it is technology which has played an overwhelming role in defining the changing perception of the environment among human societies. Those which used rudimentary technology were at the mercy of the environment and hence perceived it as all powerful. Those societies which developed advanced technology and gradually overcame the difficulties and problems posed by nature rose over this. They began to perceive the environment as resource which can be put to their use to fulfil their various wants and needs. 2.7 Impact of Civilization on Environment Humanity exacts a terrifying toll on the planet. After all, everything we build or consume comes out of our environment. It all requires a portion of the world and changes that portion in the process. Varied woodlands become a ubiquitous field of

NSOU ? CC-GR-08 26 corn. A wilderness becomes a grid of streets, lights and skyscrapers. What's more, we remake the world a little more to our liking every day. To better gauge civilization's impact on the environment, scientists developed eco-footprint analysis (EFA) to measure just how much land is necessary to support a particular segment of the population's consumption level. By this metric, we can judge how much of a demand individual demographics put on nature. People in developed countries such as the United States and Japan, for instance, each require an estimated 10 to 25 acres of land to support their lifestyle. According to population ecologist William E. Rees, the global average breaks down to 5.4 acres per person. Unfortunately, the planet has only enough bio productive surface area to allot 4.4 acres to each of its 6.8 billion residents. Human civilization's ecofootprint is already 22 percent beyond sustainable levels. So far in human history, this insatiable hunger has led to the extinction of countless species, ranging from the woolly mammoths of the Ice Age to the Tasmanian tiger in the 20th century. Even the Nebio-sphericerthals fell to human clubs and human competition for resources. Other species have thrived, either through cultivation and domestication or reckless introduction into new local ecosystems. We've turned deserts into farmlands and gorges into artificial lakes; we've erected architectural colossi to house both our living and our dead. Even the atmosphere itself has changed due to our bottomless hunger for resources. Many scientists date human-influenced global climate change back to the Industrial Revolution of the 1800s. Others, such as environmental scientist William F. Ruddiman, insist that carbon dioxide concentrations began to rise 8,000 years ago due to early slash-and-burn agriculture practices. Pollution has also taken its toll on the environment, poisoning ecosystems with harmful chemicals and littering them with refuse. Garbage dumps have become favoured hangouts for advantageous species such as rats and seagulls. Sunken ships and ruined piers have become new underwater habitats. Along with human enterprise, human conflict has also altered the environment. For example, more than three decades after the Vietnam War, the local ecosystem is still rife with craters, unexploded ordnance and widespread toxic residues that span the entire food chain. Some critics of this form of warfare even go so far as to brand it "ecocide" and petition for its inclusion in international law.

NSOU ? CC-GR-08 27 2.8 Rethinking about Civilization Just over a couple of hundred years ago, Edward Gibbon (1963) wrote that humankind may "acquiesce in the pleasing conclusion that every age of the world has increased and still increases the real wealth, the happiness, the knowledge, and perhaps the virtue, of the human race." In many ways, the record of human history bears this out: for example, the life expectancy of a Roman during the days of the empire was around twenty-five years. Today the world average life expectancy is somewhere in the mid- to late sixties, and life expectancy is considerably higher in many parts of the world due to advances in science and technology. (Kinsell 1992; Galor and Moav 2005). The twentieth century also witnessed unprecedented urbanization, a key marker of progress and development, with an increase from 220 million urban dwellers, or around 13% of the world's population, at the beginning of the century to 732 million or 29% by mid-century and reaching around 3.2 billion people or 49% in 2005. With urbanization expected to continue apace, it is estimated that by 2030 almost 5 billion people will live in cities, equivalent to roughly 60% of the global population (United Nations 2005). 2.9 Summary and Conclusion Today, most advanced societies view themselves as the lord and master of their environment. Since the second half of the last century, scholars have been pointing out the dangers of thinking like this and a gradual change in the perception of the environment has begun to set in. Now, it is regarded as something to be protected and preserved. However, the perception of the environment continues to be vastly different in different societies and economies. This is probably the reason why most international efforts to protect the environment ends in failure. 2.10 References 1.
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NSOU ? CC-GR-08 29 Unit 3 ? Concept of Holistic Environment and Systems Approach Structure 3.0 Objective 3.1 Introduction 3.2 Concept: Scope and Nature 3.3 Aspects 3.4 Environment as the Level-of-Integration above the Individual 3.5 Systems approach 3.6 Reference 3.0 Objective • The learners will get an overall idea about the concept of Holistic Environment and systems approach. 3.1 Introduction Environments present in different forms - global, physical, cultural, internal, political and social. Together they make up our holistic environment. The idea deals with exploring possibilities and developing benevolent co-existence of all beings on the earth. So it is both encompassing and inclusive and sees the life on the planet as a whole. 3.2 Concept: Scope and Nature First formulated by Jan Smuts, holism has been traditionally defined as a philosophical theory. The theory states that the determining factors in nature are wholes which are irreducible to the sum of their parts and that the evolution of the universe is the record of the activity and making of such wholes. More generally, it

NSOU ? CC-GR-08 30 is the concept that wholes cannot be analyzed into parts or reduced to discrete elements without unexplainable residuals. The holistic approach in ecology and environmental science derives from the idea proposed by Harrison Brown that "a precondition for solving (complex) problems is a realization that all of them are interlocked, with the result that they cannot be solved piecemeal." For some scholars holism is the rationale for the very existence of ecology. As David Gates notes, "the very definition of the discipline of ecology implies a holistic study." 3.3 Aspects The aspects that best describe a holistic environment include: 1. Basis: For an environment to be holistic, it should be based on values that are important to humanity such as love and care. People have a deep concern for their home, their community, their environment. People don't just live for now, but they also need to leave a good sustainable environment for the next generations. 2. Scope : A holistic environment takes into consideration the other forces such as cultural environment, political environment and the global environment. 3. Value : A holistic environment is timely and relevant. It tries to give the needs of the people at the present time. The environment should be valuable to the existing users or caretakers. The holistic approach to environment does not deal solely with one segment of environment, but it sees the life on the planet as a whole. Its aim is to promote benevolent co-existence of all beings on Earth taking the perspective of science and finding the solutions to the environmental issues of today. The holistic approach to environment does not only set the question of how to achieve the goal, but also WHY it is necessary and if it contributes to benevolent co- existence of all beings. Philosophers divide their "love of wisdom" in various ways. Three common sectors are, (1) what we know as real and important (ontology), (2) the ways we get that knowledge (epistemology), and (3) how in the light of knowledge we conduct ourselves (ethics). The three are connected like the points of a triangle; they reinforce one another so that cultural foolishness or wisdom shifts with the times, depending on what is known, how it is known, and what people feel committed to do about it.

NSOU ? CC-GR-08 31 Ever since the Renaissance, epistemology has been strongly influenced by science with its analytic and objective method of obtaining knowledge. Within the same time span, as theism faded, humanity moved to the centre of ontology's stage. The ethic that emerged in harmony with science and humanism is the prevalent one of individuality and self-aggrandizement. If Homo sapiens is the central reality of the universe, then human rights are the sole focus of ethical concern. Further, science is the appropriate way of knowing, for what else so effectively promotes human interests and human power over everything else? But if things other than humans are of surpassing importance, as today's deteriorating world leads some to suspect, then the conventional mode of knowing and the conventional individualistic ethic are called into question. Reconception of reality, of what is centrally important, can open avenues of escape from tradition's species-centred ethic and the mode of knowing that serves it. What humanity's leading vision and direction will be is today's portentous question. The history of where humankind has been in thought and action, and how the race has arrived at its present difficulties, is interesting but less important. The modern age has produced many theories as to what has gone wrong but few visions of what, from here on, might go right. To fulfil its promise, ecological philosophy needs to launch an imaginative quest for an attractive, rational future. 3.4 Environment as the Level-of-Integration above the individual Of all the words commonly used in discussions of ecological integrity and deterioration, "environment" is surely the vaguest. That it stands for something important is attested by the many agencies and departments of government that busy themselves with managing its parts and by the army of environmentalists eager to defend them. Yet beyond general statements pointing up, down, and around, to the air, soil, water, food, forests, wildlife, natural resources, wilderness, parks, cities, culture, society, and especially whatever impacts on community health, few agree about the exact referent of the word "environment."

NSOU ? CC-GR-08 32 The Australian Environment Protection Act defines "environment" as "including all aspects of the surroundings of man whether affecting him as an individual or in his social groupings." A proprietary essence is distilled by the Canadian Study Group on Environmental Assessment Hearing Procedures in identifying environment as "a collectively shared property." Ontario's Act Respecting Environmental Rights gives a more detailed and representatively chaotic definition, taking environment to mean: The term holism was introduced by the South African statesman Jan Smuts in his 1926 book, Holism and Evolution. Smuts defined holism as "The tendency in nature to form wholes that are greater than the sum of the parts through creative evolution." The idea has ancient roots. Examples of holism can be found throughout human history and in the most diverse socio-cultural contexts, as has been confirmed by many ethnological studies. The French Protestant missionary, Maurice Leenhardt coined the term cosmomorphism to indicate the state of perfect symbiosis with the surrounding environment which characterized the culture of the Melanesians of New Caledonia. For these people, an isolated individual is totally indeterminate, indistinct and featureless until he can find his position within the natural and social world in which he is inserted. The confines between the self and the world are annulled to the point that the material body itself is no guarantee of the sort of recognition of identity which is typical of our own culture. Ecology is the leading and most important approach to holism, as it tries to include biological, chemical, physical and economic views in a given area. The complexity grows with the area, so that it is necessary to reduce the characteristic of the view in other ways, for example to a specific time of duration. John Muir, Scottish-born American naturalist and conservationist wrote "When we try to pick out anything by itself we find it hitched to everything else in the Universe" 3.5 Systems approach The systems approach is an old concept. The approach stands on the assumption that breaking down a complex system into a simple one makes it easier to understand the complexity. Ludwig von Bertalanffy, an Austrian biologist, first proposed the systems approach under the name of 'General System Theory' in 1940 and published

NSOU ? CC-GR-08 33 it in 1968 (Ludwig von Bertalanffy,1968). He introduced system as a new scientific philosophy and defined it in a formal manner. He noted that most systems (biological or physical) of any practical relevance are open as they interact with the environment. Therefore, to understand the system it has to be differentiated from the environment, i.e., the boundary of the system has to be clearly defined along with its interaction with the environment from within this boundary. The approach concentrates on the holistic entity of the system without neglecting the components. It attempts to understand the role each component plays in the system while simultaneously understanding the activity of the whole system. Major concepts of the systems approach are: 1. Holism: A change in any part/component of a system that affects the whole system directly or indirectly. 2. Specialization: A whole system can be divided into granular (smaller easy to understand) components so that the specialized role of each component is appreciated. 3. Non-summational: Every component (subsystem/partial system) is of importance to the whole. It is therefore essential to understand the actions of each component to get the holistic perspective. 4. Grouping: The process of specialization can create its own complexity by proliferating the components with increasing specialization. To avoid this it becomes essential to group the related disciplines or sub-disciplines. 5. Coordination: The grouped components and sub-components need coordination. Without coordination, the components will not be able to work in a concerted manner and will lead to chaos. Coordination and control is a very important concept in the study of systems as without this we will not be able to develop a unified holistic concept. 6. Emergent properties: This is an important concept of systems approach. It means that the group of interrelated entities (components) has properties as a group that is not present in any individual component. This is the holistic view of a system. For example, multicellular organisms exhibit characteristics as a whole which are not present in individual constituent parts like cells.

NSOU ? CC-GR-08 34 3.6 Summary and Conclusion Thus, the holistic approach to environmental issues involves acknowledging the interconnectedness of issues that affect the environment in any development process. 3.7 Reference 1. Bowen, W. "Reductions and Holism." In Thinking About Nature: An Investigation of Nature, Value and Ecology. Athens: University of Georgia Press, 1988. 2. Johnson, L. E. "Holism." In A Morally Deep World: An Essay on Moral Significance and Environmental Ethics. Cambridge: Cambridge University Press, 1991. 3. Savory, A. Holistic Resource Management. Covelo, CA: Island Press, 1988.

NSOU ? CC-GR-08 35 Unit 4 ? Ecosystem: Concept, Structure and Functions Structure 4.0 Objective 4.1 Introduction 4.2 Structure and Function of an Ecosystem 4.3 Subdivision of modern ecology 4.4 Functions of an Ecosystem 4.5 Components of an ecosystem 4.6 Matter and cycles of matter 4.7 Energy and cycles of energy 4.8 Summary and Conclusion 4.9 References 4.0 Objective • The learners will identify with the different terms relating to Ecosystem and develop an overview of its functioning of the ecosystem. 4.1 Introduction Concept of an

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Ecosystem: Living organisms cannot live isolated from their non-living environment because the latter provides materials and energy for the survival of the

former i.e. there is interaction between a biotic community and its environment to produce a stable system; a natural self-sufficient unit which is known as an ecosystem.

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An ecosystem is, therefore, defined as a natural functional ecological unit comprising of living organisms (

biotic community) and their non-living (abiotic or physio chemical)

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environment that interact to form a stable self-supporting system.

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A pond, lake, desert, grassland, meadow, forest etc. are common examples of ecosystems.

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The term ecosystem was coined in 1935 by the Oxford ecologist Arthur Tansley to encompass the interactions among biotic and abiotic components of the environment at a given site. The living and non-living components of an ecosystem are known as biotic and abiotic components, respectively. Ecosystem was defined in its presently accepted form by Eugene Odum as, "an unit that includes all the organisms, i.e., the community in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycles, i.e., exchange of materials between living and non-living, within the system".

Smith (1966) has summarized common characteristics of most of the ecosystems as follows: 1. The ecosystem is a major structural and functional unit of ecology. 2. The structure of an ecosystem is related to its species diversity in the sense that complex ecosystem have high species diversity. 3. The function of ecosystem is related to energy flow and material cycles within and outside the system. 4. The relative amount of energy needed to maintain an ecosystem depends on its structure. Complex ecosystems needed less energy to maintain themselves. 5. Young ecosystems develop and change from less complex to more complex ecosystems, through the process called succession. 6. Each ecosystem has its own energy budget, which cannot be exceeded. 7. Adaptation to local environmental conditions is the important feature of the biotic components of an ecosystem, failing which they might perish. 8. The function of every ecosystem involves a series of cycles, e.g., water cycle, nitrogen cycle, oxygen cycle, etc. These cycles are driven by energy. A continuation or existence of ecosystem demands exchange of materials/ nutrients to and from the different components. 4.2 Structure and Function of an Ecosystem Each ecosystem has two main components: (1) Abiotic (2) Biotic (1) Abiotic Components: The non living factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on the structure, distribution, behaviour and inter-relationship of organisms.
NSOU ? CC-GR-08 37 Abiotic components

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are mainly of two types: (a) Climatic Factors include rain, temperature, light, wind, humidity etc. 1. (b) Edaphic Factors include soil, topography, minerals

etc. The functions of important factors in abiotic components are given below:

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Soils are much more complex than simple sediments. They contain a mixture of weathered rock fragments, highly altered soil mineral particles, organic matter, and living organisms. Soils provide nutrients, water, a home, and a structural growing medium for organisms. The vegetation found growing on top of a soil is closely linked to this component of an ecosystem through nutrient cycling. The atmosphere provides organisms found within ecosystems with carbon dioxide for photosynthesis and oxygen for respiration. The processes of evaporation, transpiration and precipitation cycle water between the atmosphere and the Earth's surface. Solar radiation is used in ecosystems to heat the atmosphere and to evaporate and transpire water into the atmosphere. Sunlight is also necessary for photosynthesis. Photosynthesis provides the energy for plant growth and metabolism, and the organic food for other forms of life. Most living tissue is composed of a very high percentage of water, up to and even exceeding 90%. The protoplasm of a very few cells can survive if their water content drops below 10%, and most are killed if it is less than 30-50%. Water is the medium by which mineral nutrients enter and are translocated in plants. It is also necessary for the maintenance of leaf turgidity and is required for photosynthetic chemical reactions. Plants and animals receive their water from the Earth's surface and soil. The original source of this water is precipitation from the atmosphere.(

Singh, S, 2008) (2) Biotic Components: The living organisms including plants, animals and micro-organisms (Bacteria and Fungi) that are present in an ecosystem form the biotic components. On the basis of their role in the ecosystem the biotic components can be classified into three main groups: (A) Producers (B) Consumers (C) Decomposers or Reducers. (A) Producers:

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The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compounds namely water and carbon dioxide. This process is known as photosynthesis. As the green plants manufacture their own food they are known as

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Autotrophs (i.e. auto = self, trophos = feeder) The chemical energy stored by the producers is utilised partly by the producers for their own growth and survival and the remaining is stored in the plant parts for their future use. (

B) Consumers: The animals lack chlorophyll and are unable to synthesise their own food. Therefore, they depend on the producers for their food. They are known as heterotrophs (i.e.heteros = other, trophos = feeder) The consumers are of four types, namely: (a)

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Primary Consumers or First Order Consumers or Herbivores: These are the animals which feed on plants or the producers. They are called herbivores. Examples are rabbit, deer, goat, cattle etc. (

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b)

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Secondary Consumers or Second Order Consumers or Primary Carnivores: The animals which feed on the herbivores are called the primary carnivores. Examples are cats, foxes, snakes etc. (

c)

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Tertiary Consumers or Third Order Consumers: These are the large carnivores which feed on the secondary consumers. Example are Wolves. (

d) Quaternary Consumers or Fourth Order

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Consumers or top predators or Omnivores: These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are lions and tigers. (C) Decomposers or

Reducers: Bacteria and fungi belong to this category.

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They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food and release to the environment the simple inorganic and organic substances produced as by-products of their metabolisms. These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic community and the abiotic environment of the ecosystem. The decomposers are known as Saprotrophs (i.e., sapros = rotten, trophos = feeder)

So

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an ecosystem has physical, chemical, and biological components along with energy sources and pathways of energy and materials interchange. The environment in which a particular organism lives is called its habitat. The role of an organism in a habitat is called its niche. For the study of ecology it is often convenient to divide the environment into four broad categories. 1. Terrestrial environment - The terrestrial environment is based on land and consists of biomes, such as grasslands, one of several kinds of forests, savannas, or deserts. NSOU ? CC-GR-08 39 2. Freshwater environment - The freshwater environment can be further subdivided between standing-water habitats (lakes, reservoirs) and running- water habitats (streams, rivers). 3. Oceanic marine environment - The oceanic marine environment is characterized by saltwater and may be divided broadly into the shallow waters of the continental shelf composing the neritic

or sub-littoral zone where sunlight reaches the floor 4.

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Oceanic region - The deeper waters of the ocean that constitute the oceanic region where there is not enough light for photosynthesis. 4.3 Subdivision of modern ecology Two

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major subdivisions of modern ecology are • Ecosystem ecology - which views ecosystems as large units, and • Population ecology - which attempts to explain ecosystem behaviour from the properties of individual units. In practice, the two approaches are usually merged. Descriptive ecology describes the types and nature of organisms and their environment, emphasizing structures of ecosystems and communities and dispersions and structures of populations. Functional ecology explains how things work in an ecosystem, including how populations respond to environmental alteration and how matter and energy move through ecosystems.

Ecosystems are broadly divided into natural and artificial. Natural ecosystems are those that are existing in nature; they are further classified into terrestrial and aquatic. Terrestrial includes hot desert, grass land, tropical and temperate rainforest and aquatic includes ponds, river, streams, lakes, estuaries, oceans, mangroves, swamps and bays etc. However, these two ecosystems are self-regulating, open system with a free exchange of inputs and outputs with other systems. Artificial ecosystems are simple, human-made, unstable and subjected to human intervention and manipulation. Usually it is formed by clearing a part of the forest or grassland e.g. crop field, agricultural land.
NSOU ? CC-GR-08 40 4.4 Functions of an Ecosystem Natural processes, in turn, are the result of complex interactions between biotic (living organisms) and abiotic (chemical and physical) components of ecosystems through the universal driving forces of matter and energy. Four primary groups of ecosystem functions are (1) Regulatory functions, (2) habitat functions, (3) production functions and (4) information functions. General characterization of ecosystem functions are (1)

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Regulatory functions: This group of functions relates to the capacity of natural and semi-natural ecosystems to regulate essential ecological processes and life support systems through bio-geochemical cycles and other

bio- spheric

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processes. In addition to maintaining the ecosystem (and biosphere health), these regulatory functions provide many services that have direct and indirect benefits to humans (i.e., clean air, water and soil, and biological control services). (2) Habitat functions: Natural ecosystems provide refuge and a reproduction habitat to

a variety of species,

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plants and animals and, thereby contribute to the conservation of biological and genetic diversity and the evolutionary process. (3) Production functions: Photosynthesis and nutrient uptake by autotrophs converts energy, carbon dioxide, water and nutrients into a wide variety of carbohydrate structures which are then used by secondary producers to create an even larger variety of living biomass. This broad diversity in carbohydrate structures provides many ecosystem goods for human consumption, ranging from food and raw materials to energy resources and genetic material. (4) Information functions: Since most of human evolution took place within the context of an undomesticated habitat, natural ecosystems contribute to the maintenance of human health by providing opportunities for recreation, cognitive development and aesthetic experience.

NSOU ? CC-GR-08 41 4.5 Components of an ecosystem Acomplete ecosystem consists of four basic components such as producers, consumers, decomposers and abiotic components e.g. Pond. If anyone of these four components are lacking, then it is grouped under incomplete ecosystem e.g. ocean depth or a cave. Productivity in the Environment: The productivity of an ecosystem is the rate at which solar energy is fixed by the vegetation of the ecosystem; it is further classified into primary productivity, secondary productivity and net productivity. Primary productivity refers to the rate at which radiant energy is stored by photosynthetic and chemosynthetic activity of producers; it is further distinguished as gross primary productivity (GPP) and net primary productivity (NPP). It is expressed in terms of weight (g/m2 /yr) or energy (kcal/m2). Secondary productivity refers to the rates of energy storage at consumer levels. An understanding of ecology is essential in the management of modern industrialized societies in ways that are compatible with environmental preservation and enhancement. The branch of ecology that deals with predicting the impacts of technology and development and, making recommendations such that these activities will have minimum adverse impacts, or even positive impacts, on ecosystems may be termed as Applied Ecology. It is a multidisciplinary approach. Interactions among living organisms are grouped into two major groups viz., • Positive interactions • Negative interactions In positive interaction the populations help one another, the interaction being either one way or reciprocal. These include (i) commensalism, (ii) proto co-operation and (iii) mutualism. 1. Commensalism: In this, one species derives the benefits while the other is unaffected, e.g., (i) cellulolytic fungi produce a number of organic acids from cellulose which serve as carbon sources for non-cellulolytic bacteria and fungi, (ii) growth factors are synthesised by certain microorganisms and their excretion permits the proliferation of nutritionally complex soil inhabitants.
NSOU ? CC-GR-08 42 2. Proto-cooperation: It is also called as non-obligatory mutualism. It is an association of mutual benefit to the two species but without the co-operation being obligatory for their existence or for their performance of reactions, eg. N2 can be fixed by Azotobacter with cellulose as energy source provided that a cellulose decomposer is present to convert the cellulose to simple sugars or organic acids. 3. Mutualism: Mutually beneficial interspecific interactions are more common among organisms. Here both the species derive benefit. In such association, there occurs a close and often permanent and obligatory contact more or less essential for survival of each. As examples, (i) pollination by animals, bees, moths, butterflies etc. derive food from hectar, or other plant product and in turn bring about pollination, (ii) symbiotic nitrogen fixation, legume - rhizobium symbiosis, bacteria obtain food from legume and in turn, fix gaseous nitrogen, making it available to plant. II. Negative interactions: Member of one population may eat members of the other population, compete for foods, excrete harmful wastes or otherwise interfere with the other population. It includes (i) competition, (ii) predation, (iii) parasitism and (iv) antibiosis. (i) Competition: It is a condition in which there is a suppression of one organism as the two species struggle for limiting quantities of nutrients O 2 space or other requirements, e.g., competition between Fusarium oxysporum and Agrobacterium radiobacter. (ii) Predation :A predator is free living which catches and kills another species for food. Most of the predatory organisms are animals but there are some plants (carnivorous) also, especially fungi, which feed upon other animals,eg. (i) grazing and browsing by animals on plants. Carnivorous plants such as Nepenthes, Darligtoria, Drosera etc. consume insects and other small animals for food, protozoans feeding on bacteria. (iii) Parasitism :A parasite is the organism living on or in the body of another organisms and deriving its food more or less permanently from their tissues. A typical parasite lives in its host without killing it, whereas the predator kills its upon which it feeds, eg.species of Cuscuta (total stem

NSOU ? CC-GR-08 43 parasite) grow on other plants on which they depend for nourishment. Parasitism may occur even with in the species. Hyperparasites which are chiefly fungi growing parasitically on other parasites, ie. parasite on a parasite. (iv) Antibiosis: The phenomenon of the production of antibiotic is called as antibiosis. Antibiotic is an organic substance produced by one organism which in low concentration inhibits the growth of other organism, eg. streptomycin, penicillin etc. 4.6 Matter and cycles of matter Biogeochemical cycles describe the circulation of matter, particularly, plant and animal nutrients, through ecosystems. These cycles are ultimately powered by solar energy, fine-tuned and directed by energy expended by organisms. In a sense, the solar-energy-powered hydrologic cycle acts as an endless conveyer belt to move materials essential for life through ecosystems. Most biogeochemical cycles can be described as elemental cycles involving nutrient elements such as carbon, oxygen, nitrogen, sulfur and phosphorus. Many are gaseous cycles in which the element in question spends part of the cycle in the atmosphere – O_2 for oxygen, N_2 for nitrogen, CO_2 for carbon. Others, notably the phosphorus cycle, do not have a gaseous component and are called sedimentary cycles. All sedimentary cycles involve salt solutions or soil solutions that contain dissolved substances leached from weathered minerals that may be deposited as mineral formations or they may be taken up by organisms as nutrients. The sulfur cycle, which may have H_2S or SO_2 in the gaseous phase or minerals ($CaSO_4$, $2H_2O$) in the solid phase, is a combination of gaseous and sedimentary cycles. Carbon Cycle: Carbon, the basic building block of life molecules, is circulated through the carbon cycle. This cycle shows that carbon may be present as gaseous atmospheric CO_2 , dissolved in groundwater as HCO_3 or molecular CO_2 (aq), in underlying rock strata as limestone ($CaCO_3$), and as organic matter, represented in a simplified manner as (CH_2O). Photosynthesis fixes inorganic carbon as biological carbon,

NSOU ? CC-GR-08 44 which is a constituent of all life molecules. An important aspect of the carbon cycle is that it is the cycle by which energy is transferred to biological systems. Organic or biological carbon, (CH_2O), is an energy-rich molecule that can react biochemically with molecular oxygen, O_2 , to regenerate carbon dioxide and produce energy. This can occur in an organism as shown by the "decay" reaction or it may take place as combustion, such as when wood is burned. Oxygen Cycle The oxygen cycle involves the interchange of oxygen between the elemental form of gaseous O_2 in the atmosphere and chemically bound oxygen in CO_2 , H_2O, and organic matter. Elemental oxygen becomes chemically bound by various energy yielding processes, particularly, combustion and metabolic processes in organisms. It is released during photosynthesis. Nitrogen Cycle Nitrogen, though constituting much less of biomass than carbon or oxygen, is an essential constituent of proteins. The atmosphere is 78% by volume elemental nitrogen, N_2 and constitutes an inexhaustible reservoir of this essential element. The N_2 molecule is very stable so that breaking it down to atoms that can be incorporated in inorganic and organic chemical forms of nitrogen is a limiting step in the nitrogen cycle. This does occur by high energy processes such as in lightning discharges when nitrogen chemically combines with hydrogen or oxygen to form ammonia or nitrogen oxides. Elemental nitrogen is also incorporated into chemically bound forms or fixed by biochemical processes mediated by microorganisms. The biological nitrogen is returned to the inorganic form during the decay of biomass by a process called mineralization. Phosphorus cycle The phosphorus cycle is crucial because phosphorus is usually the limiting nutrient in ecosystems. There are no common stable gaseous forms of phosphorus, so the phosphorus cycle is strictly sedimentary. In the geosphere, phosphorus is held largely in poorly soluble minerals, such as hydroxyapatite, a calcium salt. Soluble phosphorus from these minerals and other sources, such as fertilizers, is taken up by plants and incorporated into the nucleic acids of biomass. Mineralization of biomass by microbial decay returns phosphorus to the salt solution from which it may precipitate as mineral matter.

NSOU ? CC-GR-08 45 Sulfur cycle The sulfur cycle is relatively complex. It involves several gaseous species, poorly soluble minerals, and several species in solution. It is involved with the oxygen cycle in that sulfur combines with oxygen to form gaseous sulfur di-oxide (SO 2) an atmospheric pollutant, and soluble sulfate ion, (SO 4 2-). Among the significant species involved in the sulfur cycle are gaseous hydrogen sulfide, H 2 S; mineral sulfides, such as PbS; sulfuric acid, H 2 SO 4 , the main constituent of acid rain; and biologically bound sulfur in sulfur-containing proteins. 4.7 Energy and cycles of energy Biogeochemical cycles and virtually all other processes on Earth are driven by energy from the sun. The sun acts as a blackbody radiator with an effective surface temperature of 5780 K (degree Celsius above absolute zero). It transmits energy to earth as electromagnetic radiation. The maximum energy flux of the incoming solar energy is at a wavelength of about 500 nanometers, which is in the visible region of the spectrum. One square meter area perpendicular to the line of solar flux at the top of the atmosphere receives energy at a rate of 1,340 watts/m 2 , sufficient, for example, to power an electric iron. This is called solar flux. In natural systems, energy is transferred by heat. Energy flows between two bodies as a result of their difference in temperature. Otherwise transfer of energy can happen by work that does not depend upon a temperature difference, as governed by the laws of thermodynamics. The first law of thermodynamics states that, although energy may be transferred or transformed, it is conserved and is not lost. Chemical energy in the food ingested by organisms is converted by metabolic processes to work or heat that can be utilized by the organisms, but there is no net gain or loss of energy overall. The second law of thermodynamics describes the tendency toward disorder in natural systems. It demonstrates that each time energy is transformed; some is lost in the sense that it cannot be utilized for work, so only a fraction of the energy that organisms derive from metabolizing food can be converted to work; the rest is dissipated as heat. Energy Flow and Photosynthesis Whereas materials are recycled through ecosystems, the flow of useful energy may be viewed as essentially a one-way process. Incoming solar energy can be

NSOU ? CC-GR-08 46 regarded as high-grade energy because it can cause useful reactions to occur, the most important of which in living systems is photosynthesis. Solar energy captured by green plants energizes chlorophyll, which in turn powers metabolic processes that produce carbohydrates from water and carbon dioxide. These carbohydrates represent stored chemical energy that can be converted to heat and work by metabolic reactions with oxygen in organisms. Ultimately, most of the energy is converted to low-grade heat, which is eventually reradiated away from Earth by infrared radiation. Succession Environment is always keep changing over a period of time due to (1) variations in climatic and physiographic factors, (2) the activities of the species of the communities themselves. These influences bring about marked changes in the dominants of the existing community, which is thus sooner or later replaced by another community at the same place. This process continues and successive communities develop one after another over the same area until the terminal final community again becomes more or less stable for a period of time. It occurs in a relatively definite sequence. This orderly change in communities is referred to as succession. Odum called this orderly process as ecosystem development/ecological succession. Succession is an orderly process of community development that involves changes in species structure and community processes with time and it is reasonably directional and therefore predictable. Succession is community controlled even though the physical environment determines the pattern. Causes of succession Succession is a series of complex processes, caused by (i) initial/initiating cause, both climatic as well as biotic, (ii) ecesis continuing process ecesis, aggregation, competition reaction etc, (iii) stabilizing cause as a stabilization of the community. Climate is the chief cause of stabilization and other factors are of secondary value. Types of succession • Primary succession: Starts from the primitive substratum where there no living matter exists in earlier time. The first group of organisms establishing there is known as the pioneers, primary community/primary colonizers. Very slow is the series of community changes that takes place in disturbed areas that have not been totally stripped of their soil and vegetation.

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Secondary succession: Starts from previously built up substrata with already existing living matter.

Action of external force, as a sudden change in climatic factors, biotic intervention, fire etc, causes the existing community to disappear. Thus area becomes devoid of living matter but its substratum, instead of primitive is built up. Such successions are comparatively more rapid. • Autogenic succession: A community as a result of its reaction with the environment, modifies its own environment and thus causing its own replacement by new communities. This course of succession is autogenic succession. • Allogenic succession: Replacement of the existing community is caused largely by any other external condition and not by the existing organisms. • Autotrophic succession: Characterized by early and continued dominance of autotrophic organisms like green plants. Gradual increase in organic matter content supported by energy flow. • Heterotrophic succession: Characterized by early dominance of heterotrophs, such as bacteria, actinomyces, fungi and animals. There is a progressive decline in the energy content. • General Process of succession: Nudation- development of barren area without any form of life. Cause of nudation:It may be due to (a) topographic soil erosion by wind, (b) climatic - storm, frost etc., (c) biotic - man, disease and epidemics, (d) invasion- successful establishment of a species in a barren area. This species actually reaches this new site from any other area by (i) migration, (ii) ecesis and (iii) aggregation. • Retrogressive succession: Continuous biotic influences have some degenerating influence on the process. Due to destructive effects of organisms, the development of disturbed communities does not occur. Process of succession, instead of progressive, it becomes retrogressive, e.g., forest may change to shrubby or grassland community. • Deflected succession: Sometimes due to changes in local conditions as soil character or microclimate the process of succession becomes deflected in a different direction than that presumed under climatic conditions of the area.

NSOU ? CC-GR-08 48 Thus the climax communities are likely to be different from the presumed climatic climax community. In India, with a monsoon type of climate, in some habitats like temporary ponds, pools etc., it is common to observe each year, the development of different kinds of communities in different seasons of the year - seasonal succession. But such changes are simply recurrent and not developmental and should not be designated as successful. Species do not remain unchanged indefinitely. In course of time many species become extinct and disappeared forever. Or a species may form one or more new species that differ from the original one. All these changes are result of evolution, i.e., by the process of evolution organism arise by modification from ancestral forms of life. 4.8 Summary and Conclusion

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Ecosystems are made up of abiotic (non-living, environmental) and biotic components, and these basic components are important to nearly all types of ecosystems. Ecosystem ecology looks at energy transformations and biogeochemical cycling within

the

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ecosystems. Energy is continually is added into an ecosystem in the form of light energy, and some energy is lost with each transfer to a higher trophic level. Nutrients, on the other hand, are recycled within an ecosystem, and their supply normally limits biological activity. So, "energy flows, elements cycle". Energy is moved through an ecosystem via a foodweb, which is made up of interlocking food chains. Energy is first captured by photosynthesis (primary production). The amount of primary production determines the amount of energy available to higher trophic levels. The study of how chemical elements cycle through an ecosystem is termed biogeochemistry. A biogeochemical cycle can be expressed as a set of stores (pools) and transfers, and can be studied using the concepts of "stoichiometry", "mass balance", and "residence time". Ecosystem function is controlled mainly by two processes, "top-down" and "bottom-up" controls. NSOU ? CC-GR-08 49 A biome is a major vegetation type extending over a large area. Biome distributions are determined largely by temperature and precipitation patterns on the Earth's surface. 4.9

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NSOU ? CC-GR-08 50 Unit 5 ? Wetland ecosystem with special reference to East Kolkata Wetlands Structure 5.1 Objective 5.2 Introduction 5.3 Ramsar Convention 5.4 What the Wetlands offer? 5.5 The East Calcutta Wetlands Serves to: 5.6 The East Calcutta Wetlands face several problems or threats from different quarters: 5.7 Importance and Sustainability of the wetlands 5.8 Summary and Conclusion 5.9 Reference 5.1 Objective • to understand a wetland ecosystem • to understand the types and characteristics of wetlands • to understand why wetlands are a unique ecosystem 5.1 Introduction Wetlands have been described

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as lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

The importance of wetlands lie in the fact that it maintains the food chain, ecological balance and absorb pollution, treat sewage and fulfills the requirement of fishes. 5.3 Ramsar Convention It is an international convention came in force in 1975.

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The convention provides the framework for international cooperation for the conservation and wise use of

NSOU ? CC-GR-08 51 wetland habitats. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) serves as the Depositary for the Convention, and its secretariat, the Ramsar Bureau, is in Gland, Switzerland. India became signatory to this convention in 1981. The Convention aims to halt the loss of wetlands and to ensure the conservation of fauna and flora and their ecological processes. Obligations of parties include: • designating one or more wetlands for inclusion in the list of Wetlands of International Importance (e.g. six Ramsar wetlands in India). • promoting judicious use of wetlands including mangroves. • promoting conservation of wetlands through establishment of nature reserves. • promoting training in the field of wetland research, managing and warding. • consulting with other parties about implementation of the convention, especially with regard to trans frontier wetlands, shared water systems, shared species, and development of wetland projects. East Calcutta Wetlands (ECW), are the combination of natural and human- made wetlands lying at the east of the city of Calcutta (Kolkata), of West Bengal in India. It includes salt marshes, and agricultural fields, sewage farms and settling ponds. The wetlands are also used to treat Kolkata's sewage, and the nutrients contained in the wastewater sustain fish farming and agriculture. The name East Kolkata Wetlands was coined by Drubojyoti Ghosh. As an engineer of the Government of West Bengal's Water and Sanitation Department, he reached this neglected part of the city and tried to find an answer to a question what happens to the city sewage? He found the answer from the local fishermen and farmers who devised their own means of solutions in the form of wetlands that served as the natural sewage treatment plant for the city. The wetlands to the east of Calcutta (220 27'N 880 27'E) comprises a large number of water bodies distributed across the districts of South and North 24 Parganas. The multifunctional wetland ecosystem is spread over 12,500 hectares. It has, along with the wetlands, 264 sewage-fed fisheries, agriculture and solid waste farms and some built up areas. The resource recovery system developed by the local people over many years using waste water from the city is the largest and the only one of its kind in the world. It also helps in water treatment and is home to waterfowl

NSOU ? CC-GR-08 52 and a large biodiversity. In August, 2002, 12,500 hectares of the East Calcutta Wetland area was included in the 'Ramsar-List' making it a wetland of International Importance. The Ramsar Bureau List was established under Article 8 of the Ramsar Convention. Historical aspects of ECW. The earliest known accounts (year 1748) of the wetlands picture it as marshy Salt Lakes teeming with fish and birds. The Lakes were spread over a vast area, stretching from the vicinity of River Hooghly to about 5-6 km. to the east. According to these early accounts, the circumference of the lakes was much bigger than it is at present. From the late 18th century, the edge of the lakes receded about one and a half kilometers. The loss of head water feed from the river Hooghly, the gradual deterioration of the River Bidyadhari (within the wetland area), the ever expanding city of Calcutta with its increasing demands for drainage and waste disposal led to rapid silting and reclamation of the East Calcutta Wetlands. Human interventions have played a decisive role in the shrinking of the East Calcutta Wetland to their present size. The East Calcutta Wetlands have an interesting hydrological history. The area had been a brackish water lagoon swamp but as fresh drainage water came out of Calcutta it became suitable for raising fish. Local farmers stocked some of the ponds and then dug more. Currently, there are 300 or so large fish farms and ponds cover a total area of 3,500 hectares, some individual ponds extend to 70ha. Landlords, many of them absentee, let the majority of ponds to commercial managers, some others are managed by the government and some have been given to fishermen's groups and cooperatives. Vegetable production is a household activity with people renting small plots or sub-letting smaller plots for their own household sustenance and income. Apart from those people, there are porters, auctioneers, traders, retailers and people raising fish seed, making nets, maintaining drainage canals and reinforcing the banks. A large number of people, many of them poor, depend on the Wetlands for their livelihoods. Many more, in Calcutta city, depend on the fish and vegetables produced; 13,000 tonnes of fish are produced annually in ponds managed for wastewater aquaculture and 150 tonnes vegetables per day are harvested from smallscale horticultural plots irrigated with wastewater. But there are a number of problems. The salt lake to the East of Calcutta have been for the abundance of fish fauna, which up to few years ago consisted mainly of brackish water forms (Gupta

NSOU ? CC-GR-08 53 1908).Latex calcifer(Bloch) which is commonly known as "Bhetki" and Mughal persii (Ham) known as "perse". Hilisahilisa(Ham) was also known not uncommon when the lakes were fed by water from the tidal river, Bidyadhari which of late has siltedup. There is at present no ingress of saline water into the salt Lake from this source. Sewell (1934) in studying the fauna of the Salt Lake also remarked on the rapid deterioration of the river Bidyadhari owing to deposition of salt and silt during the flood tides. The natural process of delta formation and the consequent change in the river system, as also engineering construction, such as bridges and canals, have also been instrumental in bringing the present moribund condition of the river.Several fish culture ponds have been started in the villages bordering in the Salt Lake, and the Lakes themselves are being more and more bunded up into small reservoirs or "bheris" as time passes(Gupta 1908). Farmers around Calcutta developed a technique of using domestic sewage for fish culture almost a century ago. This technique is widely used to meet the growing demand for fish in this thickly populated city. The technique is considered to be unique and is the largest operational system in the world to convert waste to consumable products. The large scale usage of sewage for fish culture began in 1930s. Early success of fish culture in stabilized sewage ponds, which were used as a source of water for growing vegetables provided stimulus for the large scale expansion of sewage fed fish culture system. The area under this unique system of culture peaked at 12,000 hectare, but in recent years there has been a steep decline in the area due to the increasing pressure of urbanization. 5.4 What the Wetlands offer? Fish: The city of Calcutta gets its huge volumes of daily sewage treated at no expense and gets in addition a substantial daily supply of highly edible freshwater fish (essential protein supplement for the local people in their daily food). In fact, Calcutta City receives about one third of its daily requirement of fish from the sewage-fed fisheries (about 11,000 metric tones annually.) Garbage: Calcutta generates roughly 2,500 metric tons of garbage (solid waste) a day which is collected and dumped at designated sites in the wetlands. The garbage

NSOU ? CC-GR-08 54 filled areas are extensively used to raise a variety of vegetables. The city receives roughly 150 metric tons of vegetable everyday from its garbage farms. Foodgrains: The paddy fields in the wetlands (many of which are irrigated by the effluent water of the fisheries) produce 15,000 metric tons of paddy annually. Air purification: It is claimed by environmentalists that these wastewater bodies and fisheries act as a carbon-dioxide sink and help to improve the quality of air of Kolkata and its environs. Any loss of the wetlands, therefore, will have a negative impact on the overall environmental condition of the area. So, the role and importance of the wetland in relation to its surroundings cannot be undermined. 5.5 The East Calcutta Wetlands Serves to: (a) absorb and treat in a most efficient, economical and natural way the huge volume of sewage and wastewater and urban solid and air wastes generated by Calcutta at no cost to the city; (b) fulfill substantially the requirement of fish, vegetables and foodgrains in the city; (c) absorb the pollution from, and purify the air that citizens breathe; (d) absorb and pass to downstream creeks and the sea the flood waters that the monsoon brings to the city; (e) provide a habitat for a variety of flora and fauna and living organisms endemic to wetlands; (f) provide the food chain and waste-to-wealth recycling so unique and essential to this city; (g) maintain the micro-climatic condition of the region; (h) maintain the delicate ecological balance in a fragile environment and eco-system; (i) provide livelihood support for thousands of local villagers who also have the unique skill of using wastewater to grow fish and vegetable and thereby help sustain a stable urban fringe.

NSOU ? CC-GR-08 55 5.6 The East Calcutta Wetlands face several problems or threats from different quarters: 1) Threats of encroachment from real estate developers: The East Calcutta Wetlands represent vast areas of shallow filled land in the fringe areas of the bustling metropolis of Calcutta which are easily reclaimable by filled up and act as magnet for “land sharks”. Before the current realization of the importance of the wetlands several “development” schemes also made in-roads in the area, leading to a gradual shrinkage in the total area of the wetlands. Solution : legal measures The conservation area boundary for the East Calcutta Wetlands and waste-recycling region was mapped in 1985 by the State Planning Board, Government of West Bengal. This wetland area is protected by order of the Calcutta High Court in 1992, which prohibits change in land use. High Court directed the State Government to take recourse to statutory cover, if required, to prevent any private alienation of land. Recently, the Director of land and Land Records, Govt. of West Bengal has issued a fresh order prohibiting any conversion of land use within the conservation area boundary and declaring all such conversions, that have taken place since 1992, as void. Filling up of water bodies in this area is not permissible under West Bengal Town and Country (Planning and Development) Act, 1979 as well as under the West Bengal Inland Fisheries Act, 1984 (with amendment in 1993). 2) Metal deposition Metal deposition in the canal sludge rendering the waste water incapable of ensuring the edible quality of the fish and vegetable grown in the wetland is another recent threat. Indiscriminate dumping of untreated solids and hazardous industrial wastes like heavy metals, without ascertaining the assimilative capacity of the wetland, may lead to severe pollution of the wetlands and adverse health impact to local population. Some unscrupulous businessmen do not run effluent treatment plants efficiently and directly discharge untreated effluents from factories and sewage into the East Calcutta Wetlands through Bagjola, Bhangar and Tiljola Canals. The water of these canals gets further mixed with water from the Dhapa dump yard through leaching. Heavy metals released from effluents after reaching Wetland Water are transferred to vegetables and fishes and finally to human beings through food chain.

NSOU ? CC-GR-08 56 Solution : 1. Tougher enforcement of environmental laws. 2. Use of water hyacinths which accumulate heavy metals in their body. By applying water hyacinths and benthos in polluted water it is observed that heavy metallic pollution decreased unto 8-10%. Water hyacinths accumulate heavy metals in their body. 2) Workers' Problems: A. Loss of income during non crop seasons a) Handicraft training for women, b) Setting up of co-operatives, c) Development of Eco tourism/amusement parks in or around the bheris, will solve the problem. B. Lack of proper education Literacy level is not impressive in this area. Most of the women folks are illiterate. Scope of higher education is also very limited. Government initiatives could be taken to set up schools both at primary as well as secondary level. These schools must be set up in locations from where they are easily accessible to the students. Care must be taken to motivate the students and their family members to pursue education in order to reduce the drop out rates. To accomplish this income level of the family members must be increased so that they do not stop their child's education due to crunch for money. C. Indebtedness of labourers: A serious issue that must be given adequate attention is the indebtedness of the labourers, especially those working for recycling firms. Many bheri workers also become indebted to the bheri owners. As a result they reach the status of bonded labourers. Measures must be taken to relieve them from this bondedness. Micro finance and micro-credit schemes can be developed so that they can save small amounts and borrow from the banks at low rates. Several NGOs active in these areas pursue micro finance schemes and have helped many families, to earn a steady source of income. The women and families who work as garbage pickers have shown good response to such schemes. But with the help of the government, this scheme can be strengthened. D. Health Hazard: Though the fishermen working for long hours rarely develop any disease related to wastewater, their household members do complain of

NSOU ? CC-GR-08 57 diaohrrea, dysentery and other waterborne diseases. Garbage picking for the recycling and compost production also adds to the health hazards of the workers. The following actions could resolve the issue. 1) provision for better sanitation facilities including better quality of drinkingwater; 2) better access to medical facilities; 3) better protective area and awareness. 5.7 Importance and Sustainability of the wetlands 1. Fish and vegetable production and supply providing food security and nutrition. Fertiliser and pesticides are not required. 2. Recycling process of sewage waste water fed aquaculture with recycling of solid waste controls pollution and improves environment with more oxygen. It protects bioregion. 3. It provides employment, income for other casual workers and provide better living standards. 4. Preservation of biodiversity. East Kolkata wetlands provide a blue and green buffer to between urban and rural areas. 5. It helps ground water recharge and monsoon flood control due to climate change. 6. Improved irrigation and agriculture 7. Indigenous process and recycling instead of expensive wastewater treatment plants can purify waste water with exposure to sun in photosynthesis process with phytoplankton. 8. It is cost effective, it helps recover materials. 9. It provides recreation, ecotourism etc. 10. Ecosystem services of Wetlands are more valuable compared to rivers, lakes, forests and grasslands. 5.8 Summary and Conclusion East Calcutta wetlands serve as one of the best examples to the world on concepts of integrated resource recovery systems and water recycling using peripheral wetlands around cities. It is the largest ensemble of sewage for fish ponds in one place in the world. But it is being lost due to the urban expansion without consideration of the ecological, environmental and economic benefits of the sewage

NSOU ? CC-GR-08 58 fed aquaculture system. There is necessity to understand the science behind the management practices evolved by fishermen themselves. Costanza et al (1997), when estimating the value of the world's ecosystem services, estimated that wetlands are 75% more valuable than lakes and rivers, 15 times more valuable than forests, and 64 times more valuable than grasslands and rangelands. Steps must be taken to protect the East Calcutta Wetlands and to improve the living standards of the people residing in most interior parts of the wetland. Focused and directed developmental programmes must be evolved. Areas and target groups must be decided, specific needs must be chalked out according to priorities before any developmental funds are allocated for these areas with stakeholders' participation in the programmes. 5.9 Reference 1. D. Ghosh and S. Sen (1987) environmental Conservation vol.14(3) 2. D.Ghosh and S.Sen, "Developing waterlogged areas for urban fishery and waterfront recreation project", AMBIO, Journal of Royal Swedish Academy of Sciences vol. 21(2). 3. Purnendu, Sen, " Observations on the method of Carp Culture in the so called Salt Lakes near Calcutta, with a note on the fish Fauna of the Lakes", 2. Journal and Proceedings of Royal Asiatic Society of Bengal. Vol. VII, Third Series (Science),1941, 7-13. 4. K.G.Gupta, "Results of Enquiry into the fisheries of Bengal and into fishery matters", Bengal Secretariat Book Depot, Calcutta :65-109. 5. R.B.S.Sewell (1926)," Investigations regarding an epidemic of fish mortality in the tanks in the Indian Museum Compound". Journal. Asiatic. Soc. Bengal, XXII:177-201. 6. Constanza R., d'Arge, R., deGroot, R. et.al. " The value of the world's ecosystem services and natural capital", Nature 387,1997:253-600.

NSOU ? CC-GR-08 59 Unit 6 ? Environmental pollution and degradation: Land, water and air Structure 6.0 Objective 6.1 Introduction 6.2 Environmental pollution 6.3 Causes of Environmental Degradation 6.4 Land degradation 6.5 Water Pollution 6.6 Air Pollution: 6.7 Summary and Conclusion 6.8 References 6.9 Model Questions 6.0 Objective • This unit introduces pollution and degradation of environmental quality as an example of the interactions between natural and human systems. It will enable learners to understand environmental problems, looking at causal linkages between pollution sources, exposure pathways and impacts to environmental quality and human health. • Students will learn how to assess pollution sources, study exposure pathways, and evaluate consequences of human exposure to pollution and its impacts to environmental quality. 6.1 Introduction Environment can be defined as the physical surrounding of man/woman of which he/she is a part and on which he/she is dependent for his/her activities like physiological functioning, production and consumption. This physical environment

NSOU ? CC-GR-08 60 stretches from air, water and land to natural resources like energy carriers, soil and plants, animals and ecosystems. The relationship between physical environment and the well-being of individuals and societies is multi-fold and multi-faceted with a qualitative as well as a quantitative aspect to it. The availability and use of natural resources have a bearing on the outcome and the pace of development process. For an urbanized society, a large part of environment is man-made. But, even then the artificial environments (building, roads) and implements (clothes, automobiles) are based on an input of both labour and natural resources. The term 'Environment' is commonly restricted to ambient environment. In that view, the indoor environment (home, work place) is regarded as isolated piece of environment to be treated on its own terms. The indoor environment usually is under the jurisdiction of the Public Health authorities. Health risks are mainly linked to space heating, cooking and lighting. Low grade fuels, insufficient ventilation are often the main problems. Additionally, there may be problems connected with moisture, light, hazardous substances from building materials, lacquers and paints. Problems with drinking water, sewage and waste are not linked to the dwelling as such but rather to lack of appropriate infrastructure. 6.2

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Environmental pollution It is not a new phenomenon, yet it remains the world's greatest problem facing humanity, and the leading environmental causes of morbidity and mortality. Man's activities through urbanization, industrialization, mining, and exploration are at the forefront of global environmental pollution. Both developed and developing nations share this burden together, though awareness and stricter laws in developed countries have contributed to a larger extent in protecting their environment. Despite the global attention towards pollution, the impact is still being felt due to its severe long-term consequences.

Pollution is a very serious worldwide problem.It results in the deterioration of the quality of natural biotic and abiotic factors. Water pollution is a very big problem especially in developing countries in the world. The groundwater scarcity is quite a common phenomenon in the developing nations. Water is an indispensable resource

NSOU ? CC-GR-08 61 for human activities including water for drinking and irrigation, recreational opportunities and habitat for economically important fisheries and all urban and rural amenities. Pollution poses a serious risk to life, as polluted waters are potent agents of diseases such as cholera, typhoid, and tuberculosis. Water pollution is the contamination of water bodies, usually as a result of human activities, in such a manner that negatively affects its legitimate uses. Environmental degradation is a process through which general health of the natural environment is compromised.

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It is the deterioration of the environment through consumption of assets, like, air, water and soil.

Air pollution, water pollution, garbage accumulation, and pollution of the natural environment are all challenges for

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India. According to World Bank experts, India has made one of the fastest progresses in the world, in addressing its environmental issues and improving its environmental quality

between 1995 and 2010.

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Still, India has a long way to go to reach environmental quality similar to those enjoyed in developed economies.

Pollution remains a major challenge for India. It is one of the ten threats officially cautioned by the high-level Panel on Threats, Challenges and Change of the United Nations. The United Nations International Strategy for Disaster Reduction defines environmental degradation as "the reduction of the capacity of the environment to meet social and ecological objectives, and needs". When natural habitats are destroyed or natural resources are depleted, the environment is degraded. Efforts to counteract this problem include environmental protection and environmental resources management. 6.3

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Causes of Environmental Degradation The major causes of the environmental degradation are modern urbanization, industrialization, population growth, deforestation etc. Environmental pollution refers to the degradation of quality and quantity of natural resources. Various types ofthe human exercises are the fundamental reasons of environmental degradation.

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The smoke radiated by the vehicles and processing plants expands the measure of toxic gases noticeable all around affecting every single living being. These waste items and smoke radiated by vehicles are the fundamental driver of contamination. Spontaneous urbanization and industrialization have caused water, air and sound

pollution. So the
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ventures like Chlorofluorocarbon, nitrogen oxide, carbon monoxide and other particles pollute air. 6.4

Land degradation Land degradation is a worldwide problem. Land is a vital resource to humankind, like air and water. Land degradation, the deterioration or loss of the productive capacity of the soils for present and future, is a global challenge that affects everyone through food insecurity, higher food prices, climate change, environmental hazards, and the loss of biodiversity and ecosystem services. Land degradation is happening at an alarming pace, contributing

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to a dramatic decline in the productivity of croplands and rangelands worldwide. Land degradation is one of the world's most pressing environmental problems and it will worsen without

rapid remedial action. Globally, about 25 percent of the total land area has been degraded. When land is degraded, soil carbon and nitrous oxide is released into the atmosphere, making land degradation one of the most important contributors to climate change. Scientists recently warned that 24 billion tons of fertile soil was being lost per year, largely due to unsustainable agriculture practices. If this trend continues, 95 percent of the Earth's land areas could become degraded by 2050. Globally, 3.2 billion people are affected by land degradation, especially rural communities, small farmers, and the very poor. The world population is projected to increase by about 35 percent to 9.7 billion in 2050, with rising demands for agricultural products including food, feed, fiber, and fuel. However, pressure on the global land resource is increasing due to other factors as well, such as agricultural production systems made less resilient by the loss of biodiversity, and natural factors such as climate variability and extreme weather events. Climate change exacerbates variations in yields and income from agriculture, threatening the resilience of agro- ecosystems and stability of food production systems. The problems are particularly severe in the driest parts the planet. Dryland landscapes cover approximately 40 percent of the world's land area and support two billion people. The vast majority of people who depend on drylands live in developing countries, where women and children are most vulnerable to the impacts of land degradation and drought.
NSOU ? CC-GR-08 63 6.5 Water Pollution Water pollution is defined as, 'Any direct or indirect alteration of the physical, thermal, chemical, biological, radioactive properties of any part of the environment by, discharge, emission or deposit of wastes so as to affect any beneficial use adversely or to cause a condition, which is hazardous to public health, safety or welfare of animals, birds, wildlife, aquatic life or to plants of every description' (Environment Act of 1980). Water pollution occurs when harmful substances—often chemicals or microorganisms—contaminate a stream, river, lake, ocean, aquifer, or other body of water, degrading water quality and rendering it toxic to humans or the environment. Causes of Water Pollution Water is uniquely vulnerable to pollution. Known as a "universal solvent," water is able to dissolve more substances than any other liquid on earth. It is also why water is so easily polluted. Toxic substances from farms, towns, and factories readily dissolve into and mix with it, causing water pollution. Categories of Water Pollution Groundwater When rain falls and seeps deep into the earth, filling the cracks, crevices, and porous spaces of an aquifer (basically an underground storehouse of water), it becomes groundwater, one of our least visible but most important natural resources. Nearly 40 percent of Americans rely on groundwater, pumped to the earth's surface, for drinking water. For some folks in rural areas, it is their only freshwater source. Groundwater gets polluted when contaminants from pesticides, fertilizers and wastes leached from land fills and septic systemsmake their way into an aquifer, rendering it unsafe for human use. Ridding groundwater of contaminants can be difficult to impossible, as well as costly. Once polluted, an aquifer cannot be used for decades, or even thousands of years. Groundwater can also spread contamination far from the original polluting source as it seeps into streams, lakes, and oceans. Surface water Covering about 70 percent of the earth, surface water is what fills our oceans, lakes, rivers, and all those other blue bits on the world map. Surface water from

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NSOU ? CC-GR-08 64 freshwater sources (that is, from sources other than the ocean) accounts for more than 60 percent of the water delivered to American homes. But a significant pool of that water is in peril. According to the most recent surveys on national water quality from the U.S. Environmental Protection Agency, nearly half of our rivers and streams and more than one-third of our lakes are polluted and unfit for swimming, fishing, and drinking. Nutrient pollution, which includes nitrates and phosphates, is the leading type of contamination in these freshwater sources. While plants and animals need these nutrients to grow, they have become a major pollutant due to farm waste and fertilizer runoff. Municipal and industrial waste discharges contribute their fair share of toxins as well. There is also all the random junk that industry and individuals dump directly into waterways. Ocean water Eighty percent of ocean pollution (also called marine pollution) originates on land, whether along the coast or far inland. Contaminants such as chemicals, nutrients, and heavy metals are carried from farms, factories, and cities by streams and rivers into our bays and estuaries; from there they travel out to sea. Meanwhile, marine debris, particularly plastic, is blown in by the wind or washed in via storm drains and sewers. Our seas are also sometimes spoiled by oil spills and leaks and are consistently soaking up carbon pollution from the air. The ocean absorbs as much as a quarter of man-made carbon emissions. Point source When contamination originates from a single easily identified source, it is called point source pollution. Examples include wastewater (also called effluent) discharged legally or illegally by a manufacturer, oil refinery, or wastewater treatment facility, as well as contamination from leaking septic systems, chemical and oil spills, and illegal dumping. The EPA regulates point source pollution by establishing limits on what can be discharged by a facility directly into a body of water. While point source pollution originates from a specific place, it can affect miles of waterways and ocean. Nonpoint source Nonpoint source pollution is contamination derived from diffuse sources. These may include agricultural or stormwater runoff or debris blown into waterways from
NSOU ? CC-GR-08 65 land. Nonpoint source pollution is the leading cause of water pollution, but it is difficult to regulate, since there is no single, identifiable culprit. Transboundary Water pollution cannot be contained by a line on a map. Transboundary pollution is the result of contaminated water from one country spilling into the waters of another. Contamination can result from a disaster, like an oil spillor the slow, downriver creep of industrial, agricultural, or municipal discharge. The Most Common Types of Water Contamination Agricultural The agricultural sector is the biggest consumer of global freshwater resources. With farming and livestock production this sector uses about 70 percent of the earth's surface water supplies. But it is also a serious water polluter. Around the world, agriculture is the leading cause of water degradation. In the United States, agricultural pollution is the top source of contamination in rivers and streams, the second-biggest source in wetlands, and the third main source in lakes. It's also a major contributor of contamination to estuaries and groundwater. Every time it rains, fertilizers, pesticides, and animal wastes from farms and livestock operations wash nutrients and pathogens into waterways. Nutrient pollution, caused by excess nitrogen and phosphorus in water or air, is the number-one threat to water quality worldwide and can cause algal blooms, a toxic soup of blue-green algae that can be harmful to people and wildlife. Sewage and wastewater Used water is wastewater. It comes from our sinks, showers, and toilets and from commercial, industrial, and agricultural activities (metals, solvents, and toxic sludge). The term also includes stormwater runoff, which occurs when rainfall carries road salts, oil, grease, chemicals, and debris from impermeable surfaces into our waterways More than 80 percent of the world's wastewater flows back into the environment without being treated or reused, according to the United Nations. In some least developed countries, the figure tops 95 percent. In the United States, wastewater treatment facilities process about 34 billion gallons of wastewater per day. These facilities reduce the amount of pollutants such as pathogens, phosphorus, and nitrogen in sewage, as well as heavy metals and toxic chemicals in industrial waste,

NSOU ? CC-GR-08 66 before discharging the treated waters back into waterways. That is when all goes well. But according to EPA estimates, our nation's aging and easily overwhelmed sewage treatment systems also release more than 850 billion gallons of untreated wastewater. Oil pollution Big spills may dominate headlines, but consumers account for the vast majority of oil pollution in our seas, including oil and gasoline that drips from millions of cars and trucks every day. Moreover, nearly half of the estimated 1 million tons of oil that makes its way into marine environments each year comes not from tanker spills but from land-based sources such as factories, farms, and cities. At sea, tanker spills account for about 10 percent of the oil in waters around the world, while regular operations of the shipping industry through both legal and illegal discharges contribute about one-third. Oil is also naturally released from under the ocean floor through fractures known as seeps. Radioactive substances Radioactive waste is a type of hazardoud waste that contains radioactive material. It emits radiation. It is generated by uranium mining, nuclear power plants, and the production and testing of military weapons, as well as by universities and hospitals that use radioactive materials for research and medicine. Radioactive waste can persist in the environment for thousands of years, making disposal a major challenge. In decommissioned Hanford nuclear weapons production site in Washington, the clean up of 56 million gallons of radioactive waste is expected to cost more than $100 billion and last through 2060. Accidentally released or improperly disposed of contaminants threaten groundwater, surface water, and marine resources. What Are the Effects of Water Pollution? On human health Water pollution kills. Contaminated water can also make people ill. Every year, unsafe water sickens about 1 billion people. Low-income communities are disproportionately at risk because their homes are often closest to the most polluting industries. Waterborne pathogens, in the form of disease-causing bacteria and viruses from human and animal waste, are a major cause of illness from contaminated drinking
NSOU ? CC-GR-08 67 water. Diseases spread by unsafe water include cholera, giardia, typhoid, hepatitis and various other diseases. Even in wealthy nations, accidental or illegal releases from sewage treatment facilities, as well as runoff from farms and urban areas, contribute harmful pathogens to waterways. On the environment In order to thrive, healthy ecosystems rely on a complex web of animals, plants, bacteria, and fungi, all of which interact, directly or indirectly, with each other. Harm to any of these organisms can create a chain effect, imperiling entire aquatic environments. When water pollution causes an algal bloom in a lake or marine environment, the proliferation of newly introduced nutrients stimulates plant and algae growth, which in turn reduces oxygen levels in the water. This dearth of oxygen, known as eutrophication, suffocates plants and animals and can create "dead zones," where waters are essentially devoid of life. In certain cases, these harmful algal blooms can also produce neurotoxins that affect wildlife, from whales to sea turtles.Chemicals and heavy metals from industrial and municipal wastewater contaminate waterways as well. These contaminants are toxic to aquatic life, most often reducing an organism's life span and ability to reproduce. Marine ecosystems are also threatened by marine debris, which can strangle, suffocate, and starve animals. Much of this solid debris, such as plastic bags and soda cans, gets swept into sewers and eventually drains out to sea, turning our oceans into trash soup and sometimes consolidating to form floating garbage patches. Discarded fishing gear and other types of debris are responsible for harming more than 200 different species of marine life. Meanwhile, ocean acid ification is making it tougher for shellfish and coral to survive. Though they absorb about a quarter of the carbon pollution created each year by burning fossil fuels, oceans are becoming more acidic. This process makes it harder for shellfish and other species to build shells and may impact the nervous systems of sharks, clownfish, and other marine life. Prevention of Water Pollution It is easy to disapprove the oil company with a leaking tanker, but we are all accountable to some degree for today's water pollution problem. Fortunately, there are some simple ways that can prevent water contamination.

NSOU ? CC-GR-08 68 Plastic consumption should be reduced. Chemical cleaners, oils, and non-biodegradable items should be properly disposed. Car should not leak oil. Every yard should come under landscaping that reduces runoff without apply in gpesticides and herbicides. 6.6 Air Pollution Air is essential for life it self; without it we could survive only a few minutes. It constitutes immediate physical environment of living organisms. It is a mixture of various gases like nitrogen, oxygen and carbon dioxide, and others in traces; along with water vapor perceptible as humidity and suspended solids in particulate form. The atmosphere is layered in to four distinct zones of contrasting temperature due to differential absorption of solar energy. The four atmospheric layers are: Troposphere, stratosphere, mesosphere, and thermosphere. Understanding how these layers differ and what creates them helps us understand atmospheric function. Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentrations that they can produce undesirable effects on man and his environment. These substances include gases (SO_2, NO_2, CO, HCs, etc) particulate matter (smoke, dust, fumes, aerosols) radioactive materials and many others. Most of these substances are naturally present in the atmosphere in low (background) concentrations and are usually considered to be harmless. Thus, a particular substance can be considered as an air pollutant only when its concentration is relatively high compared with the back ground value and causes adverse effects. Air pollution is a problem of obvious importance in most of the world that affects human, plant and animal health. For example, there is good evidence that the health of 900 million urban people suffers daily because of high levels of sulfur dioxide concentrations. Air pollution is one of the most serious environmental problems in societies at all level of economic development. Air pollution can also affect the properties of

NSOU ? CC-GR-08 69 materials (such as rubber), visibility, and the quality of life in general. Industrial development has been associated with emission to air of large quantities of gaseous and particulate emissions from both industrial production and from burning fossil fuels for energy and transportation. When technology was introduced to control air pollution by reducing emissions of particles, it was found that the gaseous emissions continued and caused problems of their own. Currently efforts to control both particulate and gaseous emissions have been partially successful in much of the developed world, but there is recent evidence that air pollution is a health risk even under these relatively favourable conditions. In societies that are rapidly developing sufficient resources may not be invested in air pollution control because of other economic and social priorities. The rapid expansion of the industry in these countries has occurred at the same time as increasing traffic from automobiles and trucks, increasing demands for power for the home, and concentration of the population in large urban areas called mega cities. The result has been some of the worst air pollution problem in the world. In many traditional societies, and societies where crude household energy sources are widely available, air pollutionis a serious problem because of inefficient and smoky fuels used to heat buildings and cook. This causes air pollution both out door and indoors. The result can be lung disease, eye problems, and increased risk of cancer. The quality of air indoors is a problem also in many developed countries because buildings were built to be airtight and energy efficient. Chemicals produced by heating and cooling systems accumulate indoors and create a pollution problem. Types of Air pollution i) Primary pollutant: Pollutants that are emitted directly from the human or natural activities are known as primary pollutant. For example, CO_2, SO_2, NO_x, particulate matter, hydrocarbons etc. ii) Secondary pollutant: When primary pollutants react with atmospheric moisture content, a new category of pollutants forms. These are known as secondary pollutants. For example, carbonic acid, nitric acid, sulphuric acid etc.

NSOU ? CC-GR-08 70 Cause of Air pollution a) Urbanization b) Population growth c) Deforestation d) Industrialization e) Vehicle emission Major Air pollutants and their effects a) The concentration of carbon dioxide increases in atmosphere due to emission from vehicles, burning of fossil fuel, emission from volcano, industries, agricultural activity etc. It increases green house effect which causes global warming and climate change. b) Carbon monoxide releases after incomplete combustion of fossil fuel or other product. The source of CO is vehicle emission, burning of coal, biomass combustion etc. CO causes headache, dizziness, heart failure (in blood CO combines with oxygen which reduced the affinity of haemoglobin towards oxygen), etc. c) Sulphur dioxide releases from oil refineries, volcanic eruption, and chemical industries etc. Sulphur dioxide reacts with moisture to form secondary pollutant which causes eye irritation. It can also cause allergic reaction and asthma. d) Tetraethyl lead is used as anti-knocking agents in petrol, gasoline and jet fuel for smooth function. Lead particles are coming out from the exhaust of vehicle and mixed with air. It causes injurious effect on kidney and liver. It also lowers down the intelligence power in children. e) Nitrogen oxide releases from vehicle exhausts, volcanic eruption, lighting etc. It also reacts with moisture content present in atmosphere and causes eye irritation. Techniques used for prevention of Air pollution i) Filters remove particulate matter from the gas stream. Bag house filter system is the most common and it is made up of cotton fibers. When

NSOU ? CC-GR-08 71 polluted gas passed through it, polluted gases are deposited on cotton fibers. ii) Electrostatic scrubber: The emitting dust is charged with ions and ionized particulate matter is collected on oppositely charged surface. The collected particles are removed by shaking the surface. iii) Scrubbers are wet collectors. They remove aerosol from a stream of gas either by collecting wet particle on a surface. 6.7 Summary and Conclusion The quality of air at various locations is monitored regularly by government and other agencies. We can use this data to generate awareness about air pollution among friends and neighbours. There is a need to switch over to alternative fuels instead of the fossil fuels for our energy requirements. These could be solar energy, hydropower and wind energy.Small contributions on our part can make a huge difference in the state of the environment. 6.8 References 1. Millennium Ecosystem Assessment, pp. 42–47 2. World Wide Fund for Nature (2008). Living Planet Report 2008. Retrieved on: 2009-03-29. 3. World Resources Institute (1998). World Resources 1998–1999. Oxford: Oxford University Press. ISBN 0-19-521408-0. 6.9 Model Questions 1. What are the different ways in which water gets contaminated ? 2. At an individual level, how can you help reduce air pollution? 3. Clear, transparent water is always fit for drinking. Comment. NSOU ? CC-GR-08 72 4. You are a member of the municipal body of your town. Make a list of measures that would help your town to ensure the supply of clean water to all its residents. 5. Explain the differences between pure air and polluted air. 6. Explain circumstances leading to acid rain. How does acid rain affect us? 7.

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Which of the following is not a greenhouse gas? (a)

Carbon dioxide (b) Sulphur dioxide.(c) Methane (d) Nitrogen 8. Describe the 'Green House Effect' in your own words. 9. Describe the threat to the beauty of the Taj Mahal. 10. Why does the increased level of nutrients in the water affect the survival of aquatic organisms?
NSOU ? CC-GR-08 73 Unit 7 ?
Space–time hierarchy of environmental problems: Local, regional and global
Structure 7.0 Objective 7.1 Introduction 7.2 What is Environment? 7.3 Environmental issues 7.4 Solution to Waste Disposal : Eco responsibility—"reduce, reuse, recycle" 7.5 Summary and Conclusion 7.6 Reference 7.7 Model Questions 7.0 Objective • The learners will know about the environmental problems that occur globally. As economic growth and development continues, the environmental impacts increases from local to regional, national, international and even global scale. 7.1 Introduction

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Human activities in past decades have raised serious issues related to environment and its conservation. Air pollution, poor management of its waste, growing water scarcity, falling ground water tables, water pollution, waste disposal, desertification, endangered species, preservation and quality of forest, biodiversity loss, and land/soil degradation, global climate change, pollution, environmental degradation, global warming, greenhouse effect, acidification, ozone depletion and other local, regional and global level environmental problems. Genetically modified foods are the current environment problem that make us vulnerable to disasters and tragedies now and in the future.

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In this chapter the essential aspects of environmental problems, causes, effects will be reviewed with some prescribed solutions to overcome from the environmental issues.

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NSOU ? CC-GR-08 74 The scale of spatial resolution is also important. Often the early models of the environment developed in the 1960s and 1970s were aspatial, i.e., no geographical dimensions were explicitly incorporated into their structure. With the development of more powerful computers and software packages it has become possible to include spatial disaggregation into modelling efforts. The development of Geographical Information Systems (GIS) is based essentially on relational databases with an explicit geographical set of co-ordinates that has been a major development in modeling spatial aspects of the "real world". Today, many models do include spatial dissaggregated data and can display the information at local, regional, national, international and global levels of resolution. 7.2.

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What is Environment? The word environment refers to all ecological units which are naturally present on earth in the form of land, water, air, soil, forest, sunlight, minerals, living organisms etc. This earth is full of natural surroundings, some are biotic and some are non-biotic. Biotic elements are those elements like human, birds, animals, plants, and microorganisms. Whereas non-biotic elements are those which have no life like air, sunlight, water, land, soil, minerals etc., furthermore, it is also divided among four different spheres viz. biospheres, lithosphere, atmosphere and hydrosphere. Hydrosphere is the largest part on the earth among all life on earth.

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Currently, the situation of environment is very poor that could never be imagined by our ancestor in earlier time. We have endlessly spoilt our environment by using its resources in

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very wrong way. We can see that every day and everywhere pollution is rapidly increasing on earth where it is air, land, water or soil pollution, deforestation, acid rain, and other dangerous disasters that have been created by the humans through technological advancement. Use of natural resources should be carefully planned and executed for providing a better and healthy life to our forth coming generation. 7.3

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Environmental issues An environmental problem occurs when there comes a change in quality or the quantity of the environmental factors that directly or indirectly affect everything on

NSOU ? CC-GR-08 75 earth. "Environmental issues are defined as problems within

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the planet system (air, water, soil etc.) that have developed as a result of human interference or mistreatment of the planet." A variety of environmental problems now affect our entire world. As globalization continues and the earth's natural processes transform local problems into international issues. Some largest problems now affecting the world are: acid rain, air pollution, global warming, hazardous wastes, ozone depilation, smog, water pollution, overpopulation and rain forest destruction. It is related to not only environment but also with everyone that lives in the planet. It affects every human, animal, and nation on this planet. Human have faced poor environmental conditions throughout history, but what we think of as environmental problems become more common and apparent with industrialization and urbanization. In the United States for example, air and water pollution from the factories and dense urban living conditions attracted growing attention throughout the last centuries, and by the 1960s become recognized as significant problems. Air and water pollution rapidly spread to a range of other conditions- soil erosion, pesticides contamination, deforestation, declining animal population and species and so on. Environmental scientists, activists, and policy-makers

constantly alerted over the issues. Finally, a global environmental problem is greenhouse effect. Whoever introduces carbon dioxide and other gases into the atmosphere, the source causes atmospheric increase of such gases everywhere. Right now carbon dioxide concentration is over 400 ppm and still increasing. This is a global problem.

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These diverse concerns gradually merge into environmental problems, and the 1970 Earth Day in United States and then the 1972 United Nation Conference on the Human Environment in Stockholm helped turn "Environmental Quality" into a major international issue. By the time of the United Nation Conference on Environment and Development in Rio De Janeiro in 1992, significant "Green Parties" had been formed in Europe and environmental problems were the subject of citizen and governmental attention worldwide. Environmentalist, a social and environmental movement addresses environmental issues through advocacy, education and activism. The environmental issues can occurs at three levels, local, regional and global. Local environmental issues- Some major local environmental issues are given below-1. Pollution, 2. Waste Disposal, 3. Desertification, 4. Water Scarcity, 5. Endangered Species NSOU ? CC-GR-08 76 1. Pollution: Pollution can be defined as an undesirable addition of constituents to water, land, air which adversely affect human life, species, living conditions and will deteriorate our resources. Pollution can be classified mainly into four categories air pollution, water pollution, soil pollution, noise pollution. The pollution occurs at the local and also global level. Air pollution: Air pollution refers to any physical, chemical and biological change in the air. It is the contamination of air by harmful gases, dust and smoke which affect plants, animals, and humans drastically. There is a certain percentage of gases present in the atmosphere. Major air pollutants, their sources and their impact: Carbon monoxide (CO): Its main source is fuel combination from engines and vehicles. It reduces the amount of oxygen, aggravate heart disease, chest pain. Lead (Pb): It releases from metal refineries and other metal industries, waste incinerators. It impacts on our nervous system, results in IQ loss, cardiovascular and renal effects in adult, effects related to an aemia. Nitrogen oxide: It is released in environment by fuel combustion, wood burning. It mainly enhances lung diseases leading to respiratory symptoms that increase susceptibility to respiratory infection. Sulphur dioxide (SO_2): It is released by fuel combustion as well as natural occurrences like volcanoes. It causes asthma and breathing difficulty.

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Air pollution control: The techniques employed to reduce or eliminate the emission into the atmosphere of substances that can harm the environment or human health. Different types of

methods are in

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use for the air pollution control –control of particulates airborne particles can be removed form a polluted airstream by a variety of physical process. Some common types of equipment for collecting fine particulates includes cyclones, scrubbers, electrostatic precipitators, and baghouse filters. Once collected, particulates adhere to each other, forming agglomerates that can readily be removed from equipment and disposed of, usually in landfill. Control of gases- gaseous criteria pollutants, as well as volatile organic compounds (VOCs) and other gaseous air toxics, are controlled by means of three basic techniques, absorption, adsorption and incineration. These techniques can be employed singly or in combination. They are effective against the major greenhouse gases as well. In addition, a fourth NSOU ? CC-GR-08 77 technique, known as carbon sequestration, is in development as a means of controlling carbon dioxide levels. b) Water pollution: Water pollution is the contamination of pollutants in water bodies like lakes, rivers, oceans, aquifers and groundwater without treatment very often by human activities that lead to harmful effects. Source of water pollution: Natural sources: These include decay

and decomposition

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of plants and animals, volcanic eruptions, coastal, cliff erosion, landslides and soil erosion. Anthropogenic sources: This includes industry, urban, agricultural and cultural sources. Effect of water pollution: Death of aquatic animals. Irrigation by polluted water affects plants resulting in yellowish coloration and defoliation. Diseases- hepatitis, cholera, typhoid, jaundice, diarrhoea and skin diseases. Disruption of food chains. Destruction of ecosystems. Control measure of water pollution: 1.Water pollution, to a larger extent, can be controlled by a variety of methods. Rather than releasing sewage waste in water bodies, it is better to treat them before discharge. Practicing this can reduce the initial toxicity and the remaining substances can be degraded by the water bodies itself. If the secondary treatment of water has been carried out, then this can be reused in sanitary systems and agricultural fields. Some chemical methods that help in the control of water pollution are precipitation, the ion exchange process, reverse osmosis and coagulation. As an individual, reusing, reducing, and recycling wherever possible will advance a long way in overcoming the effects of water pollution. 2. Waste Disposal: Waste disposal is the collection, processing and recycling or deposition of waste material of human society. Waste is classified by source and composition. Waste materials are either liquid or solid in form, and their components may be either hazardous or inert in their effects on health and environment. We used plastic bag, broken glass, obsolete cell phone, or used battery cells.

These are all used
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products that require appropriate disposal to limit their harm to the environment. The term waste is typically applied to solid waste, sewage, hazardous waste, and electronic waste. Sources of waste: Medical or clinical sources of wastes include the surgical items, pharmaceuticals, blood, body parts, wound dressing materials, needles, syringes. • Agricultural sources of wastes: Wastes generated by agricultural activities, include horticulture, livestock breeding, market gardens and seedling nurseries. • Industrial sources of wastes: These are released from manufacturing and processing industries like chemical plants, cement factories, power plants, textile industries, petroleum industries. Wastes from construction or demolition

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concrete debris, wood, huge package boxes. Some other sources such as commercial sources, mining sources, radioactive sources, electronic sources are also the big sources of waste pollution. Waste disposal problems: Production of too much waste, one of the major problems, related to disposal is attributed to the generation of too much waste. Mumbai and Delhi generate about 11,000 and 8,700 tones of solid waste per day, respectively. India is getting buried under mounds of garbage as the country has been generated more than 1.50 lakh metric tonnes of solid waste every day.

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Most of the waste is toxic and harmful for the human beings and the environment. The majority of the states and local authority legislations are generally lax on regulating toxic industrial products that end up getting thrown away after use. Most of the products contain hazardous and health threatening chemicals. This chemical causes majority of water pollution, soil pollution. Landfills are a problem as well. Most landfills lack proper on-site waste management, thereby contributing to additional threats to the environment. In long term, landfills leak and pollute ground water and other neighbouring environment habitat making waste disposal very difficult. They also release potentially unsafe gases. 7.4

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Solution to Waste Disposal: Eco responsibility –"reduce, reuse, recycle" Eco-responsibility pertains to the "three Rs" mantra of reuse, reduce and recycle. Local communities' authorities and state need to put more efforts towards the NSOU ? CC-GR-08 79 education of waste management. Effective waste disposal and management ensures a gradual improvement of new and cost- effective facilities which aim to encourage higher environmental protection standards. Landfills are generally located to ease waste collection, transfer, and monitoring or recycling. Thousand of tonnes of construction and demolition materials are generated by various local construction industries. In most of

the cases,

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a large portion of these waste materials can be re used, reclaimed or recycled. With the control and monitoring of land filling and fly tipping activities in the area of public work, constructions and demolition materials can be resourcefully reclaimed, reused or recycled in other projects such as landscaping, village houses, recreation facilities, car parks,

and

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roads.· Waste diversion plans- A multifaceted approach on waste transfer and diversion in terms of more hygienic and efficient waste disposal management can offer tremendous solution to waste problems. Improvement of thermal waste treatment has been proved not to be 100% green as they are normally pronounced. Therefore, to mitigate the problems that come with thermal waste treatment issues such as emission of toxic gases with organic compounds such as furans, PAHs, and dioxins, states and researches as well as green groups and academicians can explore the possible developments with regards to advanced thermal waste treatment techniques. 2. Desertification– Desertification is a type of land degradation in dry lands in which biological productivity is lost due to natural processes or induced by human activities by which fertile areas become increasingly more arid. It is the spread of arid areas caused by a variety of factors, such as through climate change and through the overexploitation of soil through human activity. Various causes of desertification- • Overgrazing – if there are too much animals that

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that are overgrazing in certain spots it makes it difficult for the plant

to

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grow back, which hunts the biome and make it loss its former green glory. • Deforestation- wood extraction, and infrastructure expansion such as road building and urbanization

contribute to the problems related to desertification. •

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Farming practice- some farmers do not know how to use the land effectively. They may essentially strips the land of everything that it has, before moving

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another plot of land. By stripping the soil of its nutrients, desertification becomes more of a reality for the area that is being used for the farming.

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Excessive use of fertilizers and pesticides- the use of excessive amount of fertilizer and pesticides to maximize to their crop yields in the short term often lead to significant damages for the soil. In the long run, this may turn from arable into arid land over time and not suitable for the farming. • Over drafting of ground water is a process in which groundwater is extracted in excess of the equilibrium yield of the aquifer that is pumping or pulling excessive groundwater from underground aquifers. Its depletion causes desertification. • Climate change plays a huge role in desertification. As the days get warmer and periods of drought become more frequent, desertification becomes more and more eminent. Unless climate change is slowed down, huge areas of land will become desert. • There are also some reasons such as natural disasters, soil pollution, overpopulation and excessive consumptions, mining etc.

that cause desertification.

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Effects of desertification- • Farming becomes next to impossible. It is impossible to grow sustainable crops without special technologies. This can cost a lot of money to try.So many farmers will have to sell their desert land.

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Flooding is a lot more imminent. Not all desert are dry; those that are wet could experience a lot of flooding because there is nothing to stop the water from gathering and going all over the place. • Biodiversity loss: Endangerment and extinction of species, the destruction of habitats and desertification may also contribute to a loss of biodiversity. Many species will not

be able

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to adjust to the altered environmental conditions and may suffer from serious decline in population. • Migration: When large areas of land that were used for farming will no longer be suitable for farming due to many reasons results in serious migration movements. Solution to desertification: • Policy change related to how much people can farm and how much they can farm on a certain area could be put into place to help reduce the problems that are often associated with farming and desertification. NSOU ? CC-GR-08 81 • Education: In developing countries, education is an incredibly important tool that needs to be utilized in order to help people to understand the best way to use the land that they are farming on. By educating them on sustainable practices, more land will be saved from becoming desert. Research and application of the latest technology can limit the desertification process. • Mining often implies the destruction of large area of land. Therefore, it should be regulated by governments to keep the nature reserves intact and protect the natural habitats of animals, plants and micro-organisms. Thus, the desertification issues can be mitigated to a certain extent. Reforestation: The area that have been subject to deforestation in past should be considered for reforestation. Planting trees in those areas are quite important since they are natural carbon dioxide storage spaces; they slow down the global warming and contribute to maintaining a natural balance. Therefore, planting trees in the affected areas not only prevents desertification but also fight against additional environmental issues. 4. Water Scarcity: Water scarcity involves water crisis, water shortage, water deficit or water stress. Water scarcity can be due to physical water scarcity and economic water scarcity. Physical water scarcity refers to a situation where natural water resources are unable to meet a region's demand while economic water scarcity is a result of poor management of water resources. "Water scarcity is the lack of sufficient available water resources to meet the demands of water usage within a region.

Almost two thirds of the world's population experience severe water crisis for

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at least one month each year. More than 1.2 billion people lack access to clean drinking water. Causes of water scarcity: • Overuse of water is a huge issue that a lot of people are dealing with. It may be overused on people, animals, land or many other numbers of things. • Pollution of water can occur from a variety of sources. Pollution comes from oil, carcasses, chemicals, industrial wastes, and from municipality waste. •

Global warming: Increase of average air temperature may contribute to drying up of water bodies due to rising evaporation rate.
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Illegal dumping: Industries frequently dispose of their industrial garbage into

near by

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river and lakes since it is an easy and cheap way to get rid of this waste. It leads to serious water pollution, which may result in water scarcity for local people. • Natural disasters like tsunamis, floods may also cause serve water shortages for local people since important public infrastructure may be destroyed. •

Drought is a prolonged period of abnormally low rainfall, leading to a shortage of water.

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Some areas are in a perpetual drought, whereas other areas may be dealing with drought on occasion.

It can last for months or years. It has substantial impact on the ecosystem and agriculture of the affected region.

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Effects of water scarcity: Lack of access to drinking water

is the biggest problem that may occur due to

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water scarcity. People are not able to get fresh, clean drinking water. • Hunger and poverty:

Water scarcity has a direct impact on rain-fed and irrigated agriculture as well as livestock. It leads to food shortages which in turn stuck People in hunger and poverty as well. • Diseases and sanitation issues: Access to clean water is necessary to get rid of water-borne diseases. •

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Destruction of habitats and loss of biodiversity: Water is crucial for all life forms on our planet. If water scarcity persists over a longer period, it leads to the destruction of whole habitats. Animals and plants may no longer be able to get enough water and may therefore die or have to move to other regions. Some animals become extinct. They no longer be able to grow and reproduce in a sufficient manner causing serious biodiversity loss. Solutions to control water scarcity • Save water whenever possible: This could mean limiting the use of water, the use of washing machines, taking short showers instead of full baths. •

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Recycle water:There are plenty of technologies available that allow to recycle rainwater and other water that can be used in residential areas. Not only does it help to prevent scarcity, but it can save some money as well.

Water can be conserved using advance technology.
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Improve practices related to farming: Farming and irrigation are often a huge culprit when it comes to water scarcity. Because of that, we need to improve practices so that we don't use as much water and those who are using water are using it to fullest potential. • Less use of chemical in farming: At present, excessive levels of chemical fertilizers and pesticides are used to maximize crop yields. It leads to serious soil pollution, which in turn translates into groundwater pollution and contributes to the water scarcity issue. It is crucial that farmers reduce the use of chemicals for farming to ensure clean water and reduced water shortage problem. • Improve sewage systems: Clean drinking water starts with a good sewage system. Without proper sanitation, the water in an area becomesridden with disease and any number of other problems. By improving thesewage sys- tems, we canprevent water scarcity from becoming worse. • Better water distribution infrastructure: Many people worldwide, especially in poor developing countries, are still not connected to the public water infrastructure. These people are at high risk to suffer from severe water shortages. By connecting these people to the public water supply, water scarcity risk could be greatly reduced. 7.5

Summary and Conclusion All of us are inheritors of common global environment.All of us are responsible for its growing deterioration. If the deterioration exceeds alimit, it shall be a dangerous place to live in.Pollution, ozone-hole, greenhouse effect, desertification, loss of biodiversity, oil spills,nuclear disasters, hazardous waste management, are some of the global environmentalproblems that need immediate collective attention. Increased human activity, urbanisation, industrialisation are led to rapid deteriorationof the environment. This has severely affected the life supporting system. 7.6 Reference 1. Alcamo J. (1994). IMAGE2.0 Integrated Modelling of Global Environmental Change. Kluwer Academic Press, Dordrecht. [Update of IMAGE1.].
NSOU ? CC-GR-08 84 2. Alcamo J, Leekmans R and Kreileman E (Eds.) (1998). Global Change Scenarios of the 21st Century Results from the IMAGE2.1 Model, Oxford: Pergamon, xii + 296 pp. [A major reference to recent work with IMAGE2.1.] 3. Arrhenius S. (1896). On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground. Philosophical Magazine, 41, 237-76. [An early paper predicting global warming due to CO2 in the atmosphere.] 4. Harvey D. (1969). Explanation in Geography. London: Arnold. [A good exposition of explanation.] 5. Turner B. L. (Ed.) (1990). The Earth as Transformed by Human Activity. Cambridge: Cambridge University Press. [Detailed study of human activities and their impact on the rest of the planet.] 6.https://www.researchgate.net/publication/345674317_ENVIRONMENTAL_ISSUES_LOCAL_REGIONAL_AND_GLOBAL_ENVIRONMENTAL_ ISSUES 7.7 Model Questions 1. Why do you think environmental issues are of global significance? 2. Enumerate at least 3 environmental issues that confront us today. 3. Define global warming. 4. Why is green-house effect called so? 5. Which kind of radiations are not reflected back out of atmosphere causing greenhouse effect? 6. Name four green-house gases.
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Unit 8 ? Urban environmental issues with special reference to waste management
and rural environmental issues with special reference to sanitation and public health Structure 8.0 Objective 8.1 Introduction 8.2 Some important environmental problems in urban areas 8.3 Waste management or waste disposal 8.4 Rural Environmental Issues 8.5 Summary and Conclusion 8.6 Reference 8.0 Objective The learners will get an overview of the urban and rural environmental problem. 8.1 Introduction Urban areas are considered as the cradles of human civilization and culture. These are also considered as centres for consumption and products of emissions, solid waste and sewage because population in urban centres is growing day by day not only in India but also all over the world. Urban Environmental issues are harmful effects of mankind on the biophysical environment. Environmental degradation, pollution, climate change, noise from traffic or neighbours, congestion, shortage of basic amenities, health problems etc., are some environmental problems in urban areas. These urban areas have their characteristic problems such as explosive increases in population, gross inadequacy
NSOU ? CC-GR-08 86 of infrastructural facilities and services, overcrowding and traffic congestion, crumbling old city centres, neighbourhood degradation, etc. They are also congested, chaotic, squalid and unpleasant. At the same time they provide better employment opportunities, higher income levels, better education, health and social services. Various types of problems like shortage of housing and sanitation, growth and expansion of slums, environmental pollution, urban poverty, lack of pure drinking water, unemployment, poor public transport, improper treatment of sewage, uncollected solid waste, etc. are at present people are facing due to urbanization. These problems are not all of recent making and becoming threats to people's present and future wellbeing. According to Census 2011, India's Urban population is 377 million and world's urban population is 3.6 Billion. The proportion of urban population raised from 28% to 31% during 2001-2011, while the proportion of rural population declined from 72% to 69%. Thisrapid urban population growth exerts more pressure on environment. In developing countries like India, natural population increase and rural to urban migration are significant factors in the growth of towns/ cities. Improved medical felicities, better sanitation and improved food supplies are the reasons for population to grow, whereas migration caused by poverty drives people from the rural to urban areas in search of employment, food, shelter and education. In rural areas, people become victims of unpredictable weather conditions like drought and floods, which can affect their livelihood. Due to this, many farmers from villages move to cities in search of jobs and other facilities. In contrast, cities offer job opportunities and other services. 8.2 Some important environmental problems in urban areas a. Solid waste : Urban areas consume large quantities of materials and release a lot of garbage. It includes domestic, municipal and industrial solid waste. Stagnation of solid wastes for many days releases poisonous gases with pungent smell that causes different vector borne diseases. NSOU ? CC-GR-08 87 b. Depletion of natural resources :The consumption of natural resources is very high in urban areas creating shortage of electricity, drinking water, Space etc.. c. Destruction of Habitats: A lot of agricultural and forest lands are decreasing due to expansion of towns and cities eliminating habitats to many animals and birds. d. Water pollution :Ground water contamination occurs due to sewage obtained from domestic, commercial and industrial buildings. Water containing lead can cause serious damage to the brain, kidneys, nervous system and red blood cells. Chemicals, gasoline, oil etc. get into the groundwater and become unsafe for human use. e. Air pollution: Most of the urban areas are prone to air pollution due to automobiles, industries and human induced activities. Automobiles emit gases like carbon monoxide, carbon dioxide, hydrocarbons, oxides of Nitrogen and Sulphur, toxic substances as fine particles and vapors of organic compounds. There are more adverse effects of these pollutants on wellness and environment. Ozone is a concern of air pollution which damage in the upper atmosphere. Chloro-Fluro carbons are responsible for ozone depletion. Fluorinated greenhouse gases (F-gases) are powerful greenhouse gases that trap heat in the atmosphere and contribute to global warming. f. Sound pollution: Sound pollution is the propagation of noise that has become a part of urban life. Sound in urban areas produced by automobiles, social functions industries etc. creates noise pollution. This pollution causes psychological and physical health hazards. Noise can increase stress, which over the long period can lead to heart disease, high blood pressure, stroke, deafness etc. g. Rise in Temperature: Temperature increases drastically in urban areas due to unplanned construction of apartments and large buildings. These buildings absorb and emit solar radiation which causes many health problems.

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NSOU ? CC-GR-08 88 h. Growth of Slums : Rapid growth of urbanization and industrialization has resulted the growth and spread of slums. These are densely populated areas where living conditions are not good. The expansion of slums happens due to migration of rural population to urban areas for employment. Human interactions with the environment: Human activities have always resulted in waste production. As population and purchasing power of people increases worldwide, more goods are produced to meet increasing demand, thereby leading to the production of more waste. These continuous flows of waste resulting from human activities, overburdened the environment. Proper planning is required to prevent the negative impact of waste on the environment. Thus waste management particularly of solid waste management has become an essential task needed to safeguard the urban environment. Provision of an efficient solid waste management system is now as important as other essential amenities such as electricity, airports, and highways. Due to the increasing volume of waste the continuous disposal of waste to landfill is unsustainable. Hence, the processing of waste is a necessary step needed to safeguard public health. 8.3 Waste management or waste disposal

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Waste management or waste disposal includes the activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process and waste-related laws, technologies, economic mechanisms. Waste can be solid, liquid, or gaseous and each type has different methods of disposal and management. Waste management deals with all types of waste, including industrial, biological and household. In some cases, waste can pose a threat to human health. Health issues are associated

with

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the entire process of waste management. Health issues can also arise indirectly or directly, directly through the handling of the waste and indirectly through the consumption of

contaminated water, soil and food.
NSOU ? CC-GR-08 89 Waste is produced by human activities.

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Waste management is intended to reduce adverse effects of waste on human health, the environment, planetary resources and aesthetics. Waste management practices are not uniform among countries.

The developed and developing nations, the urban and rural areas, and the

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residential and industrial sectors can take different approaches. Proper management of waste is important for building sustainable cities, but it remains a challenge for

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many developing countries. A report found that effective waste management is relatively expensive, usually comprising 20%–50% of municipal budgets. Operating this essential municipal service requires integrated systems that are efficient, sustainable, and socially supported.Large portion of waste management practices deal with municipal solid waste (MSW) which is the bulk of the waste that is created by household, industrial, and commercial activity. Measures of waste management include measures for integrated techno-economic mechanisms of a circular economy, effective disposal facilities, export and import control and optimal sustainable design of products that are produced.

Principles of Waste Management Waste hierarchy The waste hierarchy refers to the "3 Rs" Reduce, Reuse and Recycle, which classifies waste management strategies according to their desirability in terms of waste minimisation. The waste hierarchy is the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of end waste i.e. resource recovery. The waste hierarchy is represented as a pyramid. The policies should promote measures to prevent the generation of waste. The next preferred action is to seek alternative uses for the waste that has been generated i.e. by re-use. The next step is recycling which includes composting. Following this step is material recovery and coversion of waste-to-energy. The final action is disposal in landfills or through incineration without energy recovery. This last step is the final resort for waste which has not been prevented, diverted or recovered. The waste hierarchy represents the progression of a product or material through the sequential stages of the pyramid of waste management. The hierarchy represents the latter parts of the life-cycle for each product.
NSOU ? CC-GR-08 90 Life-cycle of a product The life-cycle begins with design, then proceeds through manufacture, distribu- tion, and primary use and then follows through the waste hierarchy's stages of reduce, reuse and recycle. Each stage in the life-cycle offers opportunities for policy
NSOU ? CC-GR-08 91 intervention, to rethink the need for the product, to redesign to minimize waste potential, to extend its use. Product life-cycle analysis is a way to optimize the use of the world's limited resources by avoiding the unnecessary generation of waste. Resource efficiency Resource efficiency reflects the understanding that global economic growth and development can not be sustained at current production and consumption patterns. Globally, humanity extracts more resources to produce goods than the planet can replenish. Resource efficiency is the reduction of the environmental impact from the production and consumption of these goods, from final raw material extraction to the last use and disposal. Polluter-pays principle The polluter-pays principle mandates that the polluting party pays for the impact on the environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the unrecover- able material. Waste Handling Waste collection methods vary widely among different countries and regions. Domestic waste collection services are often provided by local government authori- ties, or by private companies for industrial and commercial waste. Some areas, especially those in less developed countries, do not have formal waste-collection systems. Waste handling practices Curbside collection is the most common method of disposal in most European countries, Canada, New Zealand, United States, and many other parts of the developed world in which waste is collected at regular intervals by specialised trucks. This is often associated with curb-side waste segregation. In rural areas, waste may need to be taken to a transfer station. Waste collected is then transported to an appropriate disposal facility. In some areas, vacuum collection is used in which waste is transported from the home or commercial premises by vacuum along small bore tubes. Systems are in use in Europe and North America. In some jurisdictions unsegregated waste is collected at the curb-side or from waste transfer stations and then sorted into recyclables and unusable waste. Such

NSOU ? CC-GR-08 92 systems are capable of sorting large volumes of solid waste, salvaging recyclables, and turning the rest into bio-gas and soil conditioner. Other businesses such as Waste Industries use a variety of colors to distinguish between trash and recycling cans. In addition, in some areas of the world the disposal of municipal solid waste can cause environmental strain due to official not having benchmarks that help measure the environmental sustainability of certain practices. Waste segregation This is the separation of wet waste and dry waste. The purpose is to recycle dry waste easily and to use wet waste as compost. When segre- gating waste, the amount of waste that gets landfilled reduces consider- ably, resulting in lower levels of air and water pollution. Waste segregation should be based on the type of waste. This also makes it easier to apply different processes to the waste, like composting, recycling and incineration. Segregated waste is also often cheaper to dispose of because it does not require as much manual sorting as mixed waste. There are a number of important reasons why waste segregation is important such as legal obligations, cost savings and protection of human health and the environment. Institutions should make it as easy as possible for their staff to correctly segregate their waste. Labeling is especially important when dealing with medical and nuclear wastes. Recommended colour coding of containers • Yellow- for infectious waste • Brown- for chemical and pharmaceutical waste • Black- for general waste Disposal methods

NSOU ? CC-GR-08 93 Landfill A landfill compaction vehicle in action. incineration plant in Vienna A landfill is a site for the disposal of waste materials by burial. Landfill is the oldest form of waste treatment, although the burial of the waste is modern; historically, refuse was simply left in piles or thrown into pits. Landfills must be open and avail- able to users every day. While the majority of its customers are municipalities, commercial and construction companies, residents are also allowed to use the landfill in most cases. Historically, landfills have been the most common method of organized waste disposal and remain so in many places around the world. Incineration Incineration is a disposal method in which solid organic wastes are sub- jected to combustion so as to convert them into residue and gaseous prod- ucts. This method is useful for dis- posal of both municipal solid waste and solid residue from waste water treatment. This process reduces the volumes of solid waste by 80 to 95 percent. Incineration and other high temperature waste treatment systems are some- times described as “thermal treatment”. Incinerators convert waste materials into heat, gas, steam, and ash. Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants including substantial quantities of carbon dioxide.

NSOU ? CC-GR-08 94 Recycling Steel crushed and baled for recycling Recycling is a resource recovery prac- tice that refers to the collection and reuse of waste materials such as empty bever- age containers. This process involves breaking down and reusing materials that would otherwise be gotten rid of as trash. There are numerous benefits of recycling, and with so many new technologies mak- ing even more materials recyclable, it is possible to clean up the Earth. Recycling not only benefits the environment but also positively effects the economy. The materials from which the items are made can be made into new products. Materials for recycling may be collected separately from general waste using dedicated bins and collection vehicles, a procedure called kerbside collection. In some communities, the owner of the waste is required to separate the materials into different bins (e.g. for paper, plastics, metals) prior to its collection. In other com- munities, all recyclable materials are placed in a single bin for collection, and the sorting is handled later at a central facility. The latter method is known as “single-stream recycling.” A recycling point in Finland The most common consumer products recycled include aluminium such as beverage cans, copper such as wire, steel from food and aerosol cans, old steel furnishings or equipment, rubber tyres, polyethylene and PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines and light paper, and corrugated fiberboard boxes. Polyvinyl Chloride (PVC), low density polythylene (LDPE), polypropylene(PP),and polystyrene(PS) are also recyclable. These items are usually composed of a single

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NSOU ? CC-GR-08 95 type of material, making them relatively easy to recycle into new products. The recycling of complex products (such as computers and electronic equipment) is more difficult, due to the additional dismantling and separation required. The type of material accepted for recycling varies by city and country. Each city and country has different recycling programs that can handle the various types of recyclable materials based on the resale value of the material once it is reprocessed. Some of the types of recycling include waste paper and cardboard, plastic recycling, metal recycling, electronic devices, wood recycling, glass recycling, cloth and textile and so many more. In July 2017, the Chinese government announced an import ban of 24 categories of recyclables and solid waste, including plastic, textiles and mixed paper, placing tremendous impact on developed countries globally, which exported directly or indirectly to China. Re-use Biological reprocessing An active compost heap. Recoverable materials that are organic in nature, such as plant material, food scraps, and paper products, can be recovered through composting and digestion processes to decompose the or- ganic matter. The resulting organic material is then recycled as mulch or compost for agricul- tural or landscaping purposes. In addition, waste gas from the pro- cess such as methane can be cap- tured and used for generating elec- tricity and heat. There are differ- ent types of composting and di- gestion methods and technologies. They vary in complexity from simple home compost heaps to large scale industrial digestion of mixed domestic waste. NSOU ? CC-GR-08 96 Energy recovery Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolyzation, anaerobic digestion, and landfill gas recovery. This process is often called waste-to-energy. Energy recovery from waste is part of the non-hazardous waste management hierarchy. Using energy recovery to convert non-recyclable waste materials into electricity and heat, generates a renewable energy source and can reduce carbon emissions by offsetting the need for energy from fossil sources as well as reduce methane generation from landfills. Globally, waste-to- energy accounts for 16% of waste management. The energy content of waste products can be harnessed directly by using them as a direct combustion fuel, or indirectly by processing them into another type of fuel. Thermal treatment ranges from using waste as a fuel source for cooking or heating and the use of the gas fuel (see above), to fuel for boilers to generate steam and electricity in a turbine. Pyrolysis and gasification are two related forms of ther- mal treatment where waste materials are heated to high temperatures with limited oxygen availability. The process usually occurs in a sealed vessel under high pressure. Pyrolysis of solid waste converts the material into solid, liquid and gas products. The liquid and gas can be burnt to produce energy or refined into other chemical products (chemical refinery). The solid residue (char) can be further refined into products such as activated carbon. Gasification and advanced Plasma arc gasification are used to convert organic materials directly into a synthetic gas (syngas) composed of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam. An alternative to pyrolysis is high temperature and pressure supercritical water decomposition (hydrothermal monophasic oxidation). Pyrolysis Pyrolysis is often used to convert many types of domestic and industrial residues into a recovered fuel. Different types of waste input (such as plant waste, food waste, tyres) placed in the pyrolysis process potentially yield an alternative to fossil fuels. Pyrolysis is a process of thermo- chemical decomposition of organic materials by heat in the absence of stoichiometric quantities of oxygen; the decomposition produces various hydrocarbon gases. Slow pyrolysis produces gases and solid charcoal. Pyrolysis hold promise for conversion of waste biomass into useful liquid fuel. Pyrolysis of

NSOU ? CC-GR-08 97 waste wood and plastics can potentially produce fuel. The solids left from pyrolysis contain metals, glass, sand and pyrolysis coke which does not convert to gas. Compared to the process of incineration, certain types of pyrolysis processes release less harmful by-products that contain alkali metals, sulphur, and chlorine. Resource recovery Resource recovery is the systematic diversion of waste, which was intended for disposal, for a specific next use.It is the processing of recyclables to extract or recover materials and resources, or convert to energy. These activities are performed at a resource recovery facility. Resource recovery is not only environmentally impor- tant, but it is also cost-effective. It decreases the amount of waste for disposal, saves space in landfills, and conserves natural resources. Application of rational and consistent waste management practices can yield a range of benefits including: 1. Economic – Valuable materials can be recovered for reuse. Improving economic efficiency and creating markets for recycles can produce new jobs and new business opportunities. 2. Social – By reducing adverse impacts on health by proper waste management practises, the resulting consequences can lead to new sources of employment and lift communities out of poverty especially inpoorer countries. 3. Environmental – Reducing or eliminating adverse impacts on the environ- ment through reducing, reusing and recycling, and minimizing resource extraction can result in improved air and water quality and help in the reduction of greenhouse gas emissions. 4. Inter-generational Equity – Effective waste management practises can pro- vide subsequent generations a more robust economy, a fairer and more inclusive society and a cleaner environment. Sustainability The management of waste encourages companies to improve their environmental efficiencies each year by eliminating waste through resource recovery practices. Wastes are a direct result of human interaction and activities. Nevertheless, there seems to be several opinions as to what constitute a waste. Several researchers

NSOU ? CC-GR-08 98 however agreed that wastes are materials whose owners no longer have a need for. Therefore, it is obvious that wastes is indeed subjective in meaning, as the term is open to several interpretations and also influenced by personal opinion. Nevertheless, it is important to provide a definition or at least a guide for the purposes of policies and legislations. This is evident from the fact that, it is the knowledge of what specifically constitute a waste and the categories of wastes that determines how wastes are dealt with or managed. Waste management involves a process whereby wastes are collected, transported and disposed of in the best possible way of limiting or eliminating the harmful effect of wastes. This aspect of environmental manage- ment is as important as other public amenities or infrastructures without which the life of contemporary man would be extremely difficult. This is because studies have shown a direct link between air, water and land pollution and diseases such as lung cancer, heart disease, cholera and hepatitis. In addition, climate change and eutrophi- cation are a direct result of water and air pollution. Little wonder why there is a huge disparity in the life expectancy of people in developed and developing countries. Since factors such as population increase lead to increase waste generation. Efforts should be directed towards making projections far ahead in order to ensure that new and existing settlements are adequately planned so as to accommodate possible increase in the volume of waste generation in future. Effective planning ahead will prevent indiscriminate disposal and other harmful practices so as to prevent the build-up of open dumps and breeding ground for rats and other vermin which pose health risks. 8.4 Rural Environmental Issues Sustainable Development Goal calls for adequate and equitable sanitation for all. The target (6.2) is tracked with the indicator of "safely managed sanitation services". Sanitation and health Some 827 000 people in low- and middle-income countries die as a result of inadequate water, sanitation, and hygiene each year, representing 60% of total diarrhoeal deaths. Poor sanitation is believed to be the main cause. Diarrhoea remains a major killer but is largely preventable. Better water, sanitation, and hygiene could prevent the deaths of 297 000 children aged under 5 years each year.

NSOU ? CC-GR-08 99 Open defecation perpetuates a vicious cycle of disease and poverty. The countries where open defection is most widespread have the highest number of deaths of children aged under 5 years as well as the highest levels of malnutrition and poverty. Benefits of improving sanitation Benefits of improved sanitation extend well beyond reducing the risk of diar- rhoea. These include: • reducing the spread of intestinal worms, schistosomiasis and trachoma, which are neglected tropical diseases that cause suffering for millions; • reducing the severity and impact of malnutrition; • promoting dignity and boosting safety, particularly among women and girls; • promoting school attendance: girls' school attendance is particularly boosted by the provision of separate sanitary facilities; and • potential recovery of water, renewable energy and nutrients from faecal waste. A WHO study in 2012 calculated that for every US$ 1.00 invested in sanitation, there was a return of US$ 5.50 in lower health costs, more productivity, and fewer premature deaths. Challenges In 2013, the UN Deputy Secretary General issued a call to action on sanitation that included the elimination of open defecation by 2025. Achieving universal access to a basic drinking water source appears within reach, but universal access to basic sanitation will require additional efforts. Environmental sanitation is a major public health issue in India. Recent interventional studies on environmental sanitation in India highlighted the importance of prioritizing control strategies. Research related to the appropriate costeffective intervention strategies and their implementation in Indian context is a big challenge. This paper discusses various intervention strategies related to environmental sanitation in India and emphasizes to prioritize it according to the need of the country.

NSOU ? CC-GR-08 100 In 2010, the UN General Assembly recognized access to safe and clean drinking water and sanitation as a human right, and called for international efforts to help countries to provide safe, clean, accessible and affordable drinking water and sanitation. The situation of the urban poor poses a growing challenge as they live increas- ingly in mega cities where sewerage is precarious or non-existent and space for toilets and removal of waste is at a premium. Inequalities in access are compounded when sewage removed from wealthier households is discharged into storm drains, waterways or landfills, polluting residential areas of poor people. Limited data available on this topic suggests that a large proportion of wastewa- ter in developing countries is discharged partially treated or untreated directly into rivers, lakes or the ocean. Environmental sanitation envisages promotion of health of the community by providing clean environment and breaking the cycle of disease. It depends on various factors that include hygiene status of the people, types of resources available, innovative and appropriate technologies according to the requirement of the commu- nity, socioeconomic development of the country, cultural factors related to environ- mental sanitation, political commitment, capacity building of the concerned sectors, social factors including behavioral pattern of the community, legislative measures adopted, and others. India is still lagging far behind many countries in the field of environmental sanitation. Improvement in sanitation requires newer strategies and targeted interventions with follow-up evaluation. The need of the hour is to identify the existing system of environmental sanitation with respect to its structure and functioning and to prioritize the control strategies according to the need of the country. These priorities are particularly important because of issue of water constraints, environment-related health problems, rapid population growth, inequitable distribution of water resources, issues related to administrative problems, urbanization and industrialization, migra- tion of population, and rapid economic growth. Lack of safe water supply, poor environmental sanitation, improper disposal of human excreta, and poor personal hygiene help to perpetuate and spread diarrheal diseases in India.

NSOU ? CC-GR-08 101 While no comprehensive study on equity issues relating to water supply, sanitation, and health has been conducted for the country as a whole, common equity issues that plague the sector in most developing countries also hold true for India. In addition, comprehensive studies on the economic value of the water and sanitation sector in India also do not exist. Implementation of low-cost sanitation system with lower subsidies, greater household involvement, range of technology choices, options for sanitary complexes for women, rural drainage systems, involvement of NGOs and local groups, avail- ability of finance, human resource development, and emphasis on school sanitation are the important areas to be considered. Appropriate forms of private participation and public private partnerships, evolution of a sound sector policy in Indian context, and emphasis on sustainability with political commitment are prerequisites to bring the change. As the international authority on public health, World Health Organization (WHO) leads global efforts to prevent transmission of diseases, advising govern- ments on health-based regulations.On sanitation, WHO monitors global burden of disease and the level of sanitation access and analyses what helps and hinders progress. Such monitoring gives Member States and donors global data to help decide how to invest in providing toilets and ensuring safe management of wastewa- ter and excreta. WHO works with partners on promoting effective risk assessment and manage- ment practices for sanitation in communities and health facilities through the WHO guidelines on sanitation and health, safe use of wastewater, recreational water quality and promotion of sanitation safety planning. WHO also supports collaboration between "water, sanitation and hygiene (WASH) and health programmes such as neglected tropical diseases, cholera, polio and antimicrobial resistance. 8.5 Summary and Conclusion Environmental issues need to be addressed through environmental education, advocacy and activism. We need to understand the scale of urban environmental

NSOU ? CC-GR-08 102 problems, from the micro to the macro. Counter urbanization is also needed. Policy should relate to proper urban planning / master planning where city planning will consist of operational, developmental and restorative planning. Proper implemen- tation of such plans is crucial in the regulated development of urban areas, which in turn have resulted in mushrooming of slums and squatters, unauthorized and haphazard development and above all environmental degradation and transporta- tion problems within and around the urban areas. Increase urban parks and greenery for better health as it promotes natural cooling. Further, the development plans / master plans are mostly documents prepared with limited forecasting capabilities without capturing the entire dynamics and are generally not responsive to dynamic problems and responsive to policy changes. It is therefore necessary to enable the administrators and planners to graduate and equip with better under- standing, methods and tools to tackle the environmental issues of urban areas. Studies are also essential to understand growth of slums, slum population and their quality of life. 8.6 Reference 1. Pandve HT. Environmental sanitation: An ignored issue in India. Indian J Occup Environ Med. 2008;12:40. [PMC free article] [PubMed] [Google Scholar] 2. Majra JP, Gur A. India needs a great sanitary awakening. Indian J Occup Environ Med. 2008; 12:143. [PMC free article] [PubMed] [Google Scholar] 3. Kumar SG, Jayarama S. Issues related to sanitation failure in India and future perspective. Indian J Occup Environ Med. 2009; 13:104. [PMC free article] [PubMed] [Google Scholar] 4. Inadequate sanitation costs India $54 billion yearly. [Last cited 2011 Apr 1]. Available from http://southasia.oneworld.net/todaysheadlines/inadequate- sanitationcosts-india-54-billion-yearly . 5. Hutton G, Haller L, Bartram J. Global cost-benefit analysis of water supply and sanitation interventions. J Water Health. 2007;5:481–502. [PubMed] [Google Scholar]

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NSOU ? CC-GR-08 104 Unit 9 ?

Environmental policies—Club of Rome, Earth Summits (special reference to Stockholm, Rio, Johannesburg)

Structure 9.0 Objective 9.1 Introduction 9.2 Environmental policy, conservation and management 9.3

Club of Rome 9.4 Earth Summits (special reference to Stockholm, Rio, Johannesburg) 9.5

The Rio Declaration 9.6. The Johanesberg Declaration 9.7 Reference 9.0 Objective The learners will aquaint themselves with the different environmental policies which are related with the protection of the environment. 9.1 Introduction

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Environmental policy is the commitment of an organization or government to the laws, regulations, and other policy mechanisms concerning environmental issues.

These issues generally include air and water pollution, waste management, ecosystem management, maintenance of biodiversity, the management of natural resources, wildlife and endangered species. The implementation of an energy policy at a global level is of utmost importance to address the issues of global warming and climate changes. Policies concerning energy or regulation of toxic substances including pesticides and many types of industrial waste are part of the topic of environmental policy. This
NSOU ? CC-GR-08 105 policy can be deliberately taken to influence human activities and thereby prevent undesirable effects on the biophysical environment and natural resources, as well as to make sure that changes in the environment do not have unacceptable effects on humans. 9.2 Environmental policy, conservation and management Environmental policy, conservation and management of natural resources were once the function of appointed officials in the public sector. More recently, environ- mental policy and management has been constructed as a broader project, requiring the direct involvement of communities, individuals, nongovernment organizations, and the corporate sector. Thus, a tendency has emerged for responsibility for environmental protection and management in support of the public interest to be assigned more broadly. Environmental policy is primarily concerned with how to govern the relationship between humans and the natural environment in a mutually beneficial manner. Traditionally, it has been defined in terms of the problems it addressed, such as controlling pollution and waste flows and limiting habitat loss. However, policy makers have begun to appreciate that environmental policy will only be genuinely successful when it is sensitively integrated with other sectors and policy areas. Politically speaking, 'environmental policy integration' represents a new but poten- tially difficult stage in the continuing metamorphosis of environmental policy into a much wider policy supporting sustainable human development. Non-Governmental organizations (NGOs) have the greatest influence on envi- ronmental policies. These days, many countries are facing huge environmental, social, and economic impacts of rapid population growth, development, and natural resource constraints. As NGOs try to help countries to tackle these issues more successfully, a lack of understanding about their role in civil society and the public perception that the government alone is responsible for the well-being of its citizens and residents makes NGOs tasks more difficult to achieve. NGOs such as Greenpeace and World Wildlife Fund can help tackling issues by conducting research to facilitate policy development, building institutional capacity, and facili- tating independent dialogue with civil society to help people live more sustainable

NSOU ? CC-GR-08 106 lifestyles. The need for a legal framework to recognize NGOs and enable them to access more diverse funding sources, high-level support/endorsement from local figureheads, and engaging NGOs in policy development and implementation is more important as environmental issues continue to increase. International organizations have also made great impacts on environmental policies by creating programmes such as the United Nations Environment Programme and hosting conferences such as the United Nations Earth Summit to address environmental issues. Though the Clean Air Act 1956 in response to London's Great Smog of 1952 was a historical step forward, and the Air Pollution Control Act 1955 was the first U.S. federal legislation that pertained to air pollution, the 1960s marked the beginning of modern environmental policy making. The publication of Rachel Carson's New York Times bestseller Silent Spring in 1962strengthened environmental movement. Earth Day founder Gaylord Nelson, then a U.S. Senator from Wisconsin, after witnessing the ravages of the 1969 massive oil spill in Santa Barbara, California, became famous for his environmental work. Administrator Ruckelshaus was confirmed by the Senate on December 2, 1970, which is the traditional date used as the birth of the United States Environmental Protection Agency (EPA). Five months earlier, in July 1970, President Nixon had signed Reorganization Plan No. 3 calling for the establishment of EPA. At the time, Environmental Policy was a bipartisan issue and the efforts of the United States of America helped spark countries around the world to create environmental policies. During this period, legislation was passed to regulate pollut- ants that go into the air, water tables, and solid waste disposal. President Nixon signed the Clean Air Act in 1970 which set the US as one of the world leaders in environmental conservation. The world's first minister of the environment was the British Politician Peter Walker from the Conservative Party in 1970. In the European Union, the very first Environmental Action Programme was adopted by national government representatives in July 1973. Since then an increas- ingly dense network of legislation has developed to all areas of environmental protection including air pollution control, water protection and waste policy. EU environmental policy has thus become a core area of European politics. It may be mentioned here that ISO 14001 Environmental Management System(EMS) is a systematic framework to manage the immediate and long term

NSOU ? CC-GR-08 107 environmental impacts of an organization's products, services and processes.EMS ensures compliance with relevant environmental legislation. 9.3 Club of Rome The Club of Rome was founded in April 1968 by Aurelio Peccei, an Italian industrialist, and Alexander King, a Scottish scientist. It was formed when a small international group of people from the fields of academia, civil society, diplomacy, and industry met at Villa Farnesina in Rome, Italy. The Club of Rome consists of one hundred full members selected from current and former heads of state and government, UN administrators, high-level politicians and government officials, diplomats, scientists, economists, and business leaders from around the globe. It stimulated considerable public attention in 1972 with the first report to the Club of Rome, The Limits to Growth. Economic growth could not continue indefinitely because of resource depletion. Since 1 July 2008 the organization has been based in Winterthur, Switzerland. The major objectives of the Club of Rome are: 1) To examine the nature and configuration of the profound imbalances that define today's problematique throughout the world, and to attempt to determine the dynamics of the interactions which seemingly exacerbate the situation as a whole. 2) To develop an initial "model" or models of this dynamic situation. These models will reveal those components that are most critical and most dangerous for the future. 3) To construct a "normative" overview from the foregoing models and to clarify the action implications regarding political, social, economic, techno- logical, institutional consequences. 4) Such findings might stimulate the conception of new lines of policy that would be effective in coping with our situation's overall dynamics and its world-wide dimensions. 5) To persuade governments to convene a World Forum,* with an aim at developing the needed operational "macro-models" conducive to endeavors

NSOU ? CC-GR-08 108 at integrated policy-planning and to the development of new institutions within whose frame of competence such work could be carried out. These objectives have been set with the full knowledge that many governments and international organizations are beginning to recognize the dangers with which our present situation is fraught. Thus on the international level bodies such as NATO or OECD are now undertaking detailed work on many individual issues, while the United Nations is planning a world conference on the problems of the "Environment" in 1972. These moves are welcome and should add greatly to our recognition and understanding of the grave matters that are facing the whole of mankind. This international society of politicians, business leaders, and scientists, appeal for mutual tolerance, understanding, and solidarity in relation to the real problems of the world, and the environmental problems in the first place. The members of the Club prescribe the setting of limits to human expansion over nature. Recently, these ideas of the Club of Rome have been criticized by economists, philosophers, and politicians, being described as "environmental alarmism", i.e. the inevitability of ecological crisis and its devastating consequences for humanity. However, the global environmental crisis is already an undeniable fact and requires a thorough study of the ethical standards of the human behaviour, which are often rooted in moral phenomena such as consumerism, irresponsibility, insensitivity or even selfishness. Nature cannot be only considered as a source of natural resources or benefits to people. The moral motive of nature conservation, despite the power of modern science, is one of the main ideas of the founders and followers of the case of the Club of Rome. It concerns the future where the respect for the value of nature is a new moral principle. 9.4 Earth Summits (special reference to Stockholm, Rio, Johannesburg) The Earth Summits are decennial meetings of world leders, organized since 1972 with the help of the United Nations, to define ways to stimulate sustainable development at global level. The first summit took place in Stockholm (Sweden) in 1972, the second in Nairobi (Kenya) in 1982, third in Rio de Janeiro (Brazil) in 1992

NSOU ? CC-GR-08 109 and the fourth in Johannesburg (South Africa). The last summit, called Rio+20 took place in Rio de Janerio in 2012. The Declaration of the United Nations Conference on the Human Environment UNCHE), or Stockholm Declaration, was adopted in 1972 to recognize the right to a healthy environment. In the declaration, the nations agreed to accept responsibility for any environmental effects caused by their actions. The document opens with seven proclamations covering the global nature of environmental problems and stating that they will require extensive cooperation among nations to resolve. These proclamations conclude that efforts for environmen- tal preservation and improvement will benefit all people and their posterity. The declaration then states twenty-six principles to guide the nations through their responsibilities. The action plan split into three categories includes an environmental assessment called Earthwatch, environmental management, and 109 supporting measures. The UNCHE is also called the Stockholm Conference. The Declaration of the Conference noted that population growth, developing economies, and technological and industrial advancements harmed the environment. The Declaration asserted that every human has the right to a clean and healthy environment. The declaration stated that humans have the responsibility to manage wildlife and their ecosystems. It sought an end to the discharge of pollution into the environment. It also requested that industrialized nations provide financial and technological support to developing nations. Such support would enable developing nations to grow their economies in an environmentally responsible manner. The action plan of the Stockholm Conference contained 109 specific recommen- dations for achieving the goals. The action plan recommended continued scientific research into the effect of pollutants on the environment. A network of pollution monitoring agencies would monitor pollution levels across the world. The United Nations founded the United Nations Environment Programme (UNEP) in 1972 largely to implement initiatives in the action plan and to provide financial and technical support to developing nations on environmental issues. The United Nations World Summit on Sustainable Development, also called Earth Summit 2002, was held in Johannesburg, South Africa (https://www.encyclopedia.com)

NSOU ? CC-GR-08 110 This Earth Summit 2002 produced the Johannesburg Declaration on Sustainable Development. The Johannesburg Declaration reiterates most of the proposals from the Rio Declaration on Environment and Development and Agenda 21, international agreements from Earth Summit 1992. Numerous environmental organizations have criticized Earth Summit 2002 for not producing any new, substantive international agreements. Historical Background and Scientific Foundations The international environmental policies established by Earth Summit 2002 were a direct result of ideas produced by previous international environmental confer- ences. The most notable of these previous conferences are

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the United Nations Conference on the Human Environment, United Nations World Commission on Environment and Development, and United Nations Conference on Environment and Development.

In 1983 the United Nations General Assembly established the World Commis- sion on Environment and Development (WCED), also called the Brundtland Com- mission. The Brundtland Commission addressed three major environmental issues. First, the commission examined critical environmental and sustainable developmen- tal issues. The commission then devised proposals for addressing these issues. Second, the commission proposed new ways in which the international community could cooperate on environmental and sustainable development issues. In 1987 the Brundtland Commission issued Our Common Future, a report of its findings and recommendations. Our Common Future asserted that sustainable devel- opment must be addressed by any international environmental initiative. Our Com- mon Future

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defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Since Our Common Future, every UN conference on the environment has made sustainable development a core aspect of international environmental policy. Our Common Future asserted that the international community could only resolve the interlocking crises of environmental preservation, economic development, and energy production through a comprehensive sustainable development plan. The Brundtland Commission stated that governments cannot manage these interlocking
NSOU ? CC-GR-08 111 crises on a local or national scale. Instead, Our Common Future stated that the only viable solution to environmental issues is an international approach that simultaneously addresses all three crises. Our Common Future contained specific recommendations for promoting environmental preservation through sustainable development. 9.5 The
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United Nations Conference on Environment and Development (UNCED), also known as the

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Rio de Janeiro Earth Summit, the Rio Summit and the Rio Conference was a major United Nations conference held in Rio de Janeiro in 1992.Rep- resentatives from 172 countries met in Rio de Janeiro, Brazil for the U.N. Confer- ence on Environment and Development (UNCED), also called Earth Summit 1992. The gathering resulted in several seminal international environmental law conven- tions that continue to shape international action on environmental issues. The Rio Declaration on Environment and Development and Agenda 21 are the most notable reports produced by Earth Summit 1992. The Rio Declaration on Environment and Development calls on nations to implement environmental and energy stewardship plans. The declaration further defines national rights and responsibilities in the areas of environmental protection and sustainable development. The Rio Declaration affirms the sovereign right of nations to exploit natural resources within their borders, but only if their actions do not harm the environment in other nations. It also requests that all levels of government devise and execute environmental preservation plans. Agenda 21 is a comprehensive environmental and sustainable development plan that requires cooperation from intergovernmental agencies, national and local gov- ernments, and NGOs. It addresses four topics: Social and Economic Dimensions, Conservation and Management of Resources for Development, Strengthening the Role of Major Groups, and Means of Implementation. The United Nations Commis- sion on Sustainable Development is responsible for executing the principles of Agenda 21. Earth Summit was created as a response for member states to cooperate together internationally on development issues after the Cold War. Due to issues relating to sustainability being too big for individual member states to handle, Earth Summit
NSOU ? CC-GR-08 112 was held as a platform for other member states to collaborate. Since the creation, many others in the field of sustainability show a similar development to the issues discussed in these conferences, including non-governmental organizations (NGOs). The issues addressed included: • systematic scrutiny of patterns of production — particularly the production of toxic components, such as lead in gasoline, or poisonous waste including radioactive chemicals • alternative sources of energy to replace the use of fossil fuels which del- egates linked to global climate change • new reliance on public transportation systems in order to reduce vehicle emissions, congestion in cities and the health problems caused by polluted air and smoke • the growing usage and limited supply of water An important achievement of the summit was an agreement on the Climate Change Convention which in turn led to the Kyoto Protocol and the Paris Agreement. Another agreement was to "not to carry out any activities on the lands of indigenous peoples that would cause environmental degradation or that would be culturally inappropriate". The Convention on Biological Diversity was opened for signature at the Earth Summit, and made a start towards redefinition of measures that did not inherently encourage destruction of natural ecoregions and so-called uneconomic growth. Although President George H.W. Bush signed the Earth Summit's Convention on Climate, his Administrator in Environmental Protection Agency (EPA) William K. Reilly acknowledges that U.S. goals at the conference were difficult to negotiate and the agency's international results were mixed, including the U.S. failure to sign the proposed Convention on Biological Diversity. Twelve cities were also honoured by the Local Government Honours Award for innovative local environmental programs. These included Sudbury in Canada for its ambitious program to rehabilitate environmental damage from the local mining industry, Austin in the United States for its green building strategy, and Kitaky?sh? in Japan for incorporating an international education and training component into its municipal pollution control program.
NSOU ? CC-GR-08 113 The Earth Summit resulted in

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the following documents: • Rio Declaration on Environment and Development • Agenda 21 • Forest Principles

Moreover, important legally binding agreements (Rio Convention) were opened for signature: • Convention on Biological Diversity • Framework Convention on Climate Change (UNFCCC) • United Nations Convention to Combat Desertification In order to ensure compliance to the agreements at Rio (particularly the Rio Declaration on Environment and Development and Agenda 21), delegates to the Earth Summit established the Commission on Sustainable Development (CSD). In 2013, the CSD was replaced by the High-level Political Forum on Sustainable Development that meets every year as part of the Economic and Social Council (ECOSOC) meetings, and every fourth year as part of the General Assembly meetings. Critics point out that many of the agreements made in Rio have not been realized regarding such fundamental issues as fighting poverty and cleaning up the environment. Green Cross International was founded to build upon the work of the Summit. The first edition of Water Quality Assessments, published by WHO/Chapman & Hall, was launched at the Rio Global Forum. Impacts and Issues In August and September 2002, representatives from 193 nations attended

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the World Summit on Sustainable Development in Johannesburg, South Africa,		

the ten- year follow-up conference to Earth Summit 1992. The United States controversially did not participate in the World Summit on Sustainable Development. Many partici- pants and NGOs consider this summit, also called Earth Summit 2002, less success- ful than Earth Summit 1992, because it did not produce any groundbreaking international environmental agreements.

NSOU ? CC-GR-08 114 9.6 The Johanesberg Declaration The main agreement produced by Earth Summit 2002, the Johannesburg Decla- ration on Sustainable Development, merely reiterates many of the goals contained in the Rio Declaration and Agenda 21. The Johannesburg Declaration also does not contain many specific proposals for preserving the environment or promoting sustainable development. Instead, the Johannesburg Declaration addresses the envi- ronment and sustainable development in more general terms. The Johannesburg Declaration also requests that nations implement measures to eliminate or minimize all threats to sustainable development, including drug use, terrorism, corruption, ethnic intolerance, and the effects of natural disasters. Earth Summit 2002 produced more than 300 partnership initiatives on the environment and sustainable development. Partnership initiatives are not multi- lateral international treaties; they are agreements between two or more governments, non-governmental organizations,or private sector participants. These Earth Summit 2002 partnership initiatives pledged more than $200 million to various environmen- tal and sustainable development projects in the areas of water and sanitation, energy, health, agriculture, biodiversity protection, and ecosystem management. The Johannesburg Declaration was the main outcome of the Summit; however, there were several other international agreements. It laid out the Johannesburg Plan of Implementation as an action plan Instead of new agreements between governments, the Earth Summit was orga- nized mostly around almost 300 “partnership initiatives” known as Type II, as opposed to Type I Partnerships which are the more classic outcome of international treaties. These were to be the key means to achieve the Millennium Development Goals. But the absence of the United States rendered the summit partially impotent. The United Nations Conference on the Human Environment, was first held in Stockholm, Sweden, in June 1972, and marked the emergence of international environmental law. The Declaration on the Human Environment also known as the Stockholm Declaration set out the principles for various international environmental issues, including human rights, natural resource management, pollution prevention and the relationship between the environment and development. The conference also led to the creation of the United Nations Environment Programme.

NSOU ? CC-GR-08 115 The Brundtland Commission set up by Gro Harlem Brundtland, the pioneer of sustainable development, provided the momentum for Earth Summit 1992. This Summit was also headed by Maurice Strong, who had been a prominent member of the Brundtland Commission – and also for Agenda 21. South Africa’s first National Conference on Environment and Development entitled, “Ecologise Politics, Politicise Ecology” was held at the University of the Western Cape in conjunction with the Cape Town Ecology Group and the Western Cape Branch of the World Conference on Religion and Peace in 1991. Prominent persons involved in this conference were Ebrahim Rasool, Cheryl Carolus, Faried Esack, and Julia Martin.

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Poverty eradication, changing unsustainable patterns of production and consump- tion and protecting and managing the natural resource base of economic and social development are essential requirements for sustainable development. 9.7

Reference 1. Johannesburg Declaration on Sustainable Development, A/CONF.199/20, Chapter 1, Resolution 1, Johannesburg, September 2002 2.

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Plan of Implementation of the World Summit on Sustainable Development, A/CONF.199/20, Chapter 1, Resolution 2,

Johannesburg, September 2002 3. Declaration of the United Nations Conference on the Human Environment, A/CONF.48/14/Rev.1, Chapter I, Stockholm, June 1972 4. Rio Declaration on Environment and Development, A/CONF.151/26 (Vol. I), Chapter I, Annex I, Rio de Janeiro, June 1992. 5. United Nations Conference on Environment and Development. "Rio Decla- ration on Environment and Development". Habitat.igc.org. Archived from the original on 2 April 2003. Retrieved 4 August 2014. 6. https://www.encyclopedia.com/places/africa/south-african-political-geography/south-africa
NSOU ? CC-GR-08 116 Unit 10 ?
Global initiatives for environmental management (special reference to Montreal, Kyoto, Paris)
Structure 10.0 Objective 10.1 Introduction 10.2 Treaties and conventions for the improvement and protection of the environment: 10.2.1 Montreal Protocol (1987) 10.2.2 Kyoto Protocol (1997) 10.2.3 Paris Agreement (2015) 10.3 Summary and Conclusion 10.4 Reference 10.0 Objective • To understand the issues of environment protection • To know about protection and conservation the environment • To understand the key areas where all the countries have to look upon and work 10.1 Introduction Margaret Mead, the American anthropologist, said that "We won't have a society if we destroy the environment". Indeed it is true and we can see the effects of exploitation in the changing environment. The main reasons for the protection are: • Ozone depletion, greenhouse effect and global warming– Ozone is a thick layer which acts as a shield to protect the earth from the ultraviolet radiations coming from the sun. This layer has great importance. Any
NSOU ? CC-GR-08 117 depletion in this layer will result in more penetration of ultraviolet radiations to the earth. The concern arises towards the environment when this layer starts depleting. It is now a prevalent and significant issue which should be tackled within a timeframe, otherwise it can cause a lot of problems to the environment as well as to humans (K. Kundlani). Exemplary effects are skin cancer, premature ageing, eye damage, weak immune system etc. The main reason affecting the ozone layer is Chlorofluorocarbons (CFCs) which are mostly produced by the industries discharging chemicals and can also be found in household products. The ozone layer depletion is linked to the greenhouse effect and also with global warming. Greenhouse effect- It is caused by the emissions of the pollutant gasses like methane, CFCs etc. When these gases are released the atmosphere, it results in temperature rise and this is known as global warming. • Desertification– In simpler terms, this issue means land degradation. The destruction of the potentiality of the land which ultimately at the end results in a drought-like situation. The example of land degradation is deforestation, change in climate etc. Where this kind of a situation arises, it forces the people residing there to migrate to another place. • Deforestation– It is a recurrent issue which every country faces. Deforestation not only affects climate but also affects the animals living in the forests. It is an alarming issue which is every country has to deal with. • Loss of biodiversity– It is related to the extinction of species from the earth and the reason is deforestation. Biodiversity means the variety of life on earth. Many of the species have already become extinct from earth. Extinction of species disturbs the balance of the ecosystem as well as disturbs the balance of the living species and also human beings. Earth's biodiversity provides various sources from which we can get food and also medicinal plants. Besides deforestation, the other reasons for the loss of biodiversity are use of chemical fertilizers, pesticides, overexploitation of the avail- able resources.

NSOU ? CC-GR-08 118 • Disposal of wastes– Disposing the waste is also an important and alarming issue. The major portion of waste is contributed by the industries and household. These industries or house- hold wastes are either dumped in water or in empty unused land. As a result, the water gets contaminated and spreads many diseases like diarrhoea, typhoid etc. Industrial wastes consist of chemicals, metal compounds, nuclear waste etc. These wastes cause serious health hazards and endanger the environment and life. 10.2 Treaties and conventions for the improvement and protection of the environment 10.2.1 Montreal Protocol (1987) It was finalized and adopted in the year 1987. It is a multilateral environmental agreement and this protocol is the UN treaty till date which was initially approved by only 46 countries but now it is ratified by all 197 UN member countries. This protocol regulates the production and consumption of man-made chemicals which can deplete the ozone layer. This treaty was made for the reason that certain substances or chemicals when released in the atmosphere that damages the stratospheric ozone layer which is earth's protective shield that protects humans as well as the environment from the harmful levels of ultraviolet radiations of the sun. The stratospheric layer in fact filters out the harmful radiation. If it doesn't get filtered then there are increasing chances of having skin cancer and cataracts, and also reduces the agricultural productivity and damages the marine ecosystems. Under this treaty, the developed and developing countries have equal but differentiated responsibilities towards the ozone-depleting substances (ODS) and both groups of countries have binding, time-targeted and measurable commitments. All countries have been given specific responsibilities relating to the curtailment of ozone-depleting substances.

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The Montreal Protocol sits under the Vienna Convention for the Protection of the Ozone Layer (			

the
Vienna Convention). The Vienna Convention was adopted in 1985
NSOU ? CC-GR-08 119 following international discussion of scientific discoveries in the 1970s and 1980s highlighting the adverse effect of human activity on ozone levels in the stratosphere and the discovery of the 'ozone hole'. Its objectives are to promote cooperation on the adverse effects of human activities on the ozone layer. The Montreal Protocol is widely considered as the most successful environment protection agreement. It sets out a mandatory timetable for the phase out of ozone depleting substances. The United Nations Industrial Development Organization (UNIDO) became an imple- menting agency of the Montreal Protocol in 1992 and is proud to be associated with its success. Since then UNIDO has recognized the significance of meeting the global environmental challenge of ozone depletion while observing national priorities, and of making meaningful technological adjustments resulting in a higher standard of living.

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The Montreal Protocol has proven to be innovative and successful, and is the first treaty to achieve universal ratification by all countries in the world. Leveraging worldwide participation, the Montreal Protocol has		

sent clear signals to the global market

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and placed the ozone layer, which was in peril, on a path to repair.		

Full implementation of the Montreal Protocol is expected to result in avoidance of more than 280

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million cases of skin cancer, approximately 1.6 million skin cancer deaths, and more than 45 million cases of cataracts		

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in the United States alone by the end of the century,

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with even greater benefits worldwide. The Montreal Protocol's Scientific Assessment Panel estimates that with implementation of the Montreal Protocol a near complete recovery of the ozone layer

is expected by the middle of the 21st century. India became the signatory member of this treaty on 19th June 1992. Hydrochlorofluorocarbons (HCFCs) is the gas which is used worldwide. It is present in the refrigerator, air-conditioners etc. It is very harmful and powerful than carbon dioxide. The Montreal protocol has taken steps to control this harmful substance. On 15th October 2016, parties of the Montreal Protocol adopted the Kigali amendment to curtail the consumption and production of the hydrofluorocarbons (HFCs). Countries have agreed to add HFCs to the list of controlled substances. The Kigali Amendment came into force on 1 January 2019 for those countries that have confirmed to this amendment.
NSOU ? CC-GR-08 120 10.2.2 Kyoto Protocol (1997)

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The Kyoto Protocol was adopted in Kyoto, Japan on 11 December 1997.

There are 192 Parties to the Kyoto Protocol. This Convention encouraged industrialized countries to stabilize GHG emissions. The Kyoto Protocol is an international

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agreement within the United Nations Framework Convention on Climate Change (UNFCCC).

This treaty commits state parties to reduce the greenhouse gas emissions. The Kyoto Protocol enlisted six greenhouse gases:

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Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs),

and Sulphur hexafluoride (SF6). So the main goal of the Kyoto Protocol was to control emissions of the anthropogenic (human-emitted) greenhouse gases (GHGs).It sets a timetable starting in 2006 for negotiations to establish emission reduction commitments for a second commitment period. The first period emission reduction commitments expired on 31 December 2012. The ultimate

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objective of the UNFCCC is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would stop dangerous anthropogenic interference with the climate system". 10.2.3

Paris Agreement (2015) It

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is an agreement within the United Nations Framework Convention on Climate Change (

UNFCC) which focuses on reducing the greenhouse gas emissions. It is replaced by its predecessor, the Kyoto protocol which is also the international treaty for similar purposes and its second commitment expires in 2020. The Paris Agreement came into force on 4th November 2016 and has been signed by 197 countries. India has also given its consent to this agreement. In the whole world, India stands at third after China and the US when it comes to the emission of the greenhouse effect according to May 2019. The primary motive of this agreement is to fight back against climate change. This agreement also aims to curb the emission of the greenhouse to a certain level. The United States withdrew from the agreement in 2020 but rejoined in 2021. 10.4 Summary and Conclusion It can be said that a proper understanding of the theissues of environment

NSOU ? CC-GR-08 121 protection is very much essential to protect and conserve the environment. This can be achieved with proper understanding of the key areas leading to conservation of the environment. • To understand the key areas where all the countries have to look upon and work 10.5 Reference 1. Kyoto Protocol on the United Nations Framework Convention on Climate Change" (PDF). United Nations. 2. "What is the Kyoto Protocol?". UNFCCC. 3. "United Nations Treaty Collection. Chapter XXVII 2.a Montreal Protocol on Substances that Deplete the Ozone Layer". treaties.un.org. 4. "MOFA: [Environment] Protection of the Ozone Layer (Vienna Convention, Montreal Protocol)". www.mofa.go.jp. Retrieved 7 September 2020. 5. "Report of the Twenty-Eighth Meeting of the Parties to

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the Montreal Protocol on Substances that Deplete the Ozone Layer" (		

PDF). October 2016. 6. McCormick, John (2001). Environmental Policy in the European Union. The European Series. Palgrave. p. 21. 7. Bührs, Ton; Bartlett, Robert V (1991). Environmental Policy in New Zealand. The Politics of Clean and Green. Oxford University Press. p. 9. 8. Eccleston, Charles H. (2010). Global Environmental Policy: Concepts, Prin- ciples, and Practice. ISBN 978-1439847664. 9. KundlaniKashish (-) International Efforts for Protecting and Improving the environment, Ramaiah Institute of Legal Studies, Bangalore. 10. https://www.state.gov/key-topics-office-of-environmental-quality-and- transboundary-issues/

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the-montreal-protocol-on-substances-that-deplete-the-ozone- layer/ 11.		

https://www.ipcc.ch/report/ar6/wg1/

NSOU ? CC-GR-08 122 Unit 11 ?Environmental Impact Assessment and Environmental Management Planning Structure 11.0 Objective 11.1 Introduction 11.2 Environmental Impact Assessment (EIA) 11.3 Evolution & History of EIA 11.4 Forms of impact assessment 11.5 Objectives of Environmental Impact Assessment are 11.6 Environmental Impact Assessment (EIA) Process 11.7 Importance of Environmental Impact Assessment 11.8 Environmental Impact Assessment In India 11.9 Environment Management 11.10 Significance 11.11 Environmental initiatives in India 11.12 Summary and Conclusion 11.13 Reference 11.14 Model questions 11.0 Objective • The unit is aimed at providing the learners can understanding of a systematic process of identifying future consequences of a current or proposed action. 11.1 Introduction Enviromental Impact Assessment (EIA) as well as Environmental Management Planning (EMP) is normally considered a planning tool which is usually accepted

NSOU ? CC-GR-08 123 asan integral component of sound decision making. It provides the environment its due place in the decision-making process by clearly evaluating the environmental consequences of a proposed project before start of its implementation. Early identi- fication and characterization of critical environmental impacts allow the regulatory authorities and the public to be aware of the environmental acceptability of a proposed project and the actions which are planned to be taken by the project authorities to mitigate or to reduce the risks and the impacts. 11.2 Environmental Impact Assessment (EIA) The rapid growth of population, improvements in standards of living and concomitant growth of infrastructure have altered the environment, sometimes beyond its power of resilience. These changes have resulted in ecological crisis and have become a matter of grave concern to managers and decision makers throughout the world. The issues both at national and global levels are focussing concern of nodal agencies (Regulatory Departments, Ministries and Boards) to support sustain- able development and curb and restrain such acts which tend to produce adverse impacts on living conditions of human, animals, plants and geographical environ- ment. EIA is required to provide a comprehensive account of the state of existing environment, the stresses produced by diverse activities and the impacts these will have on various components of environment. The proponents of the development projects also need to suggest and provide the measures to mitigate the adverse effects. Thus, EIA is a tool used to assess the positive and negative environmental, economic, and social impacts of a project. This is used to predict the environmental impacts of a project in the pre-planning stage itself so that decisions can be taken to reduce the adverse impacts. 11.3 Evolution & History of EIA Environment Impact Assessment or EIA can be defined as the study to predict the effect of a proposed activity/project on the environment. A decision making tool,
NSOU ? CC-GR-08 124 EIA compares various alternatives for a project and seeks to identify the one which represents the best combination of economic and environmental costs and benefits. EIA systematically examines both beneficial and adverse consequences of the project and ensures that these effects are taken into account during project design. It helps to identify possible environmental effects of the proposed project, proposes measures to mitigate adverse effects and predicts whether there will be significant adverse environmental effects, even after the mitigation is implemented. By considering the environmental effects of the project and their mitigation early in the project planning cycle, environmental assessment has many benefits, such as protection of environ- ment, optimum utilisation of resources and saving of time and cost of the project. Properly conducted EIA also lessens conflicts by promoting community participation, informing decision makers, and helping lay the base for environmentally sound projects. Benefits of integrating EIA have been observed in all stages of a project, from exploration and planning, through construction, operations, decommissioning, and beyond site closure. EIA is one of the successful policy innovations of the 20th Century for environmental conservation. Thirty-seven years ago, there was no EIA but today, it is a formal process in many countries and is currently practiced in more than 100 countries. EIA as a mandatory regulatory procedure originated in the early 1970s,

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with the implementation of the National Environment Policy Act (NEPA) 1969 in the US.		

A large part of the initial development took place in a few high-income countries, like Canada, Australia, and New Zealand (1973-74). However, there were some developing countries as well, which introduced EIA relatively early e.g. Columbia (1974), Philippines (1978). The EIA process really took off after the mid- 1980s. In 1989, the World Bank adopted EIA for major development projects, in which a borrower country had to undertake an EIA under the Bank's supervision The Ministry of Environment and Forest (MoEF) in India recently notified new EIA legislation in September 2006. The notification makes it mandatory for various projects such as mining, thermal power plants, river valley, infrastructure (road, highway, ports, harbours and airports) and industries including very small electroplating or foundry units to get environment clearance. However, unlike the EIA Notification of 1994, the newlegislation has put the oneself clearing projects on the state government depending on the size/ capacity of the project. Certain activities permissible under the Coastal Regulation Zone Act, 1991 also require similar clearance.

NSOU ? CC-GR-08 125 Additionally, donor agencies operating in India like the World Bank and the Asian Development Bank (ADB) have a different set of requirements for giving environmental clearance to projects that are funded by them. The EIA process: The stages of an EIA process will depend on the requirements of the country or donor. However, most EIA processes have a common structure. The environment impact assessment consists of eight steps with equal importance in determining the overall performance of the project. The eight steps of the EIA process are presented in brief below: • Screening: is the first stage. It determines whether the proposed project, requires an EIA and if it does, then the level of assessment required. • Scoping: This stage identifies the key issues and impacts that should be further investigated. This stage also defines the boundary and time limit of the study. • Impact analysis: This stage identifies and predicts the environmental and social impact of the proposed project and evaluates the significance. • Mitigation: This step recommends the actions to reduce and avoid the potential adverse environmental consequences of development activities. • Reporting: This stage presents the result of EIA in a form of a report to the decision-making body and other interested parties. • Review of EIA: It examines the adequacy and effectiveness of the EIA report and provides the information necessary for decision-making. • Decision-making: It decides whether the project is rejected, approved or needs further change. • Post monitoring: This stage comes into play once the project is commis- sioned. It checks to ensure that the impacts of the project do not exceed the legal standards and implementation of the mitigation measures are in the manner as described in the EIA report. 11.4 Forms of impact assessment There are various forms of impact assessment such as Health Impact Assessment (HIA) and Social Impact Assessment (SIA) that are used to assess the health and

NSOU ? CC-GR-08 126 social consequences of development so that they are taken into consideration along with the environmental assessment. One of the forms of impact assessment is strategic environment assessment, is briefly discussed below: i. Strategic environment assessment: Strategic Environment Assessment (SEA) refers to systematic analysis of the environmental effects of development policies, plans, programmes and other proposed strategic actions. This process extends the aims and principles of EIA upstream in the decision-making process, beyond the project level and when major alternatives are still open. SEA represents a proactive approach to integrating environmental considerations into the higher levels of decision-making. 11.5 Objectives of Environmental Impact Assessment are 1. Identifying, predicting, and evaluating economic, environmental, and social impacts of development activities. 2. Providing information on the environmental consequences for decision making. 3. Promoting environmentally sound and suitable development by identifying appropriate alternatives and mitigation measures. 11.6 Environmental Impact Assessment (EIA) Process The table below will mention the EIA Process in brief: Environmental Impact Assessment (EIA) Process Process Details in Brief Screening Which projects need a full or partial assessment study is decided in this stage Scoping • Which impacts are necessary to be assessed is de- cided in this stage. While doing so, legal require- ments, international conventions, expert knowledge, and public engagement are also considered.

NSOU ? CC-GR-08 127 • Alternative solutions that avoid or at least reduce the adverse impacts of the project are also studied in this stage • Investigation of alternate designs or sites that avoid or mitigate impact takes place Assessment & Environmental impacts of the proposed project are Evaluation of Impacts analyzed and light is thrown upon the alternatives and Development of present to such projects Alternatives EIA Report also called An environmental management plan (EMP) and also a Environmental Impact non-technical summary of the project's impact is Statement (EIS) prepared for the general public in this stage Decision Making The fate of the project is decided. Whether the project is to be given approval or not and if it is to be given, under what conditions Monitoring, compliance, Monitoring whether the predicted impacts and the mitiga enforcement and tion efforts happen as per the EMP environmental auditing 11.7 Importance of Environmental Impact Assessment 1. EIA is a good tool for prudent environment management. 2. It is government-policy that any industrial project in India has to secure EIA clearance from the Environment Ministry before approval for the project itself. 11.8 Environmental Impact Assessment In India • EIA started in India in 1976-77 when the Planning Commission directed the Department of Science & Technology to assess the river valley projects from the point of view of the environment. This was extended for all those projects that required approval from the Public Investment Board.

NSOU ? CC-GR-08 128 • Till 1994, environmental clearance from the Central Government was an administrative decision and lacked legislative support. On 27 January 1994, the Union Ministry of Environment and Forests (MEF), Government of India, under the Environmental (Protection) Act 1986, promulgated an EIA notification making Environmental Clearance (EC) mandatory for expansion or modernisation of any activity or for setting up new projects listed in Schedule 1 of the notification. Since then there have been 12 amendments made in the EIA notification of 1994. • Then, in 1986, the government enacted the Environment (Protec-tion) Act which made EIA statutory. The other main laws in this regard are the Indian Wildlife (

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Protection) Act (1972), the Water Act (1974), the Air (Prevention and Control of Pollution) Act (1981), and the Biological Diversity Act (2002). •

In 1982, the
Ministry of Environment, Forest and Climate Change set up the Environmental Information System (ENVIS) to collect, collate, storing, retrieving and disseminating information related to the environment sector. This serves as a web-based distributed network of subject-specific databases. The chief purpose of the ENVIS is to integrate all countrywide efforts to collect, store, disseminate, and use environment-information for better man- aging environmental assessment activities. Current EIA Reports – India EIA Notification 2020 draft has been made public. Once the EIA Notification 2020 will be published in the Official Gazette, it will replace EIA notification 2006. Few important terms/agencies concerning EIA notification 2020 which aspirants should know: 1. Accredited Environment Impact Assessment Consultant Organization (ACO) 2. Central Pollution Control Board 3. Certificate of Green Building 4. Corporate Environment Responsibility 5. Eco-Sensitive Area/ Eco-Sensitive Zone
NSOU ? CC-GR-08 129 11.9 Environment Management Environment Management is a comprehensive term which involves conservation of natural resources and energy (energy and resource saving), Pollution prevention, disposal of treated effluents (Waste regularization), Solid waste disposal, environ- mental audit and concept of green cities. The Environmental Management System (EMS) is designed to provide a process to ensure the Project's compliance with the applicable national and international laws and regulations. This EMP is a key component of the Environmental Management System, outlining Hunter Water's environmental objectives and targets to fulfil the commit- ments established in the Community and Environment Policy. As a key component of the EMS, it will drive organisational improvement over the life of the plan. The plan has twenty -two environmental objectives that address the responsibilities to the community and the environment. Each objective has actions and targets required to manage environmental performance over the next two years. In simple terms these actions will manage significant environmental aspects associated with the supply of water, waste water and stormwater services to the community. Achieving the targets that are set in this plan will reduce environmental risks and pursue environmental opportunities by being embedded broadly across business processes. Policy & Commitment Managememt Review Planning Checking & Corrective Action Implementation Operation

NSOU ? CC-GR-08 130 Environment Management and Planning Concept of Environmental Management It is an attempt to control human impact on and interaction with the environment in order to preserve natural resources. Environmental management focuses on the improvement of human welfare for present and future generations. Thus it involves environmental planning, conservation of resources, environmen- tal status evaluation and environmental legislation and administration. Characteristics of EMP It deals with world affected by humans; It supports sustainable development It demands a multidisciplinary approach; It has to integrate different development view points; The time-scale involved extends the short term and concern ranges from local to global; It seeks to integrate natural & social science, policy making & planning. This Environmental management implies an element of conscious choice from a variety of alternative proposals. Such a choice involves purposeful commitment for recognized and desired objectives. 11.10 Significance Cities and megacities are playing an increasingly important role in supporting and sustaining the global population. For the first time in human history, more than half of all people are living in cities, and as our cities grow, so does their environmental impact. Although cities occupy less than three percent of the Earth's surface, they consume a staggering 75 percent of global energy consumption and 80 percent of greenhouse gas (GHG) emissions. Much of this urban growth has occurred without any planning, leading to ancillary problems associated with lack of infrastructure and overcrowding. Never- theless, our urban areas provide real opportunities for improvements in sustainability, driving innovation and leading the way towards a more sustainable future.

NSOU ? CC-GR-08 131 There are several drivers and unique challenges associated with this record breaking urbanization: Unregulated construction and land development – A large influx of people can lead to unregulated construction and pressure for development in disaster-prone areas, leaving people vulnerable to flooding, sea level rise, earthquakes, and resulting destruction to life and property. Overcrowding and the proliferation of poverty – Migration to cities without proper infrastructure can lead to the proliferation of impoverished neighbourhoods and unsanitary conditions. People residing in these areas are more susceptible to disease outbreaks, which can impede their ability to work productively. Further, inequality can lead to social instability, driving companies near these areas to transfer their operations. Closing businesses exacerbates unemployment and poverty, creating a cycle that leads to further instability in the society and economy. Inadequate infrastructure – With an increase in employment, rising incomes can lead to a greater number of households owning cars. However, this growth typically exceeds the city's ability to expand the roadway infrastructure, causing traffic congestion, which takes a toll on businesses through higher fuel costs and delays in the delivery of goods and services. Heavy traffic congestion can also be detrimental to workers. Enduring long hours of heavy traffic while commuting can leave employees tired and unproductive once they reach their workplaces. And, in extending the workday with a lengthy commute, workers may have to cut back on their sleeping hours, which can also have negative effects on their health and productivity. Impact on ecosystems – Cities have extreme effects on the lives and relationships of plants and animals, both directly within the urban space and indirectly elsewhere through their ecological footprint. Poor air quality is estimated to cause over 1 million premature deaths each year. Water and waste management – Water, the world's most threatened essential resource, is a major challenge for cities, where the risk of pollution is high and urbanization can affect rainfall patterns. Improper disposal of municipal waste can

NSOU ? CC-GR-08 132 have adverse effects on everything from soil fertility and the health of plant life to the safety of drinking water. 11.11 Environmental initiatives in India • For the protection of environment and to control pollution several measures have been undertaken both by government and NGOs. • Even before independence, some laws have been enacted for the protection of environment. In Indian Penal Code of 1860, Articles 268, 290, 291, 426, 430, 431 and 432 are related with environment. Similarly, Article 277 was related with water pollution and 278 with Air pollution. • National Environmental policy, 2006- It the first initiative in strategy formulation for environmental protection in a comprehensive manner. It undertakes a diagnosis of the causative factors of land degradation with a view to flagging the remedial measures required in this direction. It recognizes that the relevant fiscal, tariffs and sectoral policies need to take explicit account of their unintentional impacts on land degradation. As the quality of life improves, demand for better quality services and products also increases. Customers all over the world and at all times demand that they be assured and satisfied that the product or services as anticipated. However, inspection is not a satisfactory way of giving assurance that the product will perform as desired during its life. It is generally agreed that the required level of quality can be built into the product only through the use of a proper quality management system. A set of international standards, which bring world-wide focus on the environ- ment, encourage a cleaner, safer, healthier world for all of us. The existence of these standards allows organizations to focus their environmental on the basis of interna- tionally accepted criteria. At present many countries and regional groupings are generating their own requirements for environmental issues, and these vary between the groups.

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A single standard will ensure that there are no conflicts between regional interpretations of good environmental practice.

NSOU ? CC-GR-08 133 11.12 Summary and Conclusion When city governments promote sustainability, using their position to build sustainable infrastructure, they also make their city a safe and attractive place to live and work. When citizens and local organizations create initiatives that complement city governments' sustainability efforts, they also contribute to improving their own health and livelihoods. By focusing on infrastructure, policy, and stakeholders' involvement, environmental planning supports a healthy and dynamic relationship between a city's people and its environments. With an increasing number of cities around the world, searching for innovative ways to implement environmental planning and sustainability remains the main challenge. 11.13 Reference • Eccleston, Charles H. (2011). Environmental Impact Assessment: A Guide to Best Professional Practices. Chapter 5. ISBN 978-1439828731 • UK Government, Environmental Impact Assessment, updated 15 March 2019, accessed 22 October 2019 • Carroll, B. and Turpin T. (2009). Environmental impact assessment handbook, 2nd ed. Thomas Telford Ltd, ISBN 978-0-7277-3509-6 • Fischer, T. B. (ed., 2016). Environmental Assessment. Critical Concepts of the Built Environment, Routledge, New York. ISBN 978-1-138-77776-7 • Glasson, J; Therivel, R; Chadwick A. (2005). Introduction to Environmental Impact Assessment. London: Routledge • Hanna, K. (2009). Environmental Impact Assessment: Practice and Participation, 2nd ed. Oxford • Petts, J. (ed.), Handbook of Environmental Impact Assessment, Vols 1 & 2. Oxford, UK: Blackwell. ISBN 0-632-04772-0 • Ruddy, T. F.; Hilty, L. M. (2008). "Impact assessment and policy learning in the European Commission". Environmental Impact Assessment Review. 28 (2– 3): 90. doi:10.1016/j.eiar.2007.05.001
NSOU ? CC-GR-08 134 11.14 Model Questions Q 1. What is EIA? Q 2. When did EIA start in India? Q 3. Who is responsible for EIA in India? Q 4. What is the main aim of EIA? Q 5. Is EIA only for developed countries?
NSOU ? CC-GR-08 135 Unit 12 ?
Overview of principal environment-related regulations of India. Review of their achievements

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Structure 12.0 Objective 12.1 Introduction 12.2 Need for Protection 12.3 Review of the achievements 12.4 Summary and Conclusion 12.5 Reference 12.6 Model Questions 12.0 Objective The learners will get an overview of principal environment-related regulations of India and also become aware of some of the achievements. 12.1 Introduction Pollution is one of the greatest causes of premature deaths and morbidity in the world, and this burden of pollution is disproportionately borne by the lower and middle income countries such as India, home to more than one-sixth of humanity. In India, due to the compound effect of its large population and high levels of environmental pollution, the human cost of pollution is among the highest in the world. The environmental degradation is partly a consequence of the development model pursued after independence in 1947 based on large-scale industrialization and exploitative resource utilization, with scant consideration for sustainability. Moreover, it is also due to the failure of the environmental administration, governance, and regulatory infrastructure to keep pace with the magnitude and pace of economic growth in India since economic liberalization in 1991. Ironically, India was also one of the early pioneers of integrating environmental considerations into

NSOU ? CC-GR-08 136 its legislative and policy-making process beginning in the early 1970s. The federal and state environmental regulation and policy framing institutions set up during this era, along with environmental legislation such as the Environment (Protection) Act 1986, are comparable in design, stringency, and comprehensiveness to other contemporary environmental regulatory regimes in many industrially developed economies. However, the widening gap between de jure expectations of environmental compliance and the de facto state of affairs has been a great concern for environmental governance in the country. The ongoing debates discuss several mechanisms to address the regulatory failures. The first is a greater emphasis on strengthening institutions and mechanisms that foster transparency and public disclosure by pollution sources with the intent to increase access to and credibility of information on pollution. Proponents argue that this will help to mobilize groups such as non- governmental organizations (NGOs) and the general public to pressure the industry and government to improve regulatory enforcement. Second, there have been calls for wider adoption of market-based instruments that are more efficient than the traditional approaches on which India relies. Again, information is a prerequisite for the functioning of such market-based regulatory mechanisms. Third, the legal infrastructure to facilitate expedited hearing of environmental litigation is being created. With the establishment of the National Green Tribunal in 2010, India is one of only three other countries in the world to have an exclusive judicial body to hear environmental cases. This is potentially a significant step in providing greater access to environmental justice. An emerging view, however, argues that the prevailing economic development model is incompatible with ensuring sustainable development and requires a radical rethink. 12.2 Need for Protection The need for protection and conservation of environment and sustainable use of natural resources is reflected in the constitutional framework of India and also in the international commitments of India. The Constitution under Part IVA (Art 51A- Fundamental Duties) casts a

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duty on every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures.

Further, the Constitution of
India under Part IV (Art
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Directive Principles of State Policies) stipulates

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that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country.

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Several environment protection legislations existed even before Independence of India. However, the true thrust for putting in force a well-developed framework came only after the UN Conference on the Human Environment (Stockholm, 1972). After the Stockholm Conference, the National Council for Environmental Policy and Planning was set up in 1972 within the Department of Science and Technology to establish a regulatory body to look after the environment-related issues. This Council later evolved into a full-fledged Ministry of Environment and Forests (MoEF). MoEF was established in 1985, which today is the apex administrative body in the country for regulating and ensuring environmental protection and lays down the legal and regulatory framework for the same. Since the 1970s, a number of environment legislations have been put in place. The MoEF and the pollution control boards,

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Central Pollution Control Board(CPCB), and State Pollution Control Boards (

SPCB) together form the regulatory and administrative core of the sector. Some of the important legislations for environment protection are as follows: •

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The Water (Prevention and Control of Pollution) Act, 1974 • The Air (Prevention and Control of Pollution) Act, 1981 • The Environment Protection Act, 1986 • The National Green Tribunal Act, 2010 • The

Hazardous Waste Management Regulations, etc. The National Green Tribunal Act, 2010 The National Green Tribunal Act(NGT Act), 2010 has been enacted with the objectives to provide for the effective and expeditious disposal

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of cases relating to environment protection and conservation of forests and other natural resources. It also includes enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and

other related matters. The Act deals with all environmental laws relating to air and water pollution, the Environment Protection Act, the Forest Conservation Act and the Biodiversity Act as have been set out in Schedule I of the NGT Act.(https://greentribunal.gov.in › sites › files › act_rules)
NSOU ? CC-GR-08 138 Consequent to enforcement of the National Green Tribunal Act, 2010, the National Environment Tribunal Act, 1995 and the National Environment Appellate Authority Act, 1997 stand repealed, vide notification number So 2570(E) dated October 18,2010.(https://www.iitr.ac.in › environment › NETA_1995)
The
Air (
Prevention and
Control of Pollution) Act, 1981

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The Air (Prevention and Control of Pollution) Act, 1981 is an act to provide for the prevention, control and abatement of air pollution

and for the establishment of Boards at the Central and State levels with a view to carrying out the aforesaid purposes. To counter the problems associated with air pollution, ambient air quality standards were established under the Air Act. The Air Act seeks to combat air pollution by prohibiting the use of polluting fuels and substances, as well as by regulating appliances that give rise to air pollution. The Air Act empowers the State Government, after consultation with the SPCBs, to declare any area or areas within the Sate as air pollution control area or areas. Under the Act, establishing or operating any industrial plant in the pollution control area requires consent from SPCBs. SPCBs are also expected to test the air in air pollution control areas, inspect pollution control equipment, and manufacturing processes.
The Water (Prevention and Control of Pollution) Act, 1974
The

71%	MATCHING BLOCK 129/145	SA	MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

Water (Prevention and Control of Pollution) Act, 1974 has been enacted to provide for the prevention and control of water pollution and to maintain or restore wholesomeness of water in the country.

It further provides for the establishment of Boards for the prevention and
control of water pollution with a view to carry out the aforesaid purposes. The Water Act prohibits the discharge of pollutants into water bodies beyond a given standard, and lays down penalties for non-compliance. At the Centre, the Water Act has set up the CPCB which lays down standards for the prevention and control of water pollution. At the State level, SPCBs function under the direction of the CPCB and the State Government. Further,
the

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Water (Prevention and Control of Pollution) Cess Act was enacted in 1977 to provide for the levy and collection of

a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected with a view to augment the resources of the Central Board and the State
NSOU ? CC-GR-08 139 Boards for

60%	MATCHING BLOCK 128/145	W	

the prevention and control of water pollution constituted under the Water Act, 1974. The Environment Protection Act, 1986 The Environment Protection Act, 1986 (the “

Environment Act”) provides for the protection and improvement of environment. The Environment Protection Act establishes the framework for studying, planning and implementing long-term requirements of environmental safety and laying down a system of speedy and adequate response to situations threatening the environment. It

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is an umbrella legislation designed to provide a framework for the coordination of central and state authorities established under the Water Act, 1974 and the Air Act, 1981.

The term “environment” is understood in a very wide term under s 2(a) of the

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Environment Act. It includes water, air and land as well as the interrelationship which exists between water, air and land, and human beings, other living creatures, plants, micro- organisms and property.

Under the Environment Act, the Central Government is empowered to take measures necessary to protect and improve the quality of environment by setting standards for emissions and discharges of pollution in the atmosphere by any person carrying on an industry or activity; regulating the location of industries; management of hazardous wastes, and protection of public health and welfare. From time to time, the Central Government issues notifications under the Environment Act for the protection of ecologically-sensitive areas or issues guidelines for matters under the Environment Act. In case of any non-compliance or contravention of the Environment Act, or of the rules or directions under the said Act, the violator will be punishable with imprisonment up to five years or with fine up to Rs 1,00,000, or with both. In case of continuation of such violation, an additional fine of up to Rs 5,000 for every day during which such failure or contravention continues after the conviction for the first such failure or contravention, will be levied. Further, if the violation continues beyond a period of one year after the date of conviction, the offender shall be punishable with imprisonment for a term which may extend to seven years. Hazardous Wastes Management Regulations

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Hazardous waste means any waste which, by reason of any of its physical, chemical, reactive, toxic, inflammable, explosive or corrosive characteristics, causes NSOU ? CC-GR-08 140 danger to health or environment, whether alone or when in contact with other wastes or substances.

There are several legislations that directly or indirectly deal with hazardous waste management. The relevant legislations are the Factories Act, 1948, the Public Liability Insurance Act, 1991, the National Environment Tribunal Act, 1995 and rules and notifications under the Environmental Act. Some of the rules dealing with hazardous waste management are discussed below: • Hazardous Wastes (Management, Handling and Transboundary) Rules, 2008, brought out a guide for manufacture, storage and import of hazardous chemicals and for management of hazardous wastes. • Biomedical Waste (Management and Handling) Rules, 1998, were formulated along parallel lines, for proper disposal, segregation, transport, etc, of infectious wastes. •

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Municipal Solid Wastes (Management and Handling) Rules, 2000, aim at enabling municipalities to dispose

municipal solid waste in a scientific manner. In view of the short-comings and overlapping of some categories causing inconvenience in implementation of the Biomedical Waste (Management and Handling) Rules, 1998 as well as the Municipal Solid Wastes (Management and Handling) Rules, 2000, the Ministry of Environment, Forest and Climate Change has formulated the draft Bio-Medical Waste (Management & Handling) Rules, 2015 (Draft BMW Rules) and the draft Solid Waste Management Rules, 2015 (Draft SWM Rules) and sought comments on the draft Rules. The Draft BMW Rules are to replace the Biomedical Waste (Management and Handling) Rules, 1998, and the Draft SWM Rules are to replace the Municipal Solid Waste (Management and Handling) Rules, 2000. The objective of the Draft BMW Rules is to enable the prescribed authorities to implement the rules more effectively, thereby,

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reducing the bio- medical waste generation and also for its proper treatment and disposal and to ensure environmentally sound management

of these wastes, and the Draft SWM Rules aim at dealing with the management of solid waste including its segregation at source, transportation of waste, treatment and final disposal.
NSOU ? CC-GR-08 141 • E - Waste (Management and Handling) Rules, 2011 have been notified on May 1, 2011 and came into effect from May 1, 2012, with primary objective

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to reduce the use of hazardous substances in electrical and electronic equipment by specifying threshold for use of hazardous material and to channelize the e-waste generated in the country for environmentally sound

recycling. The Rules apply to every producer, consumer or bulk consumer, collection centre, dismantler and recycler of e-waste involved in the manufacture, sale, purchase and processing of electrical and electronic equipment or components as detailed in the Rules. •

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Batteries (Management & Handling) Rules, 2001 deal with the proper and effective management and handling of lead acid batteries waste.

The Act requires all manufacturers, assemblers, re-conditioners, importers, dealers, auctioneers, bulk consumers, consumers, involved in manufacture, processing, sale, purchase and use of batteries or components thereof, to comply with the provisions of Batteries (Management & Handling) Rules, 2001. In addition, there are many other laws relating to environment, namely – The Wildlife Protection Act, 1972 The Wild Life (Protection) Act, 1972 was enacted with the objective of effectively protecting the wild life of this country and to control poaching, smuggling and illegal trade in wildlife and its derivatives. The Act was amended in January 2003 and punishment and penalty for offences under the Act have been made more stringent. The Ministry has proposed further amendments in the law by introducing more rigid measures to strengthen the Act. The objective is to provide protection to the listed endangered flora and fauna and ecologically important protected areas. The Forest Conservation Act, 1980 The Forest Conservation Act, 1980 was enacted to help conserve the country's forests. It strictly restricts and regulates the de-reservation of forests or use of forest land for non-forest purposes without the prior approval of Central Government. To this end the Act lays down the pre-requisites for the diversion of forest land for non- forest purposes.

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The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006,

recognises the rights of forest-dwelling Scheduled Tribes and other traditional forest dwellers over the forest areas inhabited by them and provides a framework for according the same.
NSOU ? CC-GR-08 142 The Indian Forest Act, 1927 consolidates

85%	MATCHING BLOCK 141/145	SA	bba 101.pdf (D141385747)

the law relating to forests, the transit of forest-produce and the duty leviable on timber and other forest-produce.

Public Liability Insurance Act, 1991 The Public Liability Insurance Act, 1991 was enacted with the objectives to provide for damages to victims of an accident which occurs as a result of handling any hazardous substance. The Act applies to all owners associated with the production or handling of any hazardous chemicals.) The Biological Diversity Act, 2002 The Biological Diversity Act 2002 was born out of India's attempt to realise the objectives enshrined in the United Nations

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Convention on Biological Diversity (CBD), 1992 which recognises the sovereign rights of states to use their own Biological Resources.

The Act aims at the

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conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner.

The National Biodiversity Authority in Chennai has been established for the purposes of implementing the objects of the Act. Coastal Regulation Zone Notification,2011 The Ministry of Environment and Forests had issued the Coastal Regulation Zone Notification,2011 vide Notification no. S O. 19(E), dated January 06, 2011 with an objective to ensure livelihood security to the fishing communities and other local communities living in the coastal areas, to conserve and protect coastal stretches and to promote development in a sustainable manner based on scientific principles, taking into account the dangers of natural hazards in the coastal areas and sea level rise due to global warming. 12.3 Review of the achievements India has an impressive number of environmental regulations. Have they been a success? While initiatives such as catalytic converters for cars have reduced air pollution, there has been far less success in tackling water pollution. It argues that regulators will only be effective when they are given enough power and legitimacy. Around the world, environmental regulation is one of the key public services that governments provide to their citizens. While these regulations impose costs on
NSOU ? CC-GR-08 143 businesses and households for disposal of pollution in a responsible way, in return they promise better health, a cleaner environment and other related benefits. India is no exception. The original Water Act of 1974 and Air Act of 1981 have dealt with increasingly hazardous pollution levels. Moreover, India has an extensive network of government offices (both at the national and state level) that are designed to implement these regulations. Yet public opinion on the effectiveness of these regulations has not always been positive. There are countless newspaper articles or reports detailing the ineffectiveness of these regulations. Accusations of the mismanagement of funds earmarked for these purposes, ranging from underuse and incorrect reporting to diversion of funds have also been reported. While these reports provide insight into the functioning and challenges of implementing effective environmental regulation in India and elsewhere, what has been missing is systematic evidence on whether the regulations have succeeded in their intended purpose: to reduce air and water pollution. Moreover, these reports do not provide any insight into the overall benefits of the regulations (in terms of pollution reductions and lives saved). For example, even if one policy brings about a large improvement in people's health, the cost may be so high that the money could have been better spent on other health interventions that lead to even larger effects. In recent research new evidence on the effectiveness of these regulations in accomplishing their basic goal of reducing pollution has been recorded(Greenstone and Hanna 2012) withdetail annual data on air pollution for 124 cities and water pollution for 424cities. This way of evaluating policy sheds light on the causal impact of these regulations on pollution levels. The interesting fact is that air pollution has been falling over time. It is about 17% from 1987-1990 to 2004-2007. This change is evident in all the cities in the studied sample. The mandatory adoption of catalytic converters for cars reversed worsening trends in particulate matter and sulfur dioxide concentrations and led to sharp declines in these dangerous forms of air pollution. The Supreme Court Action Plan, implemented in Delhi and other 17 cities helped reduce nitrogen dioxide (which is a precursor of ozone). Were the same successes seen in the water pollution arena? More specifically, would water pollution have been worse if the regulations had not been adopted? The study shows the effect of the National River Conservation Plan (NRCP), which is the

NSOU ? CC-GR-08 144 cornerstone of water pollution regulation in India. All the measures of water pollution failed to find any effect from the programme. Cleaner air but dirtier water Now the question is why the air pollution policy was more successful than the water policy. The history of the regulations provides some insights. The legitimacy of the regulations appears to be a predictor of success. Air pollution policies were often driven by citizen complaints and Supreme Court. This ensures the enforcement of the regulations. In contrast, the water pollution policies were less community driven than the air pollution policies. These policies were undermined by the fact that no institutional body was given the power, resources, and institutional mandate to implement them successfully. 12.4 Summary and Conclusion It can be concluded that environmental regulations in India can be successful at reducing pollution concentrations but only when regulators are sufficiently empowered and motivated. However, the deeper question on the optimal level of environmental regulation remains to be answered. This would require developing reliable estimates of the costs that regulations impose on businesses and households and then comparing them to the benefits to society of pollution reductions in terms of health and other areas. It is also critical to experiment with market-based forms of regulation that can achieve pollution reductions at lower costs. 12.5 Reference 1. Asian Development Bank. 2007. "Yamuna Action Plan – India." In Asian Water Development Outlook 2007: Achieving Water Security for Asia. Manila: Asian Development Bank. CD-ROM. B 2. Tanaka, Shinsuke. 2012. "Environmental Regulations on Air Pollution in China and Their Impact on Infant Mortality." Unpublished. 3. "THE ENVIRONMENT (PROTECTION) ACT, 1986". envfor.nic.in. Archived from the original on 13 June 2002. Retrieved 27 August 2015. "Archived copy" (PDF). Archived from the original (PDF) on 10 August 2013. Retrieved 13 November 2017.

NSOU ? CC-GR-08 145 4. "THE INDIAN WILDLIFE (PROTECTION) ACT, 1972". envfor.nic.in. Retrieved 27 August 2015. 5. https://www.iitr.ac.in › environment › NETA_1995 6. https://greentribunal.gov.in › sites › files › act_rules 12.6 Model Questions 1. What are Environmental legislations and how are they important for environmental improvement and conservation? 2. What are National Legislations and International Legislations? How are they are different from each other? 3. Describe in brief some pollution related acts. 4. What are Ramsar Convention and Montreal Protocol? Describe in brief. 5. Describe the Environmental Protection Act, 1986 6. What is main aim of biodiversity act and its salient features? 7. What are the main objectives of climate convention? 8. Write short note on (a) Water Act (b) Air Act, (c) Wildlife Act, (d) Forest Act

NSOU ? CC-GR-08 146 Unit 13 ?

Principles of wasteland management with special reference to West Bengal

Structure 13.0 Objective 13.1 Introduction 13.2 Classification 13.3 Causes of Wasteland Formation 13.4 Wasteland Management in West Bengal 13.5 Summary and Conclusion 13.6 Reference 13.0 Objective • Learners will come to know about the concept of wasteland management • The principles of wasteland management 13.1 Introduction Agriculture continues to be the main economic activity in rural areas of the developing world in spite of a steady diversification of their economic base during the preceding decades. Agriculture will continue to dominate rural economy of these areas for a long time to come. It is natural, therefore, that the availability of land, and its use pattern in agriculture would remain issues of extreme importance to policy planners. Land is not only a highly scarce resource but is also a non-reproducible means of production. In India, population pressures, and ever declining land : man ratio, preponderance of small and fragmented holdings, highly iniquitous land distribution structure, etc., has tremendous significance on land-population balance. Further, the limited capability of the urban-industrial sector to absorb the expanding rural labour force would keep a vast majority of work-seekers tagged to land, principally in agricultural activities, and to some extent, in diverse non-farm

NSOU ? CC-GR-08 147 jobs in and around the villages. From every conceivable angle, therefore, the most crucial and most vexatious issue in rural India would be of land availability. In a broad sense, the availability of land and its pattern of use in agriculture by itself would set the future pattern of India's development, most ostensibly the farm non- farm linkages, the rural-urban migration, the incidence of rural-urban poverty, and so on. The problem of declining land: man ratio gets exasperated through the increasing incidence of wastelands. Both nature and man-induced factors are at work in pushing more and more of cultivable area out of use for agricultural production, food supply and rural well-being. Inadequate property rights (most crucially access to land), poverty, population pressure and declining land-man ratio, inappropriate government policies, and lack of access to markets, credit, and technologies appropriate for sustainable agricultural development, etc., are the more glaring among such factors. Nature also contributes sizeable to the process of wasteland formation, in many different ways. For example, the continuous wind erosion takes away the top soil. Rill and gulley erosion leads to ravine formation. Floods lead to sand deposition which affects fertility status of the soil and in certain cases, renders land unfit for cultivation (Singh, et al., 1988). Desert, snow covered areas, glacial areas with unassorted sediments, impeded natural drainage and poor soils, barren and rocky surface, and steep sloping areas, etc., are all manifestation of nature's hand work in restricting man's access to cultivable land. Thus, Wasteland is that land which is presently lying unused or which is not being used to its optimum potential due to some constraints. 13.2 Classification National wastelands development board classifies wastelands into two categories: 1. Cultivable wastelands (Left uncultivated for more than five years) 2. Uncultivable wastelands which cannot be used for vegetation. The cultivable wastelands have been classified into a. Gullied and/or ravenous lands b. Undulating land without shrubs NSOU ? CC-GR-08 148 c. Surface waterlogging land and marsh d. Salt affected land e. Shifting cultivation area f. Degraded forestland g. Degraded pasture / grazing land h. Degraded forest plantations i. Strip lands j. Sand dunes k. Mining / industrial wastelands Uncultivable wastelands are classified as a) Brown rocky / stony / shut of rocks b) Steep sloppy areas c) Snow covered and / or glacier lands National remote Sensing Agency (NRSA) estimates put wastelands at 16.21% of the total land area of the country amounting to 129.57mha. The maximum waste lands are found in Jammu and Kashmir(60%). 13.3 Causes of Wasteland Formation a) Deforestation b) Over-cultivation c) Over grazing d) Unskilled irrigation e) Improper developmental activities such as dumping of wastes, mine wastes The main principles of wasteland management are: Utilizing land according to its capacity. • Putting adequate vegetal cover on the soil. • Conserving as much rainwater as possible at the place where it falls both at farmlands and common property resources • In-situ conservation. The major activities taken up under the scheme are: • In situ soil and moisture conservation measures like terracing, bunding, trenching, vegetative barriers and drainage line treatment. • Planting and sowing of multi-purpose trees, shrubs, grasses, legumes and pasture land development.

NSOU ? CC-GR-08 149 • Encouraging natural regeneration. • Promotion of agro-forestry & horticulture. • Wood substitution and fuel wood conservation measures. • Awareness raising, training & extension programmes. • Encouraging people's participation through community organization and capacity building. • Drainage Line treatment by vegetative and engineering structures • Development of small water Harvesting Structures. • Afforestation of degraded forest and non forest wasteland. • Development and conservation of common Property Resources. 13.4 Wasteland Management in West Bengal West Bengal Wasteland Development Corporation Ltd. The primary objective of the West Bengal Wasteland Development Corporation Ltd. (WBWDC Ltd). was greening of wasteland and degraded land in the State of West Bengal along with allied forestry activities. Starting with the creation of plantations on waste land and supply of organic fertilisers to forest divisions, it gradually started diversifying into activities such as landscaping, creation of green shelter belts, timber harvesting, creation of theme parks, building nature interpretation centre and aesthetically appealing animal enclosures and roadside beautification.(W.B Forest.gov.in) Objective • The overall objectives of WBWDCL is to develop wastelands through appropriate technology and financial support for productive use. Within this framework the pertinent part would consist of treatment of wasteland through raising variety of plantations to meet economic as well as environmental needs to be raised in wasteland. The plantations not only to ensure easy availability of firewood, timber, fodder, bamboo, fruits and associated forest product but also help in improvement of soil and moisture regime, the two basic physical inputs for increasing land productivity.

NSOU ? CC-GR-08 150 • To acquire, purchase or obtain by lease, on contract, gift or otherwise wasteland from the Govt. of West Bengal together with other assets, properties, rights and liabilities of whatsoever nature of the Govt. appertaining to or in any way concerning such land and all rights, obligations and liabilities of the Govt. under the contract or agreement entered into by the Governor of West Bengal with any person, firm or company in relation to the said land or assets firstly in the districts of Bankura, Purulia, western part of Medinipur and other within the areas of West Bengal. • To expeditiously develop wasteland by raising plantations. Tall Tree Nursery Tall Tree Nursery which is spread over 7 Acres at Rajarhat is a joint venture between West Bengal Housing Infrastructure Development Corporation Ltd. and West Bengal Wasteland Development Corporation Ltd. The objective of creation of this nursery is to provide adequate number of tall saplings of 2 years and more in age and about 4 Ft. and above in height for plantation along boulevards, roadsides and in organisations in and around Kolkata. This nursery will also provide high quality seedlings to purchase by various private organisations and individuals. It has been an endeavour to make the entire process of sale online for easier transactions and transparency. The present West Bengal Government has undertaken wasteland management through bamboo plantation on an experimental basis in Birbhum district. Funded by the Union Science and Technology and Biotechnology department, the pilot project is being implemented in tribal-dominated Rajnagar block in Birbhum district by the scientists of the West Bengal State Council of Science and Technology (WBSCST) with the help of the local women Self-Help Group in collaboration with Birbhum Zilla Parishad. 13.5 Summary and Conclusion In general, it has been realised that wasteland development at present should be treated as an indispensable part of total economic planning instead of looking at it as a special problem area. The objective of wastelands development must be to achieve a sustainable development through its integration with statutory rural

NSOU ? CC-GR-08 151 development planning system. To attain the objective, new policies are necessary for covering the gaps of existing policies, which cover a wide range of aspects of wasteland development, like - (i) demarcation of waste lands, (ii) formulation of integrated land use plan and (iii) identification of specific area for promulgation of Act and rules for control and regulation of the land use in wastelands. Framing detail action level policies on these aspects are important tasks for the Government for making wastelands development programme a success story. 13.6 Reference • Greenstone, M and R Hanna (2012), "Environmental Regulations, Air and Water Pollution, and Infant Mortality in India", NBER WP # 17210; MIT Dept. of Economics WP No. 11-11, 2011; CEEPR WP 2011-014. Revision requested by American Economic Review. • United Nations. "Documents: Agenda 21." December 15, 2004. http://www.un.org/ esa/sustdev /documents/agenda21/index.htm (accessed April 21, 2008). • United Nations. "Earth Summit 2002." March 24, 2003. http://www.un.org/ jsummit/ (accessed May 1, 2008). • United Nations. "Johannesburg Declaration on Sustainable Development." http:/ /www.un-documents.net/jburgdec.htm (accessed May 1, 2008). • United Nations. "

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Our Common Future: Report of the World Commission on Environment and Development."		

http://www.un-documents.net/ocf- ov.htm#
I (accessed April 27, 2008). • United Nations. "

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Plan of Implementation of the World Summit on Sustainable Development."		

http://www.un-documents.net/jburgpln.htm (accessed May 1, 2008). • Ram Parkash 1986 Forest Management, International Book Distributors Dehra Dun

NSOU ? CC-GR-08 152 Unit 14 ?

Principles of forest management with special reference to West Bengal

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Structure 14.0 Objective 14.1 Introduction 14.2 Functions and scope 14.3 Principles of Forest Management 14.4 Methods of Forest Management 14.5 Drivers of the policy changes in West Bengal 14.6 Summary and Conclusion 14.7 Reference 14.0 Objective • To have an understanding of the forests in India, which are mostly state owned, and how they are managed for various purposes, namely productive, protective, recreational and bio-aesthetic. 14.1 Introduction Definition: Forest management is defined as the practical application of the scientific, technical and economic principles of forestry. Not a basic subject in itself, forest management is concerned with practical application of science, technology and economics to a forest estate for achievement of certain objectives. The subjects on which forest management is grounded are Silviculture, Ecology, Geology, Soil Science, Botany, Mensuration, Pathology, Economics, Finance etc. 14.2 Functions and scope It follows from the definition that forest management aims to achieve three main functions, namely, (1) Control of composition and structure of growing stock; (2)
NSOU ? CC-GR-08 153 Harvesting and marketing of forest produce; (3) Administration of forest property and personnel. It is the job of forest managers to constantly manage the growing stock to achieve given objects of management. The scope of management encompasses a wide range of activities. Some major activities are • Site adaptation; • Choice of species; • Manipulation of stands; • Harvesting the produce; • Regeneration; • Protection; • Transportation and communication; • Marketing data; • Sale of produce; • Value addition; • Revenue; • Distribution of benefits; • Forest organization; • Management of personnel; • Monitoring and evaluation of works; • Financial management and efficiency • Integration in rural development. 14.3 Principles of Forest Management The objects of forest management in the regional and local level should be so formulated that they are in perfect harmony with the fundamental principles of forest management as embodied in National Forest Policy (1988). It defines the job of conservation as one which includes preservation, maintenance, sustainable utilisation, restoration, and enhancement of the natural environment. According to this Policy, the ESSENTIALS OF FOREST MANAGEMENT will be—
NSOU ? CC-GR-08 154 • Existing forests and forest lands should be fully protected and their productivity should be improved. Forest and vegetal cover should be increased rapidly on hill slopes, in catchment areas of rivers, lakes and reservoirs and ocean shores and, on semi-arid, and desert tracts. • Diversion of good and productive agricultural lands to forestry should be discouraged in view of the need for increased food production. • For the conservation of total biological diversity, the network of national parks, sanctuaries, biosphere reserves and other protected areas should be strengthened and extended adequately. • Provision of sufficient fodder, fuel and pasture, specially in areas adjoining forest, is necessary in order to prevent depletion of forests beyond the sustainable limit. Since fuelwood continues to be the predominant source of energy in rural areas, the programme of afforestation should be intensified with special emphasis on augmenting fuelwood production to meet the requirement of the rural people. • Minor forest produce provides sustenance to tribal population and to other communities residing in and around the forests. Such produce should be protected, improved and their production enhanced with due regard to generation of employment and income. 14.4 Methods of Forest Management Afforestation, Social Forestry & Farm Forestry • A massive

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need-based and time bound programme of afforestation and tree planting,

with particular emphasis on fuelwood and fodder development, on all degraded and denuded lands in the country, whether forest or non-forest land. • To encourage the planting of trees along the sides of

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roads, railway lines, rivers and streams and canals, and on other unutilised lands under State/ corporate, institutional or private ownership. •

Village and community lands, not required for other productive uses, should be taken up for the development of tree crops and fodder resources.

NSOU ? CC-GR-08 155 Technical assistance and other inputs necessary for initiating such programmes should be provided by the Government. The revenues generated through such programmes should belong to the panchayats where the lands are vested in them; in all other cases, such revenues should be shared with the local communities. The vesting, in individuals, particularly from the weaker sections (such as landless labour, small and marginal farmers, scheduled castes, tribals, women) of certain ownership rights over trees, could be considered, subject to appropriate regulations. Beneficiaries would be entitled to usufruct and would in turn be responsible for their security and maintenance. • Land laws should be so modified wherever necessary so as to facilitate and motivate individuals and institutions to undertake tree-farming and grow fodder plants, grasses and legumes on their own land. Appropriate regulations should govern the felling of trees on private holding. West Bengal is in many ways the pioneer of forest management in India. It was part of the region that saw the introduction of forest management during the Mauryan Dynasty (circa 321 B.C. to 184 B.C.). Later, under the British Colonial administration the northern forests were amongst the first areas to be declared as Reserved Forests,(forests which are accorded with certain degree of protection. This term was first introduced in the India Forest Act,1927) a process that was later extended to the entire country. The recently introduced Joint Forest Management (JFM) also had its origin in West Bengal; in the Arabari forest experiment of 1972 (in Midnapore District), and was also later adopted across India from 1990 onwards. The number of Forest Protection Committees (FPCs) in West Bengal has grown rapidly in recent years under the Joint Forest Management scheme. It grewfrom 600 in 1989, to 1,738 by 1991, and has swelled to 3,614 by the end of 2001, with a total of 415,200 members. Large parts of the forest area in a degraded condition (including plantations) have been put under the protection of FPCs. The West Bengal Forest Department estimated that 60% of the FPCs in South West Bengal is 'good' to 'very good' (i.e. active) while the figure is only 30% in North Bengal. For West Bengal the percentage of active groups averages about 50% of the total. The total area formally transferred to the protection of the people is 529,945 ha., about 44% of the total forest area of the state.

NSOU ? CC-GR-08 156 Some of these factors emanated from the political and social action of the people, others were from the state. Perhaps the most important contributing cause was the continued dependence of the people on the forests for their subsistence needs. Their continued use of the forest, in spite of forest protection staff harassing them, led to violent clashes between the two, which obviously had to be resolved. The second important factor was specific to North Bengal, where the taungya villagers began demanding cash for forest work that they had historically performed for free as part of a long term arrangement with the Forest Department(FD). The third factor was the outbreak of Naxalism in the early seventies, a radical movement for people's empowerment. There were also state-related factors involved not specific to forestry although their fall-out has influenced participatory forestry. These include the electoral success of the Left Front Government in 1977 and their distribution of surplus land to landless people, providing tenancy rights to bargadarsand the promotion of the elected panchayat system throughout the state. Through JFM, the FPC members receive conditional entitlements to collect dry firewood and other subsistence forest products unharassed, plus 25% net revenue from timber marketed from the forest; on the condition that they protect the forest from theft and damage. In case there is a breach of conditions, the FD have the power to revoke the JFM agreement. But no such case has happened so far, and the FD is not likely to take such action, as a single such action could jeopardize the whole JFM operation. Considering the provisions of JFM in West Bengal, there are three stakeholders: the FPC members, the Forest Department and to a lesser extent the Panchayat Samity/Gram Sabha. The FD has not encouraged Non-Governmental Organisations to be involved in the execution of JFM, other than in a few cases where the department has specifically permitted an NGO to be associated with FPCs as a consultant for an operation. The perspectives, objectives and strategies of the FD are found to be quite different from those of the FPCs. The FD's commitment to JFM clearly comes from their interest in protection and up-gradation of degraded forests, without wishing to make any change in the forest management system that they had conventionally pursued. The implementation strategy of the FD, in translating these twin objectives into action, is to promote participation of the FPC, by making them fully responsible in forest protection. It does not give them any decision-making powers in respect of

NSOU ? CC-GR-08 157 forest management methods, marketing, micro-plan status of JFM.It is a 'two-way street', one which can lead both to gr eat heights of ecological resurrection, social empowerment and livelihood improvements, and the other to ecological, livelihood and empowerment downturns. 14.5 Drivers of the policy changes in West Bengal In the post-colonial period, there has been forest management in West Bengal. There has been a major change in policy and forest Management in West Bengal away from 'Classical Forest Management' pattern towards Joint Forest Management. Participation of the people in state forest management, in the very restricted form, made its appearance for the first time in about 150 years. (Although on the other hand in the significant areas of West Bengal's forests that were nationalised after independence the people initially enjoyed extensive use and management rights, until the state extinguished rights by 1971) The Forest Department realized during the 1970s and 1980s that it is beyond them to manage the forests with the forest staff or according to the forest management system that it had adopted in the postcolonial period. For a long while they thought that protection could be improved by increasing the number of staff. In 1980, the staff number went on swelling even in the immediate past decade. The State Report of West Bengal Forests for the year 1990- 91 mentions the number of senior posts as 120 and 6,345 posts of all other categories. In 2001, it reports 239 and 11,778 showing that the Department has increased its staff by about 100% in 10 years without any significant gain either in the forest area, the quality of forest and its ecosystem. The FD failed to close the gap between demand and supply of the major forest produces. It indicates that JFM has been part of the continuing strategy of expanding and extending the FD 'empire'. But how and why such massive staff increases took place is certainly intriguing, as in most other states recruitments have been strictly limited since the late 80s, leading to another type of crisis. Social Forestry did not 'wean' local people away from the use of state appropriated forest as a common property resource. The people disposed the additional wood produced by them in their own land to cater to industrial and urban needs. Their dependence on the local forest for firewood and grazing was not reduced.
NSOU ? CC-GR-08 158 The people at large, but particularly those near the forest, had shown their disapproval for the Department's way of functioning through a number of local but violent protests which resulted in the death and injury of a number of people including both activists and Forest Department staff. The 1980s saw the forest staff more or less staying away from their duty of forest protection partly due to the violent nature of protests as well as mafia operation in timber smuggling. A small number of forest staff realised the value of participation as the way out of the impasse and they worked proactively to bring about the change, and indeed, with people taking over a large part of protection this impasse was effectively resolved. It became clear from two success stories (namely of the Arabari experiment in the 1970s, and farm and social forestry in the 1980s) that local people would constructively assist in the growth and development of forest provided they had benefits from its management. The Arabari experiment also indicated that the people were not thieves as they were being labelled, but long-standing users who had to satisfy some legitimate demands namely their home needs of and subsistence support for their livelihood from the forest resources. The change in the central policy of 1988 was another driving force that expedited the implementation of participatory forestry. In addition, some enabling features helped in driving management towards participatory management Positive Aspects 1. The women and the poor in many FPC associated forests have got back a certain amount of dignity as they are generally out of the clutches of the 'law and order guardians' of the FD Women normally do the collection. In addition, the women specially the poor would go to the FPC areas to collect dry and fallen firewood for sale in the local market. This is done especially in the winter and summer. 2. A reasonably friendly relationship has developed between the FD and the FPC members. 3. Involved FPCs families are receiving a sustained income from JFM. 4. A number of different local activities have received institutional suppo rt from the FPCs. These include micro-saving, women group participation,

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NSOU ? CC-GR-08 159 involvement in eco-tourism etc. The last, facilitated by West Bengal Forest Development Corporation, has been internalized by the FPCs. Such areas are few in numbers at present but are quite popular with the local people and also people from distant urban places. Few FPC members are trained in cooking and as caretakers. The visitors have to take their services during their stay in the forest cottages. 5. Some improvement in bio diversity and forest quality has taken place in forests, especially in SW Bengal. 6. Employment opportunities have gone up in certain areas. Negative Aspects 1. The West Bengal JFM orders have not fully reflected the GoIs policies and orders relating to JFM in fundamental ways: 2. The GoIs forest policy objectives of 1988 state thus: • First, to maintain country's environment stability through preservation; • Second, to conserve the natural forests; • Third, meeting the basic needs of people specially fodder, small timber and maintaining the relationship between tribal and the fringe people by protecting their customary rights on the forest. One of the strategies to do the last is to actively involve the people in the conservation of the forest 2. JFM Micro plans failed to reflect local people's needs: 3. FD failed to manage the forests to achieve JFM from technical and social point of view. 4. FD failed to socially manage the forests to achieve JFM objectives; 5. No consideration is given to compensate those deprived of them income as JFM is introduced in the village 6. Lack of interest of many forest officials in promotion of JFM 7. Lack of proper institutionalization in FPCs of decision-making, monitoring and other processes.

NSOU ? CC-GR-08 160 14.6 Summary and Conclusion This mismatch between what is demanded and the attempts of officials to produce only those products which they had routinely learnt to produce borders on intellectual blindness. And yet the foresters are adamant not to make any significant change in their perspective, nor to empower the people to take over as a dominant partner in management, as they claim local people are ignorant of forestry. 14.7 Reference 1. Husain, M (2002), Human Geography, Rawat Publications, New Delhi 2. Singh, S (2008), Environmental Geography, PrayagPustak Bhawan 3. http://www.environment-agency.gov.uk/ Environment Agency 4. C.C. Park, 1980 5. https://www.researchgate.net/publication/308439067_Concept_scope_and_ Approaches_of_Environmental_studies

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deterministic approach 1.4.2 Teleological approach 1.4.3 Possibilistic approach 1.4.4 Economic deterministic approach 1.4.5 Ecological approach 1.4.6

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2/145	SUBMITTED TEXT	15 WORDS	76%	MATCHING TEXT	15 WORDS

sum total of conditions which surrounded humans at a given point in space and time.

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can be perceived and evaluated in a variety of ways and approaches.

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environment relationship change through time with the development of human society and the dimension of environment. Thus the

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5/145	SUBMITTED TEXT	18 WORDS	82%	MATCHING TEXT	18 WORDS

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Charles Darwin in 1859 laid the foundation stone of the concept of environmental influences on humans and other	Charles Darwin, in 1859 laid the foundation stone of the concept of environment influences on man and other

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6/145	SUBMITTED TEXT	17 WORDS	85%	MATCHING TEXT	17 WORDS

environment relationships can be perceived and evaluated in a variety of ways and approaches. 1.4.1 Environmental deterministic approach

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7/145	SUBMITTED TEXT	19 WORDS	80%	MATCHING TEXT	19 WORDS

All aspects of human life viz. physical, social, economic, political, ethical and aesthetic etc. are dominantly controlled by physical environment.

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product of the earth's surface. This means not merely that he is a child of the earth, dust of her dust, but the earth has mothered him,

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confronted him with difficulties that have strengthened his body and sharpened his wits, given him his problems of irrigation and navigation and at same time whispered hints for their

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teleological approach is based on religious faith of man being superior to nature and all other creatures. This

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possibilistic approach to the study of man-environment relationships emerged through the criticism of environmental determinism and overtone of teleological approach. Right from the inception of the school of environmental determinism there was dissenting voice raised by those who believed that 'no doubt physical environment influences man and his activities but there is ample scope for man to change the environment so much so that it becomes suitable for man and his society'.

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Febvre, 'There are no necessities, but everywhere possibilities and man as a master of these possibilities is the judge of their use', (

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Economic deterministic approach This approach is based on the basic ideology of

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on wise and restrained use of natural resources, application of appropriate environmental management programmes, policies and strategies keeping in view	on wise and restrained use of natural resources, application of appropriate environmental management programs, policies and strategies keeping in view

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s mastery over environment and continued economic and industrial expansion through the application of modern technologies.

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It may be pointed out that this concept of economic determinism led to rapacious exploitation of natural resources in the western developed countries and thus created most of the environmental and ecological problems of global dimensions. 1.4.5 Ecological approach Ecological approach to the study of man-environment relationships is based on the basic principles of ecology which is the study of mutual interactions between organisms and physical environment, on the one hand and interactions among the organisms, on the other hand in a given ecosystem. Thus, man is considered as an integral part of environment. '

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17/145	SUBMITTED TEXT	16 WORDS	96%	MATCHING TEXT	16 WORDS

The complex physical, chemical and biotic factors such as climate, soil and living things that act

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18/145	SUBMITTED TEXT	79 WORDS	35%	MATCHING TEXT	79 WORDS

life is tied with the environment. Social sciences have borrowed the concept of ecology from biology. As a branch of biology, ecology is the study of the relationship between living beings and their environment. Sociology has been greatly influenced by biology. Sociology also studies the relationship between man and environment through ecology. Field of study of human ecology in sociology is centered around man and his environment. The credit of beginning the study of human ecology in the field of sociology goes to Park and Burgess.

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19/145	SUBMITTED TEXT	54 WORDS	83%	MATCHING TEXT	54 WORDS

Environment The term environment has been derived from a French word “Environia” means to surround. It refers to both abiotic (physical or non-living) and biotic (living) environment. The word environment means surroundings, in which organisms live. Environment and the organisms are two dynamic and complex component of nature. Environment regulates the life of the organisms including human beings.

SA Environmental science foundation final 7 new.pdf (D20505635)

20/145	SUBMITTED TEXT	16 WORDS	100%	MATCHING TEXT	16 WORDS

the sum total of conditions that surrounds us at a given point of time and space.

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21/145	SUBMITTED TEXT	19 WORDS	100%	MATCHING TEXT	19 WORDS

It is comprised of the interacting systems of physical, biological and cultural elements which are interlinked both individually and collectively.

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in which an organism has to survive or maintain its life process. It

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environment as anything surrounding an object and exerting a direct influence on it while E. J. Ross explains environment as an external force which influences

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24/145	SUBMITTED TEXT	21 WORDS	87%	MATCHING TEXT	21 WORDS
Ecosystem: Living organisms cannot live isolated from their non-living environment because the latter provides materials and energy for the survival of the			ECOSYSTEM Living organisms cannot be isolated from their non-living environment because the later provides materials and energy for the survival of the		

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25/145	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS
An ecosystem is, therefore, defined as a natural functional ecological unit comprising of living organisms (			An ecosystem is therefore defined as a natural functional ecological unit comprising of living organisms		

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environment that interact to form a stable self-supporting system.			environment that interact to form a stable self supporting system.		

W https://pdfcoffee.com/ge6351-evs125pages-pdf-free.html

27/145	SUBMITTED TEXT	28 WORDS	87%	MATCHING TEXT	28 WORDS

Components of Environment: Environment mainly consists of atmosphere, hydrosphere, lithosphere and biosphere. But it can also be divided into other types such as (a) Micro environment and (b) Macro

SA bba 101.pdf (D141385747)

28/145	SUBMITTED TEXT	61 WORDS	95%	MATCHING TEXT	61 WORDS

as (c) Physical and (d) biotic environment. Micro environment refers to the local surrounding of the organism. Macro environment refers to all the physical and biotic conditions that surround the organism externally. Physical environment refers to all abiotic factors like temperature, light, rainfall, soil, minerals etc. It comprises of atmosphere, lithosphere and hydrosphere. Biotic environment includes all biotic factors or living forms like plants, animals, micro-organisms. 2.4

SA bba 101.pdf (D141385747)

29/145	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

A pond, lake, desert, grassland, meadow, forest etc. are common examples of ecosystems.

SA Lesson 1 GJUST Final SBaskar 2018.docx (D40064421)

Ouriginal by Turnitin

30/145 SUBMITTED TEXT 215 WORDS	100% MATCHING TEXT 215 WORDS
Soils are much more complex than simple sediments. They contain a mixture of weathered rock fragments, highly altered soil mineral particles, organic matter, and living organisms. Soils provide nutrients, water, a home, and a structural growing medium for organisms. The vegetation found growing on top of a soil is closely linked to this component of an ecosystem through nutrient cycling. The atmosphere provides organisms found within ecosystems with carbon dioxide for photosynthesis and oxygen for respiration. The processes of evaporation, transpiration and precipitation cycle water between the atmosphere and the Earth's surface. Solar radiation is used in ecosystems to heat the atmosphere and to evaporate and transpire water into the atmosphere. Sunlight is also necessary for photosynthesis. Photosynthesis provides the energy for plant growth and metabolism, and the organic food for other forms of life. Most living tissue is composed of a very high percentage of water, up to and even exceeding 90%. The protoplasm of a very few cells can survive if their water content drops below 10%, and most are killed if it is less than 30-50%. Water is the medium by which mineral nutrients enter and are translocated in plants. It is also necessary for the maintenance of leaf turgidity and is required for photosynthetic chemical reactions. Plants and animals receive their water from the Earth's surface and soil. The original source of this water is precipitation from the atmosphere.(	Soils are much more complex than simple sediments. They contain a mixture of weathered rock fragments, highly altered soil mineral particles, organic matter, and living organisms. Soils provide nutrients, water, a home, and a structural growing medium for organisms. The vegetation found growing on top of a soil is closely linked to this component of an ecosystem through nutrient cycling. The atmosphere provides organisms found within ecosystems with carbon dioxide for photosynthesis and oxygen for respiration. The processes of evaporation, transpiration, and precipitation cycle water between the atmosphere and the Earth's surface. Solar radiation is used in ecosystems to heat the atmosphere and to evaporate and transpire water into the atmosphere. Sunlight is also necessary for photosynthesis. Photosynthesis provides the energy for plant growth and metabolism, and the organic food for other forms of life. Most living tissue is composed of a very high percentage of water, up to and even exceeding 90%. The protoplasm of a very few cells can survive if their water content drops below 10%, and most are killed if it is less than 30-50%. Water is the medium by which mineral nutrients enter and are translocated in plants. It is also necessary for the maintenance of leaf turgidity and is required for photosynthetic chemical reactions. Plants and animals receive their water from the Earth's surface and soil. The original source of this water is precipitation from the atmosphere.

W http://www.physicalgeography.net/fundamentals/9j.html

31/145	SUBMITTED TEXT	97 WORDS	98%	MATCHING TEXT	97 WORDS

The term ecosystem was coined in 1935 by the Oxford ecologist Arthur Tansley to encompass the interactions among biotic and abiotic components of the environment at a given site. The living and non-living components of an ecosystem are known as biotic and abiotic components, respectively. Ecosystem was defined in its presently accepted form by Eugene Odum as, “an unit that includes all the organisms, i.e., the community in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycles, i.e., exchange of materials between living and non-living, within the system”.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

32/145	SUBMITTED TEXT	23 WORDS	47%	MATCHING TEXT	23 WORDS

are mainly of two types: (a) Climatic Factors include rain, temperature, light, wind, humidity etc. 1. (b) Edaphic Factors include soil, topography, minerals

SA 003E1140_Environmental Studies.docx (D164979189)

33/145	SUBMITTED TEXT	47 WORDS	100%	MATCHING TEXT	47 WORDS

The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compounds namely water and carbon dioxide. This process is known as photosynthesis. As the green plants manufacture their own food they are known as

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

34/145	SUBMITTED TEXT	38 WORDS	100%	MATCHING TEXT	38 WORDS

Autotrophs (i.e. auto = self, trophos = feeder) The chemical energy stored by the producers is utilised partly by the producers for their own growth and survival and the remaining is stored in the plant parts for their future use. (

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

35/145	SUBMITTED TEXT	29 WORDS	100%	MATCHING TEXT	29 WORDS

Primary Consumers or First Order Consumers or Herbivores: These are the animals which feed on plants or the producers. They are called herbivores. Examples are rabbit, deer, goat, cattle etc. (

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

36/145	SUBMITTED TEXT	26 WORDS	100%	MATCHING TEXT	26 WORDS

Secondary Consumers or Second Order Consumers or Primary Carnivores: The animals which feed on the herbivores are called the primary carnivores. Examples are cats, foxes, snakes etc. (

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

37/145	SUBMITTED TEXT	19 WORDS	92%	MATCHING TEXT	19 WORDS

Tertiary Consumers or Third Order Consumers: These are the large carnivores which feed on the secondary consumers. Example are Wolves. (

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

38/145	SUBMITTED TEXT	32 WORDS	85%	MATCHING TEXT	32 WORDS

Consumers or top predators or Omnivores: These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are lions and tigers. (C) Decomposers or

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39/145	SUBMITTED TEXT	65 WORDS	100%	MATCHING TEXT	65 WORDS

They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food and release to the environment the simple inorganic and organic substances produced as by-products of their metabolisms. These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic community and the abiotic environment of the ecosystem. The decomposers are known as Saprotrophs (i.e., sapros = rotten, trophos = feeder)

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

40/145	SUBMITTED TEXT	129 WORDS	96%	MATCHING TEXT	129 WORDS

an ecosystem has physical, chemical, and biological components along with energy sources and pathways of energy and materials interchange. The environment in which a particular organism lives is called its habitat. The role of an organism in a habitat is called its niche. For the study of ecology it is often convenient to divide the environment into four broad categories. 1. Terrestrial environment - The terrestrial environment is based on land and consists of biomes, such as grasslands, one of several kinds of forests, savannas, or deserts. NSOU ? CC-GR-08 39 2. Freshwater environment - The freshwater environment can be further subdivided between standing-water habitats (lakes, reservoirs) and running-water habitats (streams, rivers). 3. Oceanic marine environment - The oceanic marine environment is characterized by saltwater and may be divided broadly into the shallow waters of the continental shelf composing the neritic

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

41/145	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

Oceanic region - The deeper waters of the ocean that constitute the oceanic region

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

42/145	SUBMITTED TEXT	81 WORDS	96%	MATCHING TEXT	81 WORDS

major subdivisions of modern ecology are • Ecosystem ecology - which views ecosystems as large units, and • Population ecology - which attempts to explain ecosystem behaviour from the properties of individual units. In practice, the two approaches are usually merged. Descriptive ecology describes the types and nature of organisms and their environment, emphasizing structures of ecosystems and communities and dispersions and structures of populations. Functional ecology explains how things work in an ecosystem, including how populations respond to environmental alteration and how matter and energy move through ecosystems.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

43/145	SUBMITTED TEXT	28 WORDS	100%	MATCHING TEXT	28 WORDS

Regulatory functions: This group of functions relates to the capacity of natural and semi-natural ecosystems to regulate essential ecological processes and life support systems through bio-geochemical cycles and other

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

44/145	SUBMITTED TEXT	42 WORDS	100%	MATCHING TEXT	42 WORDS

processes. In addition to maintaining the ecosystem (and biosphere health), these regulatory functions provide many services that have direct and indirect benefits to humans (i.e., clean air, water and soil, and biological control services). (2) Habitat functions: Natural ecosystems provide refuge and a reproduction habitat to

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

45/145	SUBMITTED TEXT	32 WORDS	100%	MATCHING TEXT	32 WORDS

Submitted text	Matching text
Ecosystems are made up of abiotic (non-living, environmental) and biotic components, and these basic components are important to nearly all types of ecosystems. Ecosystem ecology looks at energy transformations and biogeochemical cycling within	Ecosystems are made up of abiotic (non-living, environmental) and biotic components, and these basic components are important to nearly all types of ecosystems. Ecosystem Ecology looks at energy transformations and biogeochemical cycling within

W https://globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem/ecosystem.html

Ouriginal
by Turnitin

46/145	SUBMITTED TEXT	158 WORDS	94%	MATCHING TEXT	158 WORDS

ecosystems. Energy is continually is added into an ecosystem in the form of light energy, and some energy is lost with each transfer to a higher trophic level. Nutrients, on the other hand, are recycled within an ecosystem, and their supply normally limits biological activity. So, “energy flows, elements cycle”. Energy is moved through an ecosystem via a foodweb, which is made up of interlocking food chains. Energy is first captured by photosynthesis (primary production). The amount of primary production determines the amount of energy available to higher trophic levels. The study of how chemical elements cycle through an ecosystem is termed biogeochemistry. A biogeochemical cycle can be expressed as a set of stores (pools) and transfers, and can be studied using the concepts of “stoichiometry”, “mass balance”, and “residence time”. Ecosystem function is controlled mainly by two processes, “top-down” and “bottom-up” controls. NSOU ? CC-GR-08 49 A biome is a major vegetation type extending over a large area. Biome distributions are determined largely by temperature and precipitation patterns on the Earth’s surface. 4.9

ecosystems. • Energy is continually input into an ecosystem in the form of light energy, and some energy is lost with each transfer to a higher trophic level. Nutrients, on the other hand, are recycled within an ecosystem, and their supply normally limits biological activity. So, "energy flows, elements cycle". • Energy is moved through an ecosystem via a food web, which is made up of interlocking food chains. Energy is first captured by photosynthesis (primary production). The amount of primary production determines the amount of energy available to higher trophic levels. • The study of how chemical elements cycle through an ecosystem is termed biogeochemistry. A biogeochemical cycle can be expressed as a set of stores (pools) and transfers, and can be studied using the concepts of "stoichiometry", "mass balance", and "residence time". • Ecosystem function is controlled mainly by two processes, "top-down" and "bottom-up" controls. • A biome is a major vegetation type extending over a large area. Biome distributions are determined largely by temperature and precipitation patterns on the Earth's surface.

W https://globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem/ecosystem.html

47/145	SUBMITTED TEXT	107 WORDS	96%	MATCHING TEXT	107 WORDS

plants and animals and, thereby contribute to the conservation of biological and genetic diversity and the evolutionary process. (3) Production functions: Photosynthesis and nutrient uptake by autotrophs converts energy, carbon dioxide, water and nutrients into a wide variety of carbohydrate structures which are then used by secondary producers to create an even larger variety of living biomass. This broad diversity in carbohydrate structures provides many ecosystem goods for human consumption, ranging from food and raw materials to energy resources and genetic material. (4) Information functions: Since most of human evolution took place within the context of an undomesticated habitat, natural ecosystems contribute to the maintenance of human health by providing opportunities for recreation, cognitive development and aesthetic experience.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

Ouriginal by Turnitin

48/145	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

Secondary succession: Starts from previously built up substrata with already existing living matter.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

49/145	SUBMITTED TEXT	26 WORDS	98%	MATCHING TEXT	26 WORDS

as lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

SA EVS013 Natural Resources and Their Conservation.pdf (D164659547)

50/145	SUBMITTED TEXT	15 WORDS	80%	MATCHING TEXT	15 WORDS

The convention provides the framework for international cooperation for the conservation and wise use of

SA Addtions to CC and Biodiversity_UPSC _16.07.22 Vidya.docx (D142325495)

51/145	SUBMITTED TEXT	80 WORDS	96%	MATCHING TEXT	80 WORDS

Environmental pollution It is not a new phenomenon, yet it remains the world's greatest problem facing humanity, and the leading environmental causes of morbidity and mortality. Man's activities through urbanization, industrialization, mining, and exploration are at the forefront of global environmental pollution. Both developed and developing nations share this burden together, though awareness and stricter laws in developed countries have contributed to a larger extent in protecting their environment. Despite the global attention towards pollution, the impact is still being felt due to its severe long-term consequences.

SA bba 101.pdf (D141385747)

52/145	SUBMITTED TEXT	16 WORDS	62%	MATCHING TEXT	16 WORDS

It is the deterioration of the environment through consumption of assets, like, air, water and soil.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

Ouriginal by Turnitin

53/145	SUBMITTED TEXT	18 WORDS	100%	MATCHING TEXT	18 WORDS

Still, India has a long way to go to reach environmental quality similar to those enjoyed in developed economies.

SA bba 101.pdf (D141385747)

54/145	SUBMITTED TEXT	26 WORDS	90%	MATCHING TEXT	26 WORDS

India. According to World Bank experts, India has made one of the fastest progresses in the world, in addressing its environmental issues and improving its environmental quality

SA bba 101.pdf (D141385747)

55/145	SUBMITTED TEXT	41 WORDS	87%	MATCHING TEXT	41 WORDS

Causes of Environmental Degradation The major causes of the environmental degradation are modern urbanization, industrialization, population growth, deforestation etc. Environmental pollution refers to the degradation of quality and quantity of natural resources. Various types ofthe human exercises are the fundamental reasons of environmental degradation.

SA bba 101.pdf (D141385747)

56/145	SUBMITTED TEXT	44 WORDS	61%	MATCHING TEXT	44 WORDS

The smoke radiated by the vehicles and processing plants expands the measure of toxic gases noticeable all around affecting every single living being. These waste items and smoke radiated by vehicles are the fundamental driver of contamination. Spontaneous urbanization and industrialization have caused water, air and sound

SA bba 101.pdf (D141385747)

57/145	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

Submitted text	Matching text
Which of the following is not a greenhouse gas? (a)	Which of the following is not a greenhouse gas? (a)

W https://dokumen.pub/environmental-studies-3nbsped-9352605179-9789352605170.html

Ouriginal by Turnitin

58/145	SUBMITTED TEXT	12 WORDS	83%	MATCHING TEXT	12 WORDS

ventures like Chlorofluorocarbon, nitrogen oxide, carbon monoxide and other particles pollute air. 6.4

SA bba 101.pdf (D141385747)

59/145	SUBMITTED TEXT	26 WORDS	50%	MATCHING TEXT	26 WORDS

to a dramatic decline in the productivity of croplands and rangelands worldwide. Land degradation is one of the world's most pressing environmental problems and it will worsen without

SA bba 101.pdf (D141385747)

60/145	SUBMITTED TEXT	23 WORDS	66%	MATCHING TEXT	23 WORDS

In this chapter the essential aspects of environmental problems, causes, effects will be reviewed with some prescribed solutions to overcome from the environmental issues.

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

61/145	SUBMITTED TEXT	82 WORDS	99%	MATCHING TEXT	82 WORDS

Human activities in past decades have raised serious issues related to environment and its conservation. Air pollution, poor management of its waste, growing water scarcity, falling ground water tables, water pollution, waste disposal, desertification, endangered species, preservation and quality of forest, biodiversity loss, and land/soil degradation, global climate change, pollution, environmental degradation, global warming, greenhouse effect, acidification, ozone depletion and other local, regional and global level environmental problems. Genetically modified foods are the current environment problem that make us vulnerable to disasters and tragedies now and in the future.

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62/145	SUBMITTED TEXT	94 WORDS	96%	MATCHING TEXT	94 WORDS

What is Environment? The word environment refers to all ecological units which are naturally present on earth in the form of land, water, air, soil, forest, sunlight, minerals, living organisms etc. This earth is full of natural surroundings, some are biotic and some are non-biotic. Biotic elements are those elements like human, birds, animals, plants, and microorganisms. Whereas non-biotic elements are those which have no life like air, sunlight, water, land, soil, minerals etc., furthermore, it is also divided among four different spheres viz. biospheres, lithosphere, atmosphere and hydrosphere. Hydrosphere is the largest part on the earth among all life on earth.

SA Hitech Solutions.docx (D152429585)

63/145	SUBMITTED TEXT	29 WORDS	90%	MATCHING TEXT	29 WORDS

Currently, the situation of environment is very poor that could never be imagined by our ancestor in earlier time. We have endlessly spoilt our environment by using its resources in

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64/145	SUBMITTED TEXT	61 WORDS	83%	MATCHING TEXT	61 WORDS

very wrong way. We can see that every day and everywhere pollution is rapidly increasing on earth where it is air, land, water or soil pollution, deforestation, acid rain, and other dangerous disasters that have been created by the humans through technological advancement. Use of natural resources should be carefully planned and executed for providing a better and healthy life to our forth coming generation. 7.3

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65/145	SUBMITTED TEXT	27 WORDS	94%	MATCHING TEXT	27 WORDS

Environmental issues An environmental problem occurs when there comes a change in quality or the quantity of the environmental factors that directly or indirectly affect everything on

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Ouriginal by Turnitin

66/145	SUBMITTED TEXT	171 WORDS	93%	MATCHING TEXT	171 WORDS

the planet system (air, water, soil etc.) that have developed as a result of human interference or mistreatment of the planet.” A variety of environmental problems now affect our entire world. As globalization continues and the earth’s natural processes transform local problems into international issues. Some largest problems now affecting the world are: acid rain, air pollution, global warming, hazardous wastes, ozone depilation, smog, water pollution, overpopulation and rain forest destruction. It is related to not only environment but also with everyone that lives in the planet. It affects every human, animal, and nation on this planet. Human have faced poor environmental conditions throughout history, but what we think of as environmental problems become more common and apparent with industrialization and urbanization. In the United States for example, air and water pollution from the factories and dense urban living conditions attracted growing attention throughout the last centuries, and by the 1960s become recognized as significant problems. Air and water pollution rapidly spread to a range of other conditions- soil erosion, pesticides contamination, deforestation, declining animal population and species and so on. Environmental scientists, activists, and policy-makers

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67/145	SUBMITTED TEXT	320 WORDS	88%	MATCHING TEXT	320 WORDS

These diverse concerns gradually merge into environmental problems, and the 1970 Earth Day in United States and then the 1972 United Nation Conference on the Human Environment in Stockholm helped turn “Environmental Quality” into a major international issue. By the time of the United Nation Conference on Environment and Development in Rio De Janeiro in 1992, significant “Green Parties” had been formed in Europe and environmental problems were the subject of citizen and governmental attention worldwide. Environmentalist, a social and environmental movement addresses environmental issues through advocacy, education and activism. The environmental issues can occurs at three levels, local, regional and global. Local environmental issues- Some major local environmental issues are given below-1. Pollution, 2. Waste Disposal, 3. Desertification, 4. Water Scarcity, 5. Endangered Species NSOU ? CC-GR-08 76 1. Pollution: Pollution can be defined as an undesirable addition of constituents to water, land, air which adversely affect human life, species, living conditions and will deteriorate our resources. Pollution can be classified mainly into four categories air pollution, water pollution, soil pollution, noise pollution. The pollution occurs at the local and also global level. Air pollution: Air pollution refers to any physical, chemical and biological change in the air. It is the contamination of air by harmful gases, dust and smoke which affect plants, animals, and humans drastically. There is a certain percentage of gases present in the atmosphere. Major air pollutants, their sources and their impact: Carbon monoxide (CO): Its main source is fuel combination from engines and vehicles. It reduces the amount of oxygen, aggravate heart disease, chest pain. Lead (Pb): It releases from metal refineries and other metal industries, waste incinerators. It impacts on our nervous system, results in IQ loss, cardiovascular and renal effects in adult, effects related to an aemia. Nitrogen oxide: It is released in environment by fuel combustion, wood burning. It mainly enhances lung diseases leading to respiratory symptoms that increase susceptibility to respiratory infection. Sulphur dioxide (SO 2): It is released by fuel combustion as well as natural occurrences like volcanoes. It causes asthma and breathing difficulty.

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68/145	SUBMITTED TEXT	26 WORDS	100%	MATCHING TEXT	26 WORDS

Air pollution control: The techniques employed to reduce or eliminate the emission into the atmosphere of substances that can harm the environment or human health. Different types of

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69/145	SUBMITTED TEXT	163 WORDS	90%	MATCHING TEXT	163 WORDS

use for the air pollution control –control of particulates airborne particles can be removed form a polluted airstream by a variety of physical process. Some common types of equipment for collecting fine particulates includes cyclones, scrubbers, electrostatic precipitators, and baghouse filters. Once collected, particulates adhere to each other, forming agglomerates that can readily be removed from equipment and disposed of, usually in landfill. Control of gases- gaseous criteria pollutants, as well as volatile organic compounds (VOCs) and other gaseous air toxics, are controlled by means of three basic techniques, absorption, adsorption and incineration. These techniques can be employed singly or in combination. They are effective against the major greenhouse gases as well. In addition, a fourth NSOU ? CC-GR-08 77 technique, known as carbon sequestration, is in development as a means of controlling carbon dioxide levels. b) Water pollution: Water pollution is the contamination of pollutants in water bodies like lakes, rivers, oceans, aquifers and groundwater without treatment very often by human activities that lead to harmful effects. Source of water pollution: Natural sources: These include decay

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Ouriginal by Turnitin

70/145	SUBMITTED TEXT	218 WORDS	96%	MATCHING TEXT	218 WORDS

of plants and animals, volcanic eruptions, coastal, cliff erosion, landslides and soil erosion. Anthropogenic sources: This includes industry, urban, agricultural and cultural sources. Effect of water pollution: Death of aquatic animals. Irrigation by polluted water affects plants resulting in yellowish coloration and defoliation. Diseases- hepatitis, cholera, typhoid, jaundice, diarrhoea and skin diseases. Disruption of food chains. Destruction of ecosystems. Control measure of water pollution: 1.Water pollution, to a larger extent, can be controlled by a variety of methods. Rather than releasing sewage waste in water bodies, it is better to treat them before discharge. Practicing this can reduce the initial toxicity and the remaining substances can be degraded by the water bodies itself. If the secondary treatment of water has been carried out, then this can be reused in sanitary systems and agricultural fields. Some chemical methods that help in the control of water pollution are precipitation, the ion exchange process, reverse osmosis and coagulation. As an individual, reusing, reducing, and recycling wherever possible will advance a long way in overcoming the effects of water pollution. 2. Waste Disposal: Waste disposal is the collection, processing and recycling or deposition of waste material of human society. Waste is classified by source and composition. Waste materials are either liquid or solid in form, and their components may be either hazardous or inert in their effects on health and environment. We used plastic bag, broken glass, obsolete cell phone, or used battery cells.

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Ouriginal by Turnitin

71/145	SUBMITTED TEXT	86 WORDS	90%	MATCHING TEXT	86 WORDS

products that require appropriate disposal to limit their harm to the environment. The term waste is typically applied to solid waste, sewage, hazardous waste, and electronic waste. Sources of waste: Medical or clinical sources of wastes include the surgical items, pharmaceuticals, blood, body parts, wound dressing materials, needles, syringes. • Agricultural sources of wastes: Wastes generated by agricultural activities, include horticulture, livestock breeding, market gardens and seedling nurseries. • Industrial sources of wastes: These are released from manufacturing and processing industries like chemical plants, cement factories, power plants, textile industries, petroleum industries. Wastes from construction or demolition

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72/145	SUBMITTED TEXT	86 WORDS	94%	MATCHING TEXT	86 WORDS

concrete debris, wood, huge package boxes. Some other sources such as commercial sources, mining sources, radioactive sources, electronic sources are also the big sources of waste pollution. Waste disposal problems: Production of too much waste, one of the major problems, related to disposal is attributed to the generation of too much waste. Mumbai and Delhi generate about 11,000 and 8,700 tones of solid waste per day, respectively. India is getting buried under mounds of garbage as the country has been generated more than 1.50 lakh metric tonnes of solid waste every day.

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73/145	SUBMITTED TEXT	97 WORDS	89%	MATCHING TEXT	97 WORDS

Most of the waste is toxic and harmful for the human beings and the environment. The majority of the states and local authority legislations are generally lax on regulating toxic industrial products that end up getting thrown away after use. Most of the products contain hazardous and health threatening chemicals. This chemical causes majority of water pollution, soil pollution. Landfills are a problem as well. Most landfills lack proper on-site waste management, thereby contributing to additional threats to the environment. In long term, landfills leak and pollute ground water and other neighbouring environment habitat making waste disposal very difficult. They also release potentially unsafe gases. 7.4

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74/145	SUBMITTED TEXT	88 WORDS	66%	MATCHING TEXT	88 WORDS

Solution to Waste Disposal: Eco responsibility –"reduce, reuse, recycle" Eco-responsibility pertains to the "three Rs" mantra of reuse, reduce and recycle. Local communities' authorities and state need to put more efforts towards the NSOU ? CC-GR-08 79 education of waste management. Effective waste disposal and management ensures a gradual improvement of new and cost- effective facilities which aim to encourage higher environmental protection standards. Landfills are generally located to ease waste collection, transfer, and monitoring or recycling. Thousand of tonnes of construction and demolition materials are generated by various local construction industries. In most of

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75/145	SUBMITTED TEXT	52 WORDS	99%	MATCHING TEXT	52 WORDS

a large portion of these waste materials can be re used, reclaimed or recycled. With the control and monitoring of land filling and fly tipping activities in the area of public work, constructions and demolition materials can be resourcefully reclaimed, reused or recycled in other projects such as landscaping, village houses, recreation facilities, car parks,

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76/145	SUBMITTED TEXT	162 WORDS	96%	MATCHING TEXT	162 WORDS

roads.· Waste diversion plans- A multifaceted approach on waste transfer and diversion in terms of more hygienic and efficient waste disposal management can offer tremendous solution to waste problems. Improvement of thermal waste treatment has been proved not to be 100% green as they are normally pronounced. Therefore, to mitigate the problems that come with thermal waste treatment issues such as emission of toxic gases with organic compounds such as furans, PAHs, and dioxins, states and researches as well as green groups and academicians can explore the possible developments with regards to advanced thermal waste treatment techniques. 2. Desertification– Desertification is a type of land degradation in dry lands in which biological productivity is lost due to natural processes or induced by human activities by which fertile areas become increasingly more arid. It is the spread of arid areas caused by a variety of factors, such as through climate change and through the overexploitation of soil through human activity. Various causes of desertification- • Overgrazing – if there are too much animals that

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77/145	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

that are overgrazing in certain spots it makes it difficult for the plant

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78/145	SUBMITTED TEXT	24 WORDS	94%	MATCHING TEXT	24 WORDS

grow back, which hunts the biome and make it loss its former green glory. • Deforestation- wood extraction, and infrastructure expansion such as road building and urbanization

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79/145	SUBMITTED TEXT	25 WORDS	100%	MATCHING TEXT	25 WORDS

Farming practice- some farmers do not know how to use the land effectively. They may essentially strips the land of everything that it has, before moving

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80/145	SUBMITTED TEXT	27 WORDS	100%	MATCHING TEXT	27 WORDS

another plot of land. By stripping the soil of its nutrients, desertification becomes more of a reality for the area that is being used for the farming.

SA Hitech Solutions.docx (D152429585)

81/145	SUBMITTED TEXT	33 WORDS	79%	MATCHING TEXT	33 WORDS

Effects of desertification- • Farming becomes next to impossible. It is impossible to grow sustainable crops without special technologies. This can cost a lot of money to try.So many farmers will have to sell their desert land.

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

82/145	SUBMITTED TEXT	132 WORDS	93%	MATCHING TEXT	132 WORDS

Excessive use of fertilizers and pesticides- the use of excessive amount of fertilizer and pesticides to maximize to their crop yields in the short term often lead to significant damages for the soil. In the long run, this may turn from arable into arid land over time and not suitable for the farming. • Over drafting of ground water is a process in which groundwater is extracted in excess of the equilibrium yield of the aquifer that is pumping or pulling excessive groundwater from underground aquifers. Its depletion causes desertification. • Climate change plays a huge role in desertification. As the days get warmer and periods of drought become more frequent, desertification becomes more and more eminent. Unless climate change is slowed down, huge areas of land will become desert. • There are also some reasons such as natural disasters, soil pollution, overpopulation and excessive consumptions, mining etc.

SA Hitech Solutions.docx (D152429585)

83/145	SUBMITTED TEXT	58 WORDS	96%	MATCHING TEXT	58 WORDS

Flooding is a lot more imminent. Not all desert are dry; those that are wet could experience a lot of flooding because there is nothing to stop the water from gathering and going all over the place. • Biodiversity loss: Endangerment and extinction of species, the destruction of habitats and desertification may also contribute to a loss of biodiversity. Many species will not

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

84/145	SUBMITTED TEXT	302 WORDS	84%	MATCHING TEXT	302 WORDS

to adjust to the altered environmental conditions and may suffer from serious decline in population. • Migration: When large areas of land that were used for farming will no longer be suitable for farming due to many reasons results in serious migration movements. Solution to desertification: • Policy change related to how much people can farm and how much they can farm on a certain area could be put into place to help reduce the problems that are often associated with farming and desertification. NSOU ? CC-GR-08 81 • Education: In developing countries, education is an incredibly important tool that needs to be utilized in order to help people to understand the best way to use the land that they are farming on. By educating them on sustainable practices, more land will be saved from becoming desert. Research and application of the latest technology can limit the desertification process. • Mining often implies the destruction of large area of land. Therefore, it should be regulated by governments to keep the nature reserves intact and protect the natural habitats of animals, plants and micro-organisms. Thus, the desertification issues can be mitigated to a certain extent. Reforestation: The area that have been subject to deforestation in past should be considered for reforestation. Planting trees in those areas are quite important since they are natural carbon dioxide storage spaces; they slow down the global warming and contribute to maintaining a natural balance. Therefore, planting trees in the affected areas not only prevents desertification but also fight against additional environmental issues. 4. Water Scarcity: Water scarcity involves water crisis, water shortage, water deficit or water stress. Water scarcity can be due to physical water scarcity and economic water scarcity. Physical water scarcity refers to a situation where natural water resources are unable to meet a region's demand while economic water scarcity is a result of poor management of water resources. "Water scarcity is the lack of sufficient available water resources to meet the demands of water usage within a region.

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

Ouriginal by Turnitin

85/145	SUBMITTED TEXT	66 WORDS	89%	MATCHING TEXT	66 WORDS

at least one month each year. More than 1.2 billion people lack access to clean drinking water. Causes of water scarcity: • Overuse of water is a huge issue that a lot of people are dealing with. It may be overused on people, animals, land or many other numbers of things. • Pollution of water can occur from a variety of sources. Pollution comes from oil, carcasses, chemicals, industrial wastes, and from municipality waste. •

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

86/145	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

Illegal dumping: Industries frequently dispose of their industrial garbage into

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

87/145	SUBMITTED TEXT	49 WORDS	84%	MATCHING TEXT	49 WORDS

river and lakes since it is an easy and cheap way to get rid of this waste. It leads to serious water pollution, which may result in water scarcity for local people. • Natural disasters like tsunamis, floods may also cause serve water shortages for local people since important public infrastructure may be destroyed. •

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

88/145	SUBMITTED TEXT	17 WORDS	97%	MATCHING TEXT	17 WORDS

Some areas are in a perpetual drought, whereas other areas may be dealing with drought on occasion.

SA Hitech Solutions.docx (D152429585)

89/145	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

Effects of water scarcity: Lack of access to drinking water

SA Hitech Solutions.docx (D152429585)

90/145	SUBMITTED TEXT	15 WORDS	93%	MATCHING TEXT	15 WORDS

water scarcity. People are not able to get fresh, clean drinking water. • Hunger and poverty:

SA Hitech Solutions.docx (D152429585)

91/145	SUBMITTED TEXT	98 WORDS	98%	MATCHING TEXT	98 WORDS

Destruction of habitats and loss of biodiversity: Water is crucial for all life forms on our planet. If water scarcity persists over a longer period, it leads to the destruction of whole habitats. Animals and plants may no longer be able to get enough water and may therefore die or have to move to other regions. Some animals become extinct. They no longer be able to grow and reproduce in a sufficient manner causing serious biodiversity loss. Solutions to control water scarcity • Save water whenever possible: This could mean limiting the use of water, the use of washing machines, taking short showers instead of full baths. •

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

92/145	SUBMITTED TEXT	36 WORDS	83%	MATCHING TEXT	36 WORDS

Recycle water:There are plenty of technologies available that allow to recycle rainwater and other water that can be used in residential areas. Not only does it help to prevent scarcity, but it can save some money as well.

SA Hitech Solutions.docx (D152429585)

Ouriginal by Turnitin

93/145	SUBMITTED TEXT	182 WORDS	92%	MATCHING TEXT	182 WORDS

Improve practices related to farming: Farming and irrigation are often a huge culprit when it comes to water scarcity. Because of that, we need to improve practices so that we don't use as much water and those who are using water are using it to fullest potential. • Less use of chemical in farming: At present, excessive levels of chemical fertilizers and pesticides are used to maximize crop yields. It leads to serious soil pollution, which in turn translates into groundwater pollution and contributes to the water scarcity issue. It is crucial that farmers reduce the use of chemicals for farming to ensure clean water and reduced water shortage problem. • Improve sewage systems: Clean drinking water starts with a good sewage system. Without proper sanitation, the water in an area becomesridden with disease and any number of other problems. By improving thesewage sys- tems, we canprevent water scarcity from becoming worse. • Better water distribution infrastructure: Many people worldwide, especially in poor developing countries, are still not connected to the public water infrastructure. These people are at high risk to suffer from severe water shortages. By connecting these people to the public water supply, water scarcity risk could be greatly reduced. 7.5

SA mitalisharma.ghy@gmail.com.pdf (D154531899)

94/145	SUBMITTED TEXT	85 WORDS	100%	MATCHING TEXT	85 WORDS

Waste management or waste disposal includes the activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process and waste-related laws, technologies, economic mechanisms. Waste can be solid, liquid, or gaseous and each type has different methods of disposal and management. Waste management deals with all types of waste, including industrial, biological and household. In some cases, waste can pose a threat to human health. Health issues are associated

SA bba 101.pdf (D141385747)

95/145	SUBMITTED TEXT	26 WORDS	94%	MATCHING TEXT	26 WORDS

the entire process of waste management. Health issues can also arise indirectly or directly, directly through the handling of the waste and indirectly through the consumption of

SA bba 101.pdf (D141385747)

96/145	SUBMITTED TEXT	25 WORDS	100%	MATCHING TEXT	25 WORDS

Waste management is intended to reduce adverse effects of waste on human health, the environment, planetary resources and aesthetics. Waste management practices are not uniform among countries.

SA bba 101.pdf (D141385747)

97/145	SUBMITTED TEXT	23 WORDS	93%	MATCHING TEXT	23 WORDS

residential and industrial sectors can take different approaches. Proper management of waste is important for building sustainable cities, but it remains a challenge for

SA bba 101.pdf (D141385747)

98/145	SUBMITTED TEXT	21 WORDS	47%	MATCHING TEXT	21 WORDS
the United Nations Conference on the Human Environment, United Nations World Commission on Environment and Development, and United Nations Conference on Environment and Development.			the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972 (United Nations publication, Sales No. E.73.II.A.14 and corrigendum), chap. I. 2/ Report of the United Nations Conference on Environment and Development,		

W http://www.un-documents.net/jburgdec.htm

99/145	SUBMITTED TEXT	23 WORDS	100%	MATCHING TEXT	23 WORDS
defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”			defined Sustainable Development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. ”		

W https://www.drishtiias.com/images/uploads/1603187034_Environment-Ecology-Quick-Book-Website.pdf

Ouriginal by Turnitin

100/145	SUBMITTED TEXT	82 WORDS	98%	MATCHING TEXT	82 WORDS

many developing countries. A report found that effective waste management is relatively expensive, usually comprising 20%–50% of municipal budgets. Operating this essential municipal service requires integrated systems that are efficient, sustainable, and socially supported.Large portion of waste management practices deal with municipal solid waste (MSW) which is the bulk of the waste that is created by household, industrial, and commercial activity. Measures of waste management include measures for integrated techno-economic mechanisms of a circular economy, effective disposal facilities, export and import control and optimal sustainable design of products that are produced.

SA bba 101.pdf (D141385747)

101/145	SUBMITTED TEXT	20 WORDS	100%	MATCHING TEXT	20 WORDS

Environmental policy is the commitment of an organization or government to the laws, regulations, and other policy mechanisms concerning environmental issues.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

102/145	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS
the World Summit on Sustainable Development in Johannesburg, South Africa,				the World Summit on Sustainable Development in Johannesburg, South Africa,	

W http://www.un-documents.net/jburgdec.htm

103/145	SUBMITTED TEXT	28 WORDS	82%	MATCHING TEXT	28 WORDS
Poverty eradication, changing unsustainable patterns of production and consump- tion and protecting and managing the natural resource base of economic and social development are essential requirements for sustainable development. 9.7				Poverty eradication, changing unsustainable patterns of production and consumption and protecting and managing the natural resource base of economic and social development are overarching objectives of, and essential requirements for, sustainable development. 3.	

W http://www.un-documents.net/jburgpln.htm

Ouriginal by Turnitin

104/145	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

Plan of Implementation of the World Summit on Sustainable Development, A/CONF.199/20, Chapter 1, Resolution 2,

Plan of Implementation of the World Summit on Sustainable Development - A/CONF.199/20 Chapter 1, Resolution 2 -

W http://www.un-documents.net/jburgpln.htm

105/145	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

United Nations Conference on Environment and Development (UNCED), also known as the

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

106/145	SUBMITTED TEXT	31 WORDS	96%	MATCHING TEXT	31 WORDS

The Montreal Protocol has proven to be innovative and successful, and is the first treaty to achieve universal ratification by all countries in the world. Leveraging worldwide participation, the Montreal Protocol has

The Montreal Protocol has proven to be innovative and successful, and it is the first treaty to achieve universal ratification by all countries in the world. Leveraging this worldwide participation, the Montreal Protocol has

W https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issues/the-mon ...

107/145	SUBMITTED TEXT	15 WORDS	100%	MATCHING TEXT	15 WORDS

and placed the ozone layer, which was in peril, on a path to repair.

and placed the ozone layer, which was in peril, on a path to repair.

W https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issues/the-mon ...

108/145	SUBMITTED TEXT	19 WORDS	100%	MATCHING TEXT	19 WORDS

million cases of skin cancer, approximately 1.6 million skin cancer deaths, and more than 45 million cases of cataracts

million cases of skin cancer, approximately 2.3 million skin cancer deaths, and more than 63 million cases of cataracts,

W https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issues/the-mon ...

Ouriginal
by Turnitin

109/145	SUBMITTED TEXT	26 WORDS	91%	MATCHING TEXT	26 WORDS

with even greater benefits worldwide. The Montreal Protocol's Scientific Assessment Panel estimates that with implementation of the Montreal Protocol a near complete recovery of the ozone layer

with even greater benefits worldwide. The Montreal Protocol's Scientific Assessment Panel estimates that with implementation of the Montreal Protocol we can expect near complete recovery of the ozone layer

W https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issues/the-mon ...

110/145	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

the following documents: • Rio Declaration on Environment and Development • Agenda 21 • Forest Principles

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

111/145	SUBMITTED TEXT	15 WORDS	89%	MATCHING TEXT	15 WORDS

The Montreal Protocol sits under the Vienna Convention for the Protection of the Ozone Layer (

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

112/145	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS

The Kyoto Protocol was adopted in Kyoto, Japan on 11 December 1997.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

113/145	SUBMITTED TEXT	26 WORDS	72%	MATCHING TEXT	26 WORDS

objective of the UNFCCC is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would stop dangerous anthropogenic interference with the climate system". 10.2.3

objective of the Framework Convention was to "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."

W https://dokumen.pub/environmental-studies-3nbsped-9352605179-9789352605170.html

Ouriginal by Turnitin

114/145	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

agreement within the United Nations Framework Convention on Climate Change (UNFCCC).

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

115/145	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS
the Montreal Protocol on Substances that Deplete the Ozone Layer" (				The Montreal Protocol on Substances that Deplete the Ozone Layer	

W https://dokumen.pub/environmental-studies-3nbsped-9352605179-9789352605170.html

116/145	SUBMITTED TEXT	2 WORDS	100%	MATCHING TEXT	2 WORDS
the-montreal-protocol-on-substances-that-deplete-the-ozone- layer/ 11.				The Montreal Protocol on Substances that Deplete the Ozone Layer	

W https://dokumen.pub/environmental-studies-3nbsped-9352605179-9789352605170.html

117/145	SUBMITTED TEXT	14 WORDS	76%	MATCHING TEXT	14 WORDS
with the implementation of the National Environment Policy Act (NEPA) 1969 in the US.				with the enactment of the National Environmental Policy Act (NEPA) in the US	

W https://pdfcoffee.com/download/environmental-studies-tutorial-pdf-free.html

118/145	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs),

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

119/145	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

is an agreement within the United Nations Framework Convention on Climate Change (

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

Ouriginal by Turnitin

120/145	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

A single standard will ensure that there are no conflicts between regional interpretations of good environmental practice.

A single standard will ensure that there are no conflicts between regional interpretations of good environmental practice

W http://www.eiilmlibrary.com/library/91763_85610_Anindita%20Basak%20-%20Environmental%20Studies%20 ...

121/145	SUBMITTED TEXT	20 WORDS	77%	MATCHING TEXT	20 WORDS

Protection) Act (1972), the Water Act (1974), the Air (Prevention and Control of Pollution) Act (1981), and the Biological Diversity Act (2002). •

SA runtideb78535@gmail.com.doc (D153611841)

122/145	SUBMITTED TEXT	25 WORDS	94%	MATCHING TEXT	25 WORDS

duty on every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures.

SA bba 101.pdf (D141385747)

123/145	SUBMITTED TEXT	27 WORDS	82%	MATCHING TEXT	27 WORDS

The Water (Prevention and Control of Pollution) Act, 1974 • The Air (Prevention and Control of Pollution) Act, 1981 • The Environment Protection Act, 1986 • The National Green Tribunal Act, 2010 • The

The Water (Prevention and Control of Pollution) Act, 1974 169 6.10.3 The Air (Prevention and Control of Pollution) Act, 1981 170 6.10.4 The Environment (Protection) Act, 1986 170 6.10.5 The Wildlife Protection Act, 1971 170 6.10.6 The

W https://dokumen.pub/environmental-studies-3nbsped-9352605179-9789352605170.html

124/145	SUBMITTED TEXT	19 WORDS	100%	MATCHING TEXT	19 WORDS

that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country.

SA runtideb78535@gmail.com.doc (D153611841)

125/145	SUBMITTED TEXT	24 WORDS	97%	MATCHING TEXT	24 WORDS

The Air (Prevention and Control of Pollution) Act, 1981 is an act to provide for the prevention, control and abatement of air pollution

The Air (Prevention and Control of Pollution) Act, 1981 is an Act to provide for the prevention, control and abatement of air pollution,

W https://dokumen.pub/environmental-studies-3nbsped-9352605179-9789352605170.html

126/145	SUBMITTED TEXT	35 WORDS	87%	MATCHING TEXT	35 WORDS

of cases relating to environment protection and conservation of forests and other natural resources. It also includes enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

127/145	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

Central Pollution Control Board(CPCB), and State Pollution Control Boards (

SA EVS book.pdf (D143746725)

128/145	SUBMITTED TEXT	22 WORDS	60%	MATCHING TEXT	22 WORDS

the prevention and control of water pollution constituted under the Water Act, 1974. The Environment Protection Act, 1986 The Environment Protection Act, 1986 (the "

The Air (and Control of Pollution) Act, 1981 170 6.10.4 The Environment (Protection) Act, 1986 170 6.10.5 The Wildlife Protection Act, 1971 170 6.10.6 The

W https://dokumen.pub/environmental-studies-3nbsped-9352605179-9789352605170.html

129/145	SUBMITTED TEXT	31 WORDS	71%	MATCHING TEXT	31 WORDS

Water (Prevention and Control of Pollution) Act, 1974 has been enacted to provide for the prevention and control of water pollution and to maintain or restore wholesomeness of water in the country.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

130/145	SUBMITTED TEXT	20 WORDS	76%	MATCHING TEXT	20 WORDS

Water (Prevention and Control of Pollution) Cess Act was enacted in 1977 to provide for the levy and collection of

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

131/145	SUBMITTED TEXT	27 WORDS	68%	MATCHING TEXT	27 WORDS

is an umbrella legislation designed to provide a framework for the coordination of central and state authorities established under the Water Act, 1974 and the Air Act, 1981.

SA MGEOS_13 Environmental Geography_ All Units.docx (D123720082)

132/145	SUBMITTED TEXT	28 WORDS	64%	MATCHING TEXT	28 WORDS

Environment Act. It includes water, air and land as well as the interrelationship which exists between water, air and land, and human beings, other living creatures, plants, micro- organisms and property.

SA bba 101.pdf (D141385747)

133/145	SUBMITTED TEXT	39 WORDS	81%	MATCHING TEXT	39 WORDS

Hazardous waste means any waste which, by reason of any of its physical, chemical, reactive, toxic, inflammable, explosive or corrosive characteristics, causes NSOU ? CC-GR-08 140 danger to health or environment, whether alone or when in contact with other wastes or substances.

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

134/145	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

Municipal Solid Wastes (Management and Handling) Rules, 2000, aim at enabling municipalities to dispose

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

Ouriginal
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135/145 **SUBMITTED TEXT** 20 WORDS **100%** **MATCHING TEXT** 20 WORDS

reducing the bio- medical waste generation and also for its proper treatment and disposal and to ensure environmentally sound management

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

136/145 **SUBMITTED TEXT** 14 WORDS **100%** **MATCHING TEXT** 14 WORDS

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006,

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 39 ™

W https://www.drishtiias.com/images/uploads /1630061004_QB%20Environment%20&%20Ecology%20for%20Promo.pdf

137/145 **SUBMITTED TEXT** 30 WORDS **100%** **MATCHING TEXT** 30 WORDS

to reduce the use of hazardous substances in electrical and electronic equipment by specifying threshold for use of hazardous material and to channelize the e-waste generated in the country for environmentally sound

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

138/145 **SUBMITTED TEXT** 20 WORDS **100%** **MATCHING TEXT** 20 WORDS

Batteries (Management & Handling) Rules, 2001 deal with the proper and effective management and handling of lead acid batteries waste.

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

139/145 **SUBMITTED TEXT** 12 WORDS **100%** **MATCHING TEXT** 12 WORDS

Our Common Future: Report of the World Commission on Environment and Development."

Our Common Future: Report of the World Commission on Environment and Development

W http://www.un-documents.net/ocf-ov.htm

140/145 **SUBMITTED TEXT** 10 WORDS **100%** **MATCHING TEXT** 10 WORDS

Plan of Implementation of the World Summit on Sustainable Development."

Plan of Implementation of the World Summit on Sustainable Development

W http://www.un-documents.net/jburgdec.htm

Ouriginal by Turnitin

141/145	SUBMITTED TEXT	17 WORDS	85%	MATCHING TEXT	17 WORDS

the law relating to forests, the transit of forest-produce and the duty leviable on timber and other forest-produce.

SA bba 101.pdf (D141385747)

142/145	SUBMITTED TEXT	18 WORDS	100%	MATCHING TEXT	18 WORDS

Convention on Biological Diversity (CBD), 1992 which recognises the sovereign rights of states to use their own Biological Resources.

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

143/145	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner.

SA Visible and Invisible Air Pollution –Human criminal action -Applicability of Inte rnational and N ... (D128549500)

144/145	SUBMITTED TEXT	10 WORDS	100%	MATCHING TEXT	10 WORDS

need-based and time bound programme of afforestation and tree planting,

SA EVS013 Natural Resources and Their Conservation.pdf (D164659547)

145/145	SUBMITTED TEXT	18 WORDS	100%	MATCHING TEXT	18 WORDS

roads, railway lines, rivers and streams and canals, and on other unutilised lands under State/ corporate, institutional or private ownership. •

SA EVS013 Natural Resources and Their Conservation.pdf (D164659547)

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Sources included in the report

SA	**GE 302.pdf** Document GE 302.pdf (D109199360)	50
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W	URL: http://www.midnaporecollege.ac.in/RemoteClass/GEOC-402_Secondary%20activities.pdf Fetched: 2021-12-04 07:20:35	18
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Entire Document

PREFACE In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. core, discipline specific, generic elective, ability and skill enhancement for graduate students of all programmes at Honours level. This brings in the semester pattern, which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. I am happy to note that the university has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade "A". UGC (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for UG programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme. Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English / Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisitioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs. I wish the venture a grand success. Professor (Dr.) Subha Sankar Sarkar Vice-Chancellor

Printed in accordance with the regulations of the Distance Education Bureau of the University Grants Commission. First Print : August, 2022 Netaji Subhas Open University Under Graduate Degree Programme Choice Based Credit System (CBCS) Subject : Honours in Geography (HGR) Course : Economic Geography Course Code : CC-GR-10

Netaji Subhas Open University Under Graduate Degree Programme Choice Based Credit System (CBCS) Subject : Honours in Geography (HGR) Course : Economic Geography Course Code : CC-GR-10 : Board of Studies : Members Professor Kajal De (Chairperson) Director, School of Sciences, NSOU Dr. Chhanda Dana Kundu Associate Professor of Geography, NSOU Smt. Dipali Kundu Associate Professor of Geography, NSOU Ms. Tinki Kar Bhattacharya Assistant Professor of Geography, NSOU Dr. Biraj Kanti Mondal Assistant Professor of Geography, NSOU : Course Writer : : Course Editor : Professor Kanan Chatterjee Professor Anis Chattopadhyay Retd. Professor of Geography Former DPI, WBSES & University of Calcutta Professor of Geography Presidency College : Format Editor : Ms. Tinki Kar Bhattacharya Netaji Subhas Open University Notification All rights reserved. No part of this Study material may be repoduced in any form without permission in writing from Netaji Subhas Open University. Kishore Sengupta Registrar Professor Apurba Rabi Ghosh Retd. Professor of Geography University of Calcutta Professor Kanan Chatterjee Retd. Professor of Geography University of Calcutta Dr. Sriparna Basu Associate Professor of Geography Sibnath Sastri College Dr. Asitendu Roychowdhury Retd. Associate Professor of Geography Bhairab Ganguly College Dr. Jayanta Deb Biswas Retd. Associate Professor of Geography Ashutosh College

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NSOU ● CC-GR-10 9 Unit I ? Meaning and Approches to Economic Geography, New Economic Geography Structure 1.0 Objective 1.1 Introduction 1.2 Meaning of Economic Geography 1.3 Approaches to Economic Geography 1.4 New Economic Geography 1.5 Summary 1.6 Suggested Reading 1.0 Objective The objective of this unit is to deliver the learners. The meaning and approaches of Eco- nomic Geography and the concept of New economic geography. 1.1 Introduction Geography analyses and explains variations in activities over space and time. Economic Geography is the study of the spatial and temporal variation of activities related to production, exchange and consumption

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of goods and services. Whenever possible the goal is to develop generalizations and theories to account for these spatial variations.

This definition was given jointly by Hartshorne and Alexander. 1.2 Meaning of Economic Geography Prof

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E.W. Zimmermann pointed out that "Economic Geography deals with the economic life of man with relation to environment."

Dudley Stamp, explained that "

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Economic Geography involves consideration of the geographical and other factors which influence man's productivity, but only in limited depths, so far as they are connected with production and trade".

The economic geography relates to the location. Map provides the answer to the question "where". If no such map exists, the Geographers will have to construct one because maps are basic tools and are essential in understanding of real relationship.
10 NSOU ● CC-GR-10 The idea of pattern or distribution may facilitate the concept of location. A pattern is arrangement of an element over the surface of the earth, The world pattern of population, for example, reveals some densely populated areas in China and India, some areas of less density in the U.S.A. and Russia and some sparsely settled areas in North Africa and central Australia. Another significant characteristic of any economic activity is its spatial description. For example, one may ask, what are the characteristics of tea plantation that distinguish the regions devoted to it? How many areas do the plantation farms occupy? What kind of buildings are there on them? How much tea is produced? In what respects are these regions different from rice or wheat growing areas? Careful observation of the various aspects will enable a geographer to distinguish the tea producing regions both from regions of contrasting activities and from other regions of tea production. Then in terms of these characteristics a geographer finally decides where to draw the boundary of the distinctive region on his map. It is also necessary to carry out an analysis of cause and effect. Some geographers concentrate on relationship with physical and cultural phenomena. An alternative approach is to consider relationship within a region and those between regions. Finally, some geographers prefer to study relationship in terms of co-relationship. 1.3 Approaches To Economic Geography Among the several methods of studying Economic Geography, the four most important approaches are as follows : a) Regional Approach b) Systematic or Community Approach c) Activity Approach d) Principal Approach Regional Approach: In considering this popular approach, the world, a continent or even a country or a state may be divided into geographic regions. The basic advantage of this approach is that it gives a better and comprehensive knowledge of the different parts of unit, their relationship to each other and to the units as a whole. Systematic or Community Approach: This approach provides a systematic description and interpretation of the distributional pattern of individual resources or

NSOU ● CC-GR-10 11 commodity (e.g. wheat, rice, tea) or an industry (e.g. Iron and steel industry, cotton textile). As observed by W. Smith "it analyses the whole sequence of their development and catches them on their march to progression or retrogression." Activity Approach: This approach aims at dividing man's basic economic activities into three categories- Primary, Secondary and Tertiary. Primary activity is connected with nature and includes agriculture, forestry, fishing, hunting etc. Secondary activity depends on the process of converting the primary products into more usable ones like all branches of manufacturing industries. Tertiary activity sets up a link between primary and secondary activities such as though trade and transportation. Principal Approach: In this approach generalizations are made about man and his environment on the basis of analysis of facts at a specific time point. Generalizations like "plains invite occupancy, mountains repel settlement" are made. This approach enhances the clarity of reasoning and depth of analysis. All these approaches have their own merits and limitations. Any single approach is, therefore, incompetent to give a complete picture of the economy of a country or a region. 1.4 New Economic Geography Different types of economic activities like primary, secondary, tertiary, quaternary and quinary are included in this subject. Beside these, detailed study on different industrial activities, locational theories such as Von Thunen (1783-1850), Smith (1966), Weber (1909), Hoover (1948), Lösch (1954) lsard (1956) etc. as well as developmental policies are further dealt with. Transport and communication, trade and commerce emphasize on economic development of a country. Now studies on multi-dimensional aspect like economic inequality or disparity, unemployment, poverty, urbanization related with industrialization etc. also enter into periphery of economic geography. It emphasizes on spatial interaction among places of production and consumption. Understanding economy requires that the fundamental economic activities of production, consumption and distribution be treated as integrated parts of a system. Economic geography, as a field of study, focuses on the flows in the economic activities of distribution, while here Economics appear to be interested in the aggregates, such as national totals as well as supply and demand for goods or services in market. Government policy can affect the economic characteristics of a place or region or it can directly modify patterns of spatial interaction. Innovation may be defined by technological upliftment and theoretical advancement as well.

12 NSOU ● CC-GR-10 A review of research in Economic geography and planning would be incomplete without the consideration of recent developments in research techniques and tools employed by regional planners. There is a strong case for experimenting with the application of techniques like multiple factors analysis, grouping techniques such as nearest neighbor techniques, cluster analysis to problems in spatial planning. Economic Geography of the world changed a lot in the last 25years. During this period, the World economy mushroomed in size and complexity. At the same time, greater independence among nations added new dimensions to the World system. Major new work forms emerged as the post-industrial economy revolutionize the job market. The propelling force in economic growth became information and technology in the place of traditional raw materials and smokestack industries. New forms of management and organization develop to shape and lean these changes. The World becomes particularly aware of Japanese business practices in the 1980s. The most visible and influential institution associated with business activity remained the multinational corporation, much larger than before. Governments became more actively involved in promoting economic development. Several newly influential groups of countries became important in the global market place. These included the Organization of Petroleum Exporting Countries (OPEC) block, the Newly Industrializing Countries (NICs), the Organization of Economic Cooperation and Development (OECD) group and the European Economic Community (EEC). World trade became a crucial factor in the development process. More and more goods were 'international' in the sense that complex combinations of management, raw materials, technology, and semi processed goods, from many countries interacted to create them. As the less developed countries climbed the technology ladder, they began producing products at home to substitute for previously imported items and eventually began exporting more sophisticated products. In turn, the more developed nations moved to knowledge-intensive activities such as electronics, integrated circuits, robots, aerospace, telecommunications and biogenetics. The comprehensive measures called for in the NIEO (New International Economic Order) will dominate the agenda of economic geographers in developing countries throughout the world The measure of NIEO are grouped under the five heading in the UN resolution viz. international trade, transfer of real resources, science and . technology, industrialization and food and agriculture.

NSOU ● CC-GR-10 13 1.5 Summary The concern of economic geography in the 1990s and beyond must also include the heartland problems at a hierarchy of scales from local to global. The way in which economic geographers perceive these problems of growth and distribution reflects the development of the discipline over the country. Although a history of the subject is of interest for its own scale, it is also important if we are to understand the context in which economic geographers view the issues of current global concern. 1.6 Suggested Reading Alexander. J. W. (1977). Economic Geography. Prentice hall of India Pvt. Ltd, New Delhi. Chatterjee. K. (2015). Basics of Economic Geography, Concept Publishing Company (P) Ltd., New Delhi. Chorley. R.J. and Haggett, P. (1970). Socio-Economic Models in Geography. Methuen. Dutta, R. and Sundaram . K.P.M. (1999). Indian Economy, Chand and Company Ltd. New Delhi. Guba, J.L. and Chattaraj, P.R. (2002), A New Approach to Economic Geography, The Worl Press Pvt. Ltd .. Kolkata. Hazra, A. (2013), India's Social Sector and Millennium Development Goals,

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14 NSOU ● CC-GR-10 Unit 2 ? Concept
in Economic Geography: Goods and Services, Production, Exchange and Consumption
Structure 2.0 Objective 2.1 Introduction 2.2 Goods and Services 2.3 Production 2.4 Exchange 2.5 Consumption 2.6 Summary 2.0 Objective The learners will learn about the goods and services, production and exchange in the economy and their consumption patterns. 2.1 Introduction Economic geography analyses variations in activities over space. It is the study of the spatial variation of activities related to production, exchange and consumption

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of goods and services. The goal is to develop generalizations and theories to account for these spatial variations.

In this content, basic concept of the activities like goods and services, production, exchange and consumption is described. 2.2 Goods and Services Goods are material things which can be seen or touched. Services are non-material things which cannot be seen or touched, only their effects are felt. Forest resources, fishes, lands, minerals etc. are examples of goods. These goods can fulfill human needs in their life.

NSOU ● CC-GR-10 15 However, studying in a school or a college or a university, medical facility, legal consultation, business and financial manag~ment etc. are called services performed by teachers, professors, doctors. advocates and concerned institutional managers etc. Hence, all the human wants can be satisfied by goods and services. Goods and services are of many types, viz. • Free Goods and Economic goods: Few goods have unlimited supply and provided from nature. The goods which are not man-made do not have to be paid anything to get them. These goods are known as 'Free Goods'. For example, air, sea, water, sunlight, sand in the desert and coastal areas etc. On the other hand, goods like vegetables, grains, minerals, fruits, fishes etc. which are neither man-made nor unlimited in supply from nature are known as 'Economic Goods' All these goods are sold and purchased in the market only. • Free Services and Economic Services: Services which cannot be bought in the market and which are only rendered out of love, affection etc. are known as 'Free Services'. For example, all services given by the parents to their children are free services. However, all the services that can be bought in the market are 'Economic Services'. Services rendered by doctors, teachers, lawyers, barbers, cobblers etc. are the example of economic services. • Consumer Goods and Capital Goods: The goods which are directly used by the consumer for the purposes of consumption are known as 'Consumer Goods' Example of consumer goods are biscuit, butter, rice, fish, egg, shoes, fan, book, pen, cooking gas etc. On the other hand, all the goods which are not directly used to satisfy consumption but which are used in further production are called 'Producer Goods' or 'Capital Goods'. The examples are seeds, fertilizers, tools, machines, raw materials etc. • Consumer Services and Producer Services: Services that are used directly by consumers to satisfy their wants are called 'Consumer Service'. When services are used by producers to produce other goods and services, they are called 'Producer Services'. When the tailor stitches our shirt, it is a consumer service. However when the tailor stitches a shirt for a readymade garments shop, the service rendered by him is a producer service.

16 NSOU ● CC-GR-10 • Single Use and Durable Use Goods: Goods (both consumer goods and producer goods) which are only used or consumed for one time are called 'Single Use Goods'. Bread, milk, fruits, vegetables etc. are the example of single use consumer goods. On the other hand, seeds, fertilizers, raw materials etc. are the example of single use producer goods. Some goods (both consumer goods and producer goods) can be used for a considerable period, that is, they can be used again and again. They are called 'Durable Use Goods.' For example, table, chair, clothes, shoes etc. are the durable use consumer goods. On the other hand, tube wells, tractors, pump-sets etc. are the example of durable use producer goods, • Private Goods and Public Goods: The goods which are owned by private bodies are called 'Private Goods'. For example, a car, a house, a mobile phone, books, a television set etc. are private goods. There are large number of goods which are collectively owned by the society, the public or the government. These are called 'Public Goods or Government Goods. For example, roads, bridges, hospitals, government schools etc. are the public goods or the social goods or the government goods. 2.3 Production Production is a process of combining various material inputs, processing and outputs. Economic development is a production process, meaning all economic activities that aim directly or indirectly to satisfy human wants and needs. In production process there are two important features improving quality-price-ratio of goods and services and increasing income from growing and more efficient market production. The most important forms of production are market production, public production and household production. Economic development also increases due to the growth of income that are gained from the 1 growing and more efficient market production. Market production is the only production form which creates and distributes income to stakeholders. Public production and household production are financed by the incomes generated in market production. Thus market production has a double role in creating development, i.e. the role of producing goods and services and the role of creating income.

NSOU ● CC-GR-10 17 Production is involved with three stakeholders such as customers, suppliers, producers. Customers The customers of a company are typically consumers. There are several other market producers or producers in the public sector. Each of them has its own individual production functions. Due to competition, the price-quality-ratio of commodities tend to improve and this brings the benefits of better productivity to customers. Customers get more for less. In households and the public sector this means that more satisfaction is achieved at less cost. For this reason the productivity of customers can increase over time even though their income remain unchanged. Suppliers The suppliers of companies are typically producers of materials, energy, capital, and services. They all have their individual production functions. The changes in prices or qualities of supplied commodities have an effect on both actors' (company and suppliers) production functions. Hence, the production functions of a company and its suppliers are in a state of continuous change. Producer community The incomes are generated for those participating in production, i.e., the labour force, society and owners. These stakeholders are referred to here as producer communities or, in shorter form, as producers. The producer communities have a common interest in maximizing their incomes. These parties that contribute to production receive increased incomes from the growing and developing production. Types of production Production is undertaken by firms, also known as enterprises, or businesses. There are three stages of production:\ ? Primary production, which involves the extraction of resources from the earth, such as agriculture, fishing, and mining. Land and natural resources are the main resources used in primary production. ? Secondary production which involves the manufacture of semi-finished and finished consumer goods, such as computers, motor vehicles, and clothing. Labour and capital are the main resources used in the secondary sector.

18 NSOU ● CC-GR-10 ? Tertiary production involves the distribution of products and the creation of services, such as road construction, financial services, healthcare etc. Human capital is usually the most essential resources used in tertiary production. The tertiary sector is sometimes sub-divided into tertiary, quaternary and quinary sectors. The quaternary sector of an economy includes the infrastructure of information technology and knowledge that enables an economy to produce successfully. The quinary sector is defined as the aspect of the economic, political and social infrastructure which supports economic activitiy, including universities, charities and government activity. Sophisticated quaternary and quinary sectors are commonly viewed as essential to economic development in a globalised economy. 2.4 Exchange Exchange is communication between buyers and sellers with negotiate prices. Economic behaviour involves the exchange of one scarce resource for another. When people engage in paid work, they exchange their scarce time, effort, and skill for income, and, when people make purchases, they exchange their scarce income for scarce goods and services. Economic activity is driven by the need to exchange. At the beginning of any marketing course or programme it is important to appreciate how exchange processes work. An exchange process is simply when an individual or an organisation decides to satisfy a need or want by offering some money or goods or services in exchange. It's that simple, and you enter into exchange relationships all the time. The exchange process extends into relationship marketing. With relationship marketing we purposefully look at the long-term relationship with our target audience, and aim to grow our business. By delivering value to our customers we consistently nurture the relationship with customers. Later in your studies you will come across relationship marketing and customer relationship management, which encompass the traits of a basic marketing exchange process and take it much further. 2.5 Consumption The process of satisfying needs and wants is called consumption. Individuals need to exchange their skill and effort, or their enterprise, land or capital, for an income.

NSOU ● CC-GR-10 19 They can exchange this income for the scarce products which they need or want. Exchange and consumption fulfill a process of production. Consumption is the use of goods and services by households. Consumption is distinct from consumption etnditure, which is the purchase of goods and services for use by households.
Consumption differs from consumption expenditure primarily because durable goods, such as automobiles, generate expenditure mainly in the period when they are purchased, but they generate "consumption services" for example, an automobile provides transportation services until they are replaced or scrapped. Neoclassical economists generally consider consumption to be the final purpose of economic activity, and thus the level of consumption per person is viewed as a central measure of an economy's productive success. The study of consumption behaviour plays a central role in both macroeconomics and microeconomics. Macroeconomists are interested in aggregate consumption for two distinct reasons. First, aggregate consumption determines aggregate saving, because saving is defined as the portion of income that is not consumed. Because aggregate saving feeds through the financial system to create the national supply of capital, it follows that aggregate consumption and saving behaviour has a powerful influence on an economy's long-term productive capacity. Second, since consumption expenditure accounts for most of national output, understanding the dynamics of aggregate consumption expenditure is essential to understanding macroeconomic fluctuations in the business cycle. Microeconomists have studied consumption behaviour for many different reasons, using consumption data to measure poverty, to examine households preparedness for retirement, or to test theories of competition in retail industries. A rich variety of household level data sources allows economists to examine household spending behaviour in detail, and micro economists have also utilized these data to examine interactions between consumption and other microeconomic behaviour such as job seeking or educational attainment. 2.6 Summary Thus goods and services, production, exchange and consumption an important and integral part of the economy of the country. The nature of change of their behaviour is indeed essential to the study.
20 NSOU ● CC-GR-10 Unit 3 ? Concept of Economic Man Structure 3.0 Objective 3.1 Introduction 3.2 Concept of Economic Man 3.2.1 Economic decisions 3.4 Summary 3.0 Objective The objective of this unit is to give the learners an idea about economic man and the economic decisions taking here to. 3.1 Introduction For over a century now the foundation stone of economics, theoretical and applied, has been a generalized account of the behaviour of economic agents in which they are depicted as self-regarding, rational, and, with qualifications, well-informed in the calculated choices required by their rationality. Economic Man postulates defining him for the starting point of any economic analysis as the distinguishing mark of professionalism. 3.2 Concept of Economic Man Economic Man will act in the most rational way possible in order to maximize his utility. Rational thinking means they should be logical, not emotional and calculative for profit maximization or low risk in their enterprises. This type of behaviour is also called economic behaviour. The economic behaviours of human beings determine under the specific social circumstance. Economic man can participate in the process of decision making. Such kind of human resources also defined as having advanced managerial skill. 3.2.1 Economic decisions Economic decisions are consciously taken and have conscious experience as their immediate or ultimate objective. Economic situations, whether of individuals,
NSOU ● CC-GR-10 21 enterprises, markets, industries or whole economies, are characteristically changing; private economic decisions, even when themselves referring only to events a moment or so ahead, are always interdependent with decisions made with long-term matters in mind; all public economic decisions take time. Few Postulates may be considered for defining Economic man: ? A postulate of uniformity: One interpersonal variation rs required for economic decision. ? A postulate of intelligence: They are highly intelligent. They know their own wants, abilities, and attitudes, the facts of the markets around them, the legal framework, the technology available, etc. Their foresight about matters relevant to their economic decisions is imperfect only in relation to the dates of their own deaths and illnesses and those of their immediate relatives and the eventual outcome of long-term investments; though about all those matters they act on knowledge of well-based probability distributions. ? A postulate of self-interest: Self-interest can promote to take challenges at any kind of problems of enterprise. ? A postulate of competitiveness: Economic man takes part in buying or selling the same productive service or finished goods to obtain a better price. 3.3 Summary The presence of economic man is an assumption of many economic models. The eco- nomic man is completely rational. It states how a manager should behave in the process of decision making. This approach, besides rational, is also idealistic because it cannot be fully applied to a practical situations.

22 NSOU ● CC-GR-10 Unit 4 ??Economic Distance and Transport Cost Structure 4.1 Objective 4.2 Introduction 4.3 Economic Distance 4.4 Transport Cost 4.5 Concept And Classification of Economic Activities 4.6 Summary 4.1 Objective The learners will come to know about the economic distance and transport cost. 4.2 Introduction A distance is very often referred to as the physical distance. In statistical meaning, the distance determines the level of dissimilarity between patterns, objects or units. The economic distance defines a dissimilarity level between objects functioning in the economic space. It is one of the most important issues of spatial econometrics. However, its measurement is difficult due to the definition, description and estimation problems. 4.3 Economic Distance In general, the economic distance identifies a dissimilarity level between managing entities like companies, households, self-government units etc. They offer products or services such as cars, computer programs, credits etc. The development of spatial statistics and econometrics makes the economic distance one of the most important issues in examining the relations between territorial units, e.g. regions, cities, metropolises, countries. In the era of globalization, technological progress and other socio-economic changes, the economic distance affects relations between territorial units much more than geographical distance. International trade is considerably more determined by transport costs and economic dissimilarities between countries than by the physical distance between them. Migration decisions are made by comparing the socio-economic situation like economic situations of enterprises, labour demand and supply, the costs of living, offered services etc. of a destination region against an origin residence.

NSOU ● CC-GR-10 23 4.4 Transport Cost In dealing with transport costs distinction must be made between private costs and social costs. Private costs are the costs incurred by the individual or transport operator in providing a particular service. Social costs are the costs imposed on society as a whole through an individual making a trip or transport operator providing a service. These costs are not paid for by the user-social costs are incurred as a result of external effects of transport activity. Private transport costs are made up of three elements- ? Track Costs - Providing and maintaining a surface cove, which transport services can operate. ? Running Costs - the cost of purchasing, maintaining and operating a vehicle to run on the track surface. ? Interchange Costs - the cost of providing facilities at the beginning and completion of a journey. Categories of transport cost: Fixed costs : These costs are incurred before any traffic at all passes. They include the costs (i) of providing the infrastructure (i.e. the road, the port, or the railway line); (ii) of providing, equipping and staffing the terminal facilities (i.e. bus depots, railway stations or airport); (iii) of providing marginal, administrative and maintenance staff and their offices and workshops. These costs are inescapable because they cannot be avoided except by abandoning the whole operation. They also do not vary with the level of traffic, but remain independent of it. A railway signal-box must be manned (and thus incurs wage costs) whether there is one train or six trains per hour over the line. Variable costs: These are costs incurred by the actual movement of traffic and they vary with the level of the traffic passing. They include the costs of fuel, crew wages and the maintenance of vehicles, for example, routine inspection of an aircraft after a flight. They are escapable because they may be avoided or escaped by not running a particular train, suspending a particular flight or a private motorist leaving his car in the garage and walking to the office/shops. Terminal cost: Terminal costs are those associated with loading and unloading the commodities and the accompanying paperwork. The terminal costs are both fixed and variable. The proportion of terminal costs in the total costs varies between modes. In road haulage the terminal costs can be negligible. On the other hand, to send goods by rail may entail conveying them by lorry or truck

24 NSOU ● CC-GR-10 from factory to goods depot, loading them into wagons and receiving the process at the other end. Marginal and Average Costs: Marginal cost is the additional cost incurred in order to produce one more unit of output. Marginal cost may be incurred by carrying extra passenger on a bus with seats to spare or another tonne of goods on a half empty lorry or of a wagon on a freight train. It even means allowing 25 trains in a day instead of 20. Marginal costs are therefore time linked and it may be of short run or long run nature. It does not represent constant additional total costs. Upto the capacity of the transport unit transport mode (bus, aircraft, train, ship), any further increase in traffic incurs negligible marginal costs. Then there is sharp increase at the point, where a second unit becomes necessary. Marginal costs do vary between modes of transport. Average costs are obtained by dividing the total costs of the operation by the work done, expressed in terms of passenger-km, tonne-km or transport-unit-km, Average costs will of course vary with output, for greater the product the more fixed costs can be spread. Comparative cost advantage: Two factors influence the rate difference for alternative transport modes; terminal costs and line haul (or over-the- road) costs. These costs of course vary with the type of commodity being moved. But it is also possible to generalize about the level of terminal costs by mode of transportation. Over a short distance, truck transportation of commodities is cheap, and this is reflected in the prices offered to the customer. For longer distance, however, railway transportation comes into its own. In a sense, therefore, the cost structure preserves certain complementarities among the different media, with the trucking companies feeding goods over short distances to railheads where they will be transferred over longer distances for possible oceanic shipment overseas or to another point in the nation. Line-haul costs, in contrast to terminal cost, vary with distance; and they are not linearly related to mileage. Water movement is invariably the least expensive whereas over-the-road operating costs are highest for truck. Once again, rail transport falls in between. Looking at the distance at which each of the three modes are most competitive, it is seen that truck transportation, owing to low terminal costs, is the lowest cost mode at short distances. Beyond certain distances, water is the most economical form of transport and it is, of course, the dominant mode in world trade.
NSOU ● CC-GR-10 25 The freight rate is only one factor in choosing among alternative transport modes. Another equally important factor is service. Transportation service implies great many things, including speed of delivery, scheduling convenience, avoidance of damage and reliability. 4.5 Concept and Classification of Economic Activities The economic activities include several sectors that evolved in successive phases. These involve production, distribution and consumption of goods and services at all levels within a society which are called economic activities. Gross domestic product or GDP is one way of assessing economic activity. The degree of current economic activity and forecasts for its future level have significant impact on economy. Primary:

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The primary sector of the economy extracts or harvests products from the earth.

This sector includes the production of raw material and basic foods. The primary sector activities

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include agriculture (both subsistence and commercial), mining, forestry, farming, grazing, hunting, fishing and quarrying.

The packaging and processing of the raw material associated with this sector is also considered to be part of this sector. In developed and developing countries, a decreasing proportion of workers are involved in the primary sector. This sector of employee is called 'red collar' workers. Secondary:

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The secondary sector of the economy includes industries that produce a finished, usable product or are involved in construction. This sector generally takes the output of the primary sector and manufactures finished goods.

The activities of secondary sector are related to businesses, export, sale or domestic consumers. This sector

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is often divided into light industry and heavy industry. Many of these industries consume large quantities of energy and require factories and machinery to convert raw materials into goods and products. They also produce waste materials and waste heat that may cause environmental problems or cause pollution. The secondary sector supports both the primary and tertiary sector.

This

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field is an important source for engineering job opportunities. Among developed countries, it is an important source of well-paying jobs for the middle class to facilitate greater social mobility for successive generations on the economy. This sector

worker is called 'blue-collar' workers.
26 NSOU ● CC-GR-10 Tertiary: Tertiary sector includes all the services other than primary and secondary activities. Tertiary production involves the service sector rather than tangible goods. This work refers to a range of personal and business services involving a rapidly growing share of the labour force in highly developed countries. Rental clerks, barbers, beauticians and secretaries all fall into the personal and business service categories as a group and they have been described as 'pink-collar' workers. Quaternary: Services represent a special type of service work, focusing on professional and administrative services including financial and health service work, information processing, teaching and government service and entertainment activity. Specialized technical, communication and motivation and leadership skills provide the common thread linking these activities. Practically quaternary activity occurs in office building environment or specialized environment provided by schools, theaters, hotels and hospitals. This group has been termed as the 'white-collar' work force. Quinary: Quinary activities, the upper most one in hierarchy, remain more restrict in size compared to other groups of activities. The most visible persons in this group include chief executive officers and other top-management executive in both government and private service. Research scientist, legal authorities, financial advisers and professional consultants who provide strategic planning and problem-solving services belong to this group. Most of these high order analytical and managerial activities occur in larger urban centres or in close proximity to large university/medical or research centres. An appropriate level for this group is the 'gold-collar' workers. Quinary activities are viewed from two broad aspect. High-level managerial and executive administrative positions (public and private), and Scientific research and development services. 4.6 Summary Distance is commonly the most basic condition affecting transport

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costs. Transport costs are a monetary measure of what the transport provider must pay to produce transportation services.

The impacts of geography mainly involve distance and accessibility. Our decisions are often controlled by our financial condition. Thus the study of economic diatance and transport cost are highly interrealated.
NSOU ● CC-GR-10 27 Module - II
28 NSOU ● CC-GR-10
NSOU ● CC-GR-10 29 Unit 5 ❑
Factors Affecting Location of Economic Activity with Special Reference to Agriculture (Von Thunen) and Industry (Weber)

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Structure 5.1 Objective 5.2 Introduction 5.3 World agricultural system: Von Thunen's model and its relevance to Industrial Location: Theory of least cost approach- Weber's Model 5.4 Industrial Location 5.5 Summary 5.1 Objective The objective of this study primarily concerned about the spatial variation of economic activities and the knowledge of locational theory. 5.2 Introduction The distribution of economic activity over the world varies from each other on the basis of land use and land cover pattern,

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raw materials, the process of manufacturing, the resultant product and the markets. So, the locational preference will also differ. 5.3

World Agricultural System : Von Thunen's Model and its Relevance The very first attempt to device a scientific theory explaining the location of an economic activity can be credited to J. H. Von Thunen (1783-1850) of Germany. Both a scholar and a farm operator, Von Thunen formulated his famous theory on the basis of 40 years experience in managing an agricultural estate near the city of Rostock in Mecklenburg on the Baltic coast of Germany. Von Thunen 30 NSOU ● CC-GR-10 His theory tries to account for the types of agriculture that will prosper around an urban market. The theory rests upon several assumptions:- ? There is an isolated area considering of just one city and its agricultural hinterland. Such an area could be called "an isolated state". ? The

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city is the market for surplus products from the hinterland and receives products from no other area. ? The hinterland ships its surpluses to no other market except

its city. ? The hinterland has a homogeneous physical environment favourable to the production of mid-latitude plants and animals. ? The hinterland is inhabited by the farmers desiring to maximize their profits and capable of adjusting their type of farming to the demands of the market. ? The hinterland is traversed by only one means of land transportation. In Von Thunen's day this was

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the horse and wagon. ? Transportation costs are directly proportional to distance and are borne entirely by the farmers who ship all

food fresh. Given the above premises, different types of agriculture would develop around the city in discrete rings. The greatest distance from the city at which any given type of farming could be conducted depended on selling price at the market, production cost on the farm, and transport cost between the two. Any profit a farmer realized depended on the relationship of these three variables, as expressed in the formula. $P = V – (E+T)$ where, P= Profit; V= the value of commodities sold; E= Production expenses (labour, equipment and supplies); T= Transportation cost. Two principal themes of his theory are- (i) The number of profitable options decreases with distance from the city market, (ii) There is a minimum distance within which a farmer would not choose to produce a given commodity because some other commodity yielded a greater profit. From these two principles, Von Thunen postulated that six concentric zones of agriculture would develop around the market city on an isolated state A in the diagram.

NSOU ● CC-GR-10 31 Zone- I The land nearest to the market would be used to produce perishable items like milk and vegetables. These activities would be concentrated in the inner zone because of the slowness of transportation and the absence of food- preserving techniques. Zone- II This zone would be specialized in producing wood, with firewood in much greater demand than lumber. According to Yon Thunen, forestry yielded greater returns to the farmer near the city than did any other type of production except milk and vegetables. Zone- III, IV, and V these areas would tend to be devoted to grains and other crops. With distance from the city the intensity of cultivation would decrease. This is indicated in the proportion of fallow land zero in zone III; 14 percent in zone IV and 33 percent in zone V. Von Thunen Model (Land use pattern) Zone- VI this would be the region of livestock farming. Marketed products would be of two types: Livestock which could be driven to market, hence cutting transport costs almost to zero and cheese, which is not highly perishable and which is valuable enough to be able to stand higher transport costs. Modified Theory of Von Thunen Model

32 NSOU ● CC-GR-10 Modified Theory : This theory would be modified by the presence of a navigable river and a smaller market city. Along the river land use pattern should be located in parallel way and small town created a micro business region. Relevance: The highly empirical contents of Yon Thunen's classical model can be understood in terms of the early years of his life and their influence on his location ideas about agricultural activities. His model drew heavily for econometric analysis upon his farm accounts and many of the assumptions. His model has demonstrated certain properties of the agricultural landscape and provided a framework for location theorist like Weber (1909), Hoover (1936 and 1948), Losch (1954), Dunn (1954) and Griffin (1973). Yon Thunen's analysis is concerned with movement minimization in terms of cost, time and energy. Although the basic forces Yon Thunen tried to explain in his theory are still operative, it is difficult to find examples today. The ring model has been radically modified by changes in transportation characteristics, new technology's achievements (refrigeration) and the replacement of fire wood by certain substitutes (coal, gas, electricity etc.). Many of the needs of his time now seem obsolete. With improvement in transportation and reduction in transport cost, the radii of land use zones have become larger, but the concentric zones may still be recognized on a continental scale. At the small scale of farmstead and village, the ring effect still persists. Hence the movement continues to be measured in terms of time and man-days rather than freight costs. In the less developed and underdeveloped countries the conditions may still be similar to those of Von Thunen's isolated estate and there are several cases cited in geographical location where land use around a settlement is directly related to distance from the settlement. Moreover, the adoption of green revolution technology at all size classes, particularly in the intensively irrigated areas has disturbed the application of Von Thunen model in Indian context. His precondition was fully valid right up to the early decades of the 20 111 century. With changed conditions, the distance from the market is now only a cost factor. So, the classic Thunian agro-spatial model is no longer operative in its original format. 5.4 Industrial Location : Theory of Least Cost Approach- Weber's Model In order to explain the underlying influences on location as applied to all industries, Alfred Weber, a German economist put forward general theory of industrial location in his

NSOU ● CC-GR-10 33 book "Theory of the Industrial Location" in 1909. It was translated into English in 1929 and has since become a standard reference on the subject. His overall objective was to determine the minimum cost location for a manufacturing plant. Weber tried to explain the location of industrial activity in terms of three economic factors viz. transport costs, labour costs and aggl omera ti on economies. His explanation is based on the least-cost location for industrial production. (A. Weber) Assumptions and Principles : Weber made three explicit assumptions which were retained throughout his analysis. ? There is an uneven distribution of natural resources on the plain. Thus the raw materials, fuel and water needed for industrial productions may be found only in given locations. ? The size and location of centre of consumption of the industrial products are given. The markets are thus points on the plain. ? There are several fixed location of labour where given wager rates operate Labour is immobile and unlimited at these locations. There are other assumptions which are implied in his work. ? The area has a uniform culture, race climate and political and economic system. ? The entrepreneurs seek to minimize the total cost of production. ? Conditions of perfect competition are assumed, whereby resources and markets are unlimited at their given location and no firm may obtain a monopolistic advantage from its choice of location. ? Costs of land, building, equipment, interest and depreciation of fixed capital do not vary regionally. ? There is a uniform system of transport over a flat surface.

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34 NSOU ● CC-GR-10 Several terms introduced by Weber need to be defined. Ubiquities are material available everywhere; example-water, sand, gravels etc. Localized materials are available only at specific locations; i.e. coal, iron-ore, bauxites etc. Weber also made a distinction between pure materials and weight losing materials. Pure raw materials lose no weight in processing, i.e. cotton, whereas weight losing materials lose weight in the finished product i.e. iron and steel. Weber maintains that there are three regional factors which affect the costs of production. These are the cost of raw materials and the cost of transporting raw materials and finished products, and the cost of labour. The cost of materials varies, for example, according to the nature of the deposits and the difficulty of mining them. He suggests that this variation should be reflected within the cost of transport of the materials. So, his general regional factors affecting production are two, viz. transport costs and labour costs. He indentifies another local factor called agglomeration or de-glomeration economics. The first are the savings to the individuals' plants that result from their opening in the same location. This is possible through the common use of auxiliary industries, financial services and public utilities. In a single firm location, these processes and services have to be borne by the firm at greater cost. Agglomeration economies also include linkages between firms, flows of goods between the plants, development of a specialist labour force, and savings owing to the bulk purchasing of materials and large scale marketing of products. Weber suggests that many of these economies may be gained by the increased scale of production of one firm as well as by the clustering of several. De-glomeration economics involve the weakening of the agglomeration economies and specially, the increase in the cost of land owing to such a clustering of firms. His analysis is divided into two major sections: (1) The identification of the point of the minimum transport costs. (2) A discussion of the circumstances under which production will be attracted away from this point owing to advantages gained from cheaper labour or agglomeration. Transport costs: Following Weber, the cost of transportation will be considered under two simplified conditions: (A) One market and one source of material supply and (8) One market and two sources of material supply and involve Weber's classic location triangle. (A) One market and one source: If the material is ubiquitous, the processing would take place at the market. If the material is pure, processing may occur at the market, the
NSOU ● CC-GR-10 35 material site or any place in between. An intermediate location would entail an unnecessary additional handling cost. If the material is weight losing, the process will locate at the material sources to avoid transporting waste materials. (B) One market and two sources: In the first example of the location triangle, SI and S2 are the two material sources and M is the market location. Because distance and costs between these three points are identical, we may assign each of the three distances a cost of, say $1.00. The processing will occur at the market; because two needed materials can be supplied three at a total unit cost of $2.00. If processing were to locate at SI, there would be cost of shipping one unit from S2 to SI ($ 1.00), the cost of shipping that same unit, now processed, on to the market ($1.00, and the cost of shipping one unit of the material from SI, also now processed, to the market ($1.00). Thus, the total transport cost, if processing were to locate at SI or S2 is $3.00 versus $2.00 per unit at the market. The situation is different when we have two weight losing materials to be brought together in the processing centre. Let us assume that there is s 50 percent weight loss for each of the two materials. Let the cost of transporting one unit of the weight losing material be $2. If a market location is selected, one would have to ship one of material from both SI and S2 at total cost of $4.00. If SI is selected for processing, the cost of obtaining the material from S2 would be $2.00. No transport cost would be changed to get the material from SI and the cost to transport the product to market with the 50 percent weight loss would be $2.00. The market SI or S2 would have the same total transport cost. Locational triangle (two raw materials and one market) Weber was concerned with selecting the least-cost or optimum location. An intermediate location at P would be optimum, rather than M, S 1 or S2, where the transport cost at P would be less than $ 4.00. Besides, if one material had a greater weight-loss ratio than the other, the intermediate location for processing would be pulled towards the site of the greatest weight loss.

36 NSOU ● CC-GR-10 Labour Cost : The geographic variation is the cost of labour was viewed by Weber as a distortion of the basic transport pattern. An area handicapped by high transport cost might be attractive to industry because of expensive labour. According to Weber, an industry would select the location that has the least combined cost when transport and labour are considered together. To determine this location, Weber introduced two concepts- lsotim and lsodapane. lsotim is a line of equal transport cost for any material or product. In the diagram the Isotim are given in $1.00 interval. The cost of shipping the finished products is shown by single line isotim. If one is located for processing at the material supply site (M), there would be a $4.00 transport charge to send the finished product to the market. The isotims for the material are shown by double lines. The cost of transporting the material to the market is only $2.00, with the market being the least cost location. The cost of moving the material is thus half that of shipping the finished product. So, the total transport cost at location X would be $2.00 to ship the product to market plus $1.00 to obtain the material from the sources i.e. $3.00. Isotim and Isodapane

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The isodapane is a line of total transport cost. The isodapane is found by summing the isotims at a location. Once the

isodapanes are determined, one is able to identify the point of least total transport cost, then the variation in labour costs can be considered in combination with the isodapanes. The reason for using isodapanes is to introduce the labour component into Weber's location theory. In the diagram, the construction of isodapanes and the optimum location points are shown.
NSOU ● CC-GR-10 37 Agglomeration: Weber recognized that agglomeration may operate as a distinct location factor. He viewed agglomeration as the dollar savings per unit that would accrue to a plant from locating within a cluster of the other plants. Weber saw agglomeration not as producing internal-scale economies, but rather external economics including urbanization economics. The figure illustrates the cost of three manufacturing plants, A, B, C which have independently located at their least cost point. Around each plant is drawn a critical isodapane. If each of these three plants could locate together, the agglomeration advantages would be just matched along these lines by the higher transport costs. Thus, all plants would benefit from agglomeration savings if they were to locate within the shaded triangle. Critical Isodapane and Urban agglomeration point (A, B, & C denote as three different urban centres, most dark point indicate point of agglomeration) Criticism: Weber's purpose was to provide a general theory of industrial location and in this regard his contribution has proved most valuable. His work however, has a number of shortcomings that limit its application in explaining fully actual manufacturing location. His theory is a model hypothesis based on several premises which are possible
only in the exceptional cases. So, the theory is an exception rather than rule.

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The difference between the capitalistic and socialistic economy, institutional factors and entrepreneurial decisions were not taken seriously

by Weber. He did not effectively and realistically take into account geographic variation in market demand. He over emphasized on the role of transport cost. The transport cost is not proportional to distance and weight. Moreover, the intermediate locations necessitate added terminal charges. The advantage of the "break of bulk" location was also ignored by him. Labour is normally mobile and is not always available in unlimited quantity at any location. Many manufacturing
38 NSOU ● CC-GR-10 plants obtain a very large number of material inputs and produce a wide range of products for many diverse markets; Weber's theory does not apply to such circumstances. In his agglomeration concept, Weber

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failed to consider the space problem, energy crisis and problems of civic amenities. The assumption of perfect competition in the concept of Weber'

s theory

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is an ideal condition. In the long run it is very difficult to sustain perfect competition in the region. Competition and price fluctuation in the economy is a natural phenomenon. Weber failed to recognize that. 5.5

Summary From the above analysis it can be said that these theories on economic activities are space related and changes according to the market conditions.
NSOU ● CC-GR-10 39 Unit 6 ?
Primary Activities: Subsistence and Commercial Agriculture, Forestry, Fishing and Mining
Structure 6.1 Objective 6.2 Introduction 6.3 Subsistence Farming 6.4 Commercial Farming 6.5 Forestry 6.6 Fishing 6.7 Mining 6.8 Summary 6.1 Objective The objective of this unit is to make the learners aware of the primary activities of the economy to make them understand that economic activities are directly dependent on environment as they use the earth resources. It thus includes hunting, gathering, fishing, forestry, agriculture, mining and quarrying. 6.2 Introduction

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The primary sector of the economy extracts or harvests products from the earth.

The primary sector includes the production of raw material and basic foods. Activities associated with the primary sector

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include agriculture (both subsistence and commercial), mining, forestry, farming, grazing, hunting and gathering, fishing, and quarrying.

The packaging and processing of the raw material associated with this sector is also considered to be part of this sector. 6.3 Subsistence Farming The word 'subsistence' means self-supporting or providing sustenance. In this farming the producer lives directly on what he produces. So basically it is consumption oriented farming with little or no influence of market. Subsistence farming system becomes very important in those areas where population density is high; economic development is at a low level and a gainful employment opportunity in the non-agricultural sector is limited. Important regions of concentration are South-East Asia and tropical Africa.

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40 NSOU ● CC-GR-10 Major Characteristics : ? Subsistence farming is mainly is found in tropical climatic region in the world. ? Subsistence farm economy is more commonly associated with intensive type of farming. ? As the farming is for self-consumption, influence of market on production pattern is insignificant. ? Where growth of non-agricultural sector is poor and population growth is high, increasing pressure of man on agricultural land causes low per capita output and declining marginal returns from the land. ? Since the farming is neither profit motivated, nor market dependent, there is not much effort to make the farming cost-efficient. ? Subsistence farming is dominated by small and marginal farmers and in many cases the farm sizes are below the limits of economic viability. ? Primary emphasis is given on the product of cereals like rice or wheat. Coarse grains are cultivated in those areas where conditions are not suitable for the cultivation of these two crops. ? Although technology is predominantly traditional, in some areas modern technology is being introduced to increase the return from agricultural land. 6.4 Commercial Farming Farming is identified as commercial when the crops are cultivated with the main objectives of selling those crops in the market and earning profit. So, commercial fanning is always market oriented and profit- motivated. Consumption of the products by the farmers, if at all takes places, is an increasing proportion of the total production. Demand patterns and price structure are the major determinants of production in this farming system. Farming is organized and an effort towards excessive production is deliberately avoided to maintain price stability because more supply as compared to demand may bring down the price. Commercial farming is important in North America, Europe and Oceania. It is also significant in Argentina, Chile and portions of Brazil in South America. In recent years, commercial farming is gaining significance in the countries of East and South-East Asia.

NSOU ● CC-GR-10 41 Major Characteristics: ? Temperate climatic areas are favourable for commercial farming. ? Population fed by commercial farming is normally non-farm population who lives in urban areas and engaged in non-agricultural activities. ? Commercial farming is more commonly extensive type and as a result most of the commercial farms are large and the trend is toward even larger farms. ? Minimization of the cost and maximization of per capita output are the two most important objectives in this farming and to fulfill these objectives machinery, fertilizer and high yielding varieties of seeds are used extensively. ? Commercial farming is integrated with other allied actrvrties and these include storage, processing, canning or packing, wholesaling and retailing of the products etc. All these activities generate employment and boost up the economy. ? Monoculture (using the farm land for only one crop) may be associated with commercial farming. This has the advantages of increasing efficiency and quality of produce (by means of specialist techniques, scientific innovation and labour specialization) while at the same time reducing the costs. ? Labour input in commercial farming of the developed countries is low resulting into a low man-land ratio. This is primarily for the purpose of cost reduction and obtaining high per capita output. 6.5 Forestry Forestry is the science and craft of creating, managing, using, conserving, and repairing forests and associated resources for human and environmental benefits. Forestry is practiced in plantations and natural stands. The science of forestry has elements that belong to the biological, physical, social, political and managerial sciences. Modern forestry generally embraces a broad range of concerns, in what is known as multiple-use management. including the provision of timber, fuel wood, wildlife habitat, natural water quality management, recreation, landscape and community protection, employment. aesthetically appealing landscapes, biodiversity management, watershed management, erosion control, and preserving forests as “sinks” for atmospheric carbon dioxide. Forest ecosystems have come to be seen as the most important component of the biosphere and forestry has emerged as a vital applied science, craft, and technology. Forestry is an important economic segment in various industrial countries. For example, in Germany, forests cover nearly a third of the

42 NSOU ● CC-GR-10 land area, wood is the most important renewable resource, and forestry supports more than a million jobs in a country. 6.6 Fishing Fishing is the activity of trying to catch fish. Fish are normally caught from ocean and inland water bodies. Techniques for catching fish include spearing, netting, angling and trapping. Inland fishing is generally small in Scale. Subsistence fishing is practiced in ponds, lakes, rivers etc. using traditional techniques such as rod and tackle, arrows an harpoons throw nets and drag nets, etc. Commercial fishing is the capture of fish for commercial purposes. Commercial fishermen harvest almost all aquatic from tuna, cod and salmon to shrimp, krill, lobster, clams, squid and crab. Commercial fishing methods have become very efficient using large nets and sea-going processing factories. Individual fishing quotas and international treaties seek to control the species and quantities caught. Commercial fishing gear includes weights, seine nets, trawls, dredges, hooks and line (long line and hand line), lift nets, gillnets, entangling nets and traps. Among the total production, over 90% is marine and less than 10% is inland. 6.7 Mining Mining is the extraction of valuable minerals or other geological materials from the earth, usually from an ore body, lode, vein, seam, reef or placer deposit. These deposits form a mineralized package that is of economic interest to the miner. Ores recovered by mining include metals, coal, oil shale, gemstones, limestone, chalk, dimension stone, rock salt, potash, gravel, and clay. Mining is required to obtain any material that cannot be grown through agricultural processes, or feasibly created artificially in a laboratory or factory. Mining in a wider sense includes extraction of any non-renewable resource such as petroleum, natural gas, or even water. Mining of stones and metal has been a human activity since pre-historic times. Modem mining processes involve prospecting for ore bodies, analysis of the profit potential of a proposed mine, extraction of the desired materials, and final reclamation of the land after the mine is closed. Mining operations usually create a negative environmental impact, both during the mining activity and after the mine has closed. Hence, most of the world's nations have passed regulations to decrease the impact. Work safety has long been a concern as NSOU ● CC-GR-10 43 well, and modem practices have significantly improved safety in mines. Levels of metals recycling are generally low. Unless future end-of-life recycling rates are stepped up, some rare metals may become unavailable for use in a variety of consumer products. Due to the low recycling rates, some landfills now contain higher concentrations of metal than mines themselves. 6.8 Summary Primary activities are

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vital not only for the economy but also for the sustenance of the human race. One can say that primary economic activities form the 'building block' of other economic activities. 44

NSOU ● CC-GR-10 Unit 7 ?
Secondary Activities: Manufacturing (Cotton Textile, Iron and Steel). Concept of Manufacturing Regions, Special Economic Zones and Technology Parks
Structure 7.1 Objective 7.2 Introduction 7.3 Manufacturing Industry:
Cotton Textile 7.4 Manufacturing Industry: Iron and Steel 7.5 Concept of Manufacturing Regions 7.6 Special Economic Zones 7.7 Technology Parks 7.8
Summary 7.1 Objective The students will learn about the secondary activities that lead to secondary production after manufacturing, processing and construction. 7.2 Introduction Manufacturing sector known as secondary sector. sometimes as production sector, includes all branches of human activities that transform raw materials into products or goods. The secondary sector includes secondary processing of raw materials, food manufacturing. textile manufacturing and other industrial activities. 7.3 Manufacturing Industry: Cotton Textile Industry The textile industry is primarily concerned with the design, production and distribution of yarn, cloth and clothing. The raw material is cotton.

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Cotton is the world's most important natural fiber. In the year 2007, the global yield was 25 million tons from 35 million hectares cultivated in more than 50 countries. There are three stages

of textile processing i.e. Spinning - giving yarn, Weaving - giving fabrics and Finishing - giving textiles. The major cotton textile belts are discussed below:

NSOU ● CC-GR-10 45 United States : The United States of America is one of the front-runners among the textile manufacturing countries. Though the industry had to overcome several hurdles from the very early period of growth, the country maintained her lead position in textile production. The first cotton mill was established within Rhode Island in 1790. Since then, numerous industries were set up in the USA. The development of the US textile industry had gone through two distinct phases. The first phase of development had experienced the ascendancy of New England areas as a seat of cotton textile industry and the second phase was the tragic downfall of New England and rise of the southern states as textile producer. This shift of location was an unique event in the manufacturing history of the world. Development during First Phase: In the late 18th century, New England and adjacent areas were developed at a very rapid pace. The areas bounded by the Merrimac River and Fall River grew at a faster pace. The adjacent areas of the Massachusetts, Providence attracted a large number of cotton mills within its territory. Several factors proved advantageous for this massive growth of New England at that period. These were: ? Development of water power from small, turbulent streams. ? The skilled labourers were available in the vicinity. They had the traditional expertise of spinning and weaving. The local inhabitants collected and gained the knowledge from the emigrants of Great Britain. ? The facilities of export and import of materials through the ports of Boston and Providence. ? The humid climate of New England. The climate of New England was most suitable for spinning. ? Large financial help from the local urban tycoons. ? Cheap female worker from the surrounding regions.

46 NSOU ● CC-GR-10 ? Despite all these advantages, New England region gradually lost all of its glory. The industry started growing in the southern part of the country. Development during Second Phase: At the early quarter of 20th century, the New England region literally experienced a textile boom. The textile industry attained such a high degree of development that it was regarded as the 'textile capital' of the world. At that time, more or less 90 per cent of the textile goods was produced by New England. The cotton was then largely brought from the southern cotton growing districts. In south, the absence of the advantages enjoyed by New England was liable for the poor growth of textile industry. But the supremacy of the New England area did not last long. The initial advantages of low price of land, cheap labour and port advantages Jost their significance with the passage of time. The machines became obsolete, cost-benefit ratio became unfavorable due to low pro-ductivity, the increasing rent of the land, high wage rate, housing problem, switch over to electric power from traditional water power and above all dearth of raw material supply posed obstacles to the New England textile mills. The decline of the New England mills and rise of the southern textile industry were closely related. The humidity factor which was regarded as the major obstacle for the development of textile mills in the south had no meaning when air-conditioning system was introduced. From the very early periods, the southern Piedmont planes of Georgia, Florida, Carolina, Alabama, Virginia, Tennessee and Kentucky were the producers of most of raw cotton in the country. To ensure the steady supply, textile mills gradually shifted towards cotton-growing regions. The major reasons for growing importance of the textile mills in the southern states are as follows: o Easy access to abundant raw cotton within reach. o Relative advantage of transport facilities, due to proximity and assured availability. o Relative advantage of labour cost played a vital role in the development of the southern textile mills. The surplus agricultural labours were absorbed in the

NSOU ● CC-GR-10 47 industry at a much cheaper rate than New England. o Development of electric power in the southern states also played a vital role in shifting the industry. o The new textile mills in the south adopted latest technology and sophisticated machines for the production. Therefore, quality of the product was superior than the New England counterpart. o The low trade union activity. At present, the southern textile centres have a distinct superiority in the textile production. The textile plants in the Georgia and both the Carolinas are dominating the US textile industry. Even in the case of synthetic fiber production, this region has a edge in production over other textile producing centres. Present Position: In spite of the overall growth of the US industry, in recent years it is facing keen competition from the upcoming textile producing countries like Japan, Taiwan, Korea and India. The low production cost gives these countries distinct advantage over the US textile industry. CIS: The first textile plant in the former Soviet Union was established in Ivanovo, near Moscow. Since then, the industry has undergone a sea-change in production. After the first quarter of the 19th century, after meeting the domestic requirement, the country started to export some of her surplus product. After the downfall of Tsarist period, sound policy of Communist regime, large domestic market and excellent productivity rate per worker enabled the country to increase the existing capacity many more times. The decentralization policy of the new rulers forced the industry to disperse in the interior region from its former Moscow-Tula-lvanovo-Oblast location. The increased cotton production in the Ukraine, Caucasus, Kazakh Upland and Crimea attracted number of industries. The old industries were modernized and uneconomic plants were closed down. The age-old Moscow-Tula textile centres started to produce quality goods instead of large-scale production.

48 NSOU ● CC-GR-10 Apart from the old lvanovo-Leningrad regions, new centres have developed near Tashkent, Stalinabad, Askabad, Kirovabad and Georgia. At present, there are l 3 million looms working in the CIS with an annual production of more than 8,000 million square metre cloths. Japan: Prior to the industrial boom after Second World War, cotton textile industry was the fore-runner among the various industries. Despite the loss of relative importance, textile industry still constitutes more than 12 per cent of the value of total industrial production of Japan. Unlike the large textile mills of other countries, Japanese textile producing centres are still very small. Most of the yarn production comes from innumerable small centres, scattered all over the Japanese archipelago. The beginning of textile industry in Japan dates back to 1867, when the first textile mill took its bi rth in the vicinity of S. Kyushu. Till the outbreak of Second World War, Japanese textile industry grew at a much faster rate. The growth rate was so high that soon it surpassed the production of Britain. During the initial period, Chinese yarn market imported bulk of the Japanese product. At the middle of 20th century, Japan became one of the largest cotton textile producing nations. The importance of textile in her economy was very significant as it contributed more than 30 per cent of the export value. After Sino-Japanese war and two subsequent World Wars, Japan lost much of her Chinese yarn trade. Due to shrinkage of international demand of Japanese textile product, the industry had no other options left but to look towards home market. Due to massive industrialization in Japan, purchasing power of the people decreased considerably. Gradually Japanese textile industry became more and more dependent on national market. Due to rise of workers, wage rate, high production cost, average price of Japanese textile products have gone up and Japan concentrated more on the manufacturing of quality products.

100%	MATCHING BLOCK 23/74	SA	GE 302.pdf (D109199360)

Japan has to import almost all of the raw materials needed

in

92%	MATCHING BLOCK 24/74	W

textile industry. The pioneer attempts to set up industries were made around cotton growing tracts of Nobi and Kanto regions. Now the major textile centres are located at Chukyo, NSOU ● CC-GR-10 49 Hanshin, Toyama, Kyushu and Keihin and also at Osaka and Nagoya. Spatially, majority of the cotton mills are located within the northern half of Japan. The bulk of the textile goods are produced in following regions: ? The Kwanto Plain, ? Nagowa, ? The Kinki Plain, and ? Along the Northern Coast. As a whole, Japanese textile industry had undergone a complete metamorphosis from that of 17th century. After the complete destruction of the industry during Second World War, it took only fifteen years for complete revival of the industry, In fact, within 1960, the textile export increased in such a rate that Japan itself was forced to curb the export. Later on, it had to face restrictions on export in several countries.

100%	MATCHING BLOCK 25/74	SA	GE 302.pdf (D109199360)

As the industry became more and more export-oriented, textile establishment gradually shifted towards coasts. At the beginning of the decade of I 990s, old obsolete mills closed down their productions. The new mills with updated machineries came into

the same.

95%	MATCHING BLOCK 26/74	SA	GE 302.pdf (D109199360)

Most of the Japanese textile mills are now using the latest technologies. The priority was given to reduce the cost of production. Soon, Japan became the exporter of not only textile products but also the textile machines. At present, a healthy competition is discernible between small scale sectors and the big industrial estates of textile industry. China: This is one of the

oldest type of manufacturing industry in China. It provides employment to a large section of working force.

82%	MATCHING BLOCK 28/74	SA	GE 302.pdf (D109199360)

Since very old days, weaving and spinning were normal practices of village weavers. Most of the output was contributed by

cottage industries. The overall development of cotton textile industry in China is indeed a recent phenomenon. Till the end of Second World War, production of textile goods in China was insignificant and China was considered as the largest single textile market in the world. After the takeover of Communists, proper efforts were taken to develop national textile industry. In the Five Year Plan period from 1953, priorities were laid down to achieve self- sufficiency in the production of textile goods. Even today, one quarter of the production
50 NSOU ● CC-GR-10 is contributed by the village households. The communes introduced independent co- operatives for the development of textile goods. Distribution: The textile mills are distributed throughout China. The dominant centres are Shanghai, Manchuria, Tangshan, Beijing, Chuang, Nanchang and Lanchow. Shanghai is the oldest centre. At its initial stage of development, foreign capital, technology and management were responsible for the growth. This centre was primarily constructed for the manufacturing of coarse variety goods. The Manchuria textile units were mostly developed by the colonial Japanese. During Second World War and Communist Movement, most of these mills were destroyed. During Five Year Plan period, stress was given for the development of smaller units. Several units were developed within Yangtze river valley. At present, more than 55 per cent of the mills are concentrated within the rectangle formed by Tientsin, Shantung, Shanghai and Kaiteng. In the southern Hwangho river valley, Honanfu is the major textile centre, where quality goods are produced. In the Yangtze river valley, textile mills are concentrated within Chungking and Hankow. Tientsin was one of the oldest textile producing centres of China. The textile mills and woolen factories, however, lost their pre-eminence after the initiation of Communist rule. The Beijing-Hankow industrial conurbation including the smaller towns of Paoting, Singtai, Chengchow, emerged as leading textile centres. Even today, these mills are operative. Tsingtao became famous for carpet production.

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99%	MATCHING BLOCK 32/74	SA	GE 302.pdf (D109199360)

Of course, among all the textile-producing centres, Shanghai was most important. At one stage, this region produced more than 70 per cent of the Chinese textile production. The emergence of different textile centres lowered the relative importance of Shanghai, but it still maintains dominating role in textile industry. The adjacent Hankow region now produces huge amount of textile products. The Wushan integrated textile plants contribute significant amount of cotton products. The Canton textile units were set up very recently. As the plants are modern, output of textile goods per worker is very high in this region.

NSOU ● CC-GR-10 51 The

100%	MATCHING BLOCK 30/74	SA	GE 302.pdf (D109199360)

United Kingdom: The Industrial Revolution in the 18th century gave the impetus to the development of cotton textile industry in Great Britain. The subsequent invention of spinning machines encouraged the growth. The humid climate and local skilled labour helped a lot during the initial period of development. The cotton textile industry in the United Kingdom attained such a high fame that at end of 19th century the country became the undisputed leader of the cotton textile industry. The early centres were developed around Scottish lowlands, Nottingham, Ireland and Lancashire. Gradually, Lancashire became the most developed textile centre in the world.

Gradually, the other centres became insignificant and Lancashire earned world-wide fame in the production of high quality products. Several factors were responsible for the development of Lancashire in its early phase. The factors were: o The optimum climatic condition of Lancashire with mild humid climate. o Skilled local labours and cheaper wage rate. o Abundant water resource in the proximity and the softness of water. o Presence of coal within Pennine hill range. o Low development of other industries. o Cheap price of the land. o Undulating rolling plain land and low development of agriculture. All these factors helped immensely for the early growth of textiles in Lancashire region. Lancashire region alone contributed 50 per cent of the world's production till First World War. Since then, the relative position of Lancashire textile industry decreased considerably. The

78%	MATCHING BLOCK 27/74	W	

overall decrease of consumption of cotton goods in UK, loss of overseas market and emergence of new textile-producing nations like China, Japan,

India and worn out condition of the mills were the principal reasons for the large-scale decline of Lancashire cotton industry. The growing trade union activities, low productivity of the labour, out-dated machines and use of substitute materials gave severe blow to Lancashire industry.
52 NSOU ● CC-GR-10 Since Second World War, the industry was able to revive some of its lost ground though the early dominance was gone for-ever. At present, United Kingdom is not considered a major textile-producing nation. At least 15 other countries produce more textile goods than United Kingdom.

100%	MATCHING BLOCK 31/74	SA	GE 302.pdf (D109199360)

Germany: Germany is one of the leading producers of cotton textile.

It is the seventh largest producer

91%	MATCHING BLOCK 29/74	SA	GE 302.pdf (D109199360)

of textile goods. The history of cotton textile industry in Germany is quite old. Initially, the industry was set up depending upon imported cotton. Most of the industries were developed along

the Rhine river valley. The Rurh industrial region soon became a leading textile centre. Unlike Great Britain, German textile centres were dispersed in nature and smaller in scale. Apart from Westphalia, Rurh, the other textile centres are situated within the urban markets of Frankfurt, Munich, Bremen, Zwickaw, Chemnitz, Hamburg and Wupper river valley. Countries Total Production in Million MT China 284 India 226 USA 158 Pakistan 115 Indonesia 75 Bazil 40 Turkey 40 Korea 23 Italy 20 Source: Statistical Year Book-2018
NSOU • CC-GR-10 53 Other Producing Countries: Among the other producing countries, Italy, France, Switzerland, Belgium, Poland, Spain in Europe, Brazil, Mexico in American continents and Hong Kong, Egypt, Bangladesh, Pakistan in Afro-Asian continents are important. The French cotton textile industry had a long history. From the beginning, France was deficient in raw cotton production.

82%	MATCHING BLOCK 33/74	SA	GE 302.pdf (D109199360)

The textile industry in France was developed on imported cotton, particularly from USA. The industry is concentrated in the north-eastern industrial re-gions. The major textile-producing centres are Belford, Kolman,

Nansi etc. France is self-sufficient in the production of textile goods. Italy is the other major textile-producing country in Europe. Italian industry was basically market-oriented. Ample cheap labour and sufficient hydro-electricity helped the industry to grow. The major textile centres are Naples, Milan, Bergamo etc. In Switzerland, northern part of the country possesses some noted cotton textile centres. The most important centre is Saint Galen. In South America, Brazil is the most important textile-producing nation. Most of the textile factories are new. It is the major supplier of cotton piece goods in entire Latin America. The textile mills are located around the urban centres of Rio De Janeiro, Sao Paulo, Rio Grande and Minas Gerais. Mexico is the other cotton textile manufacturing country. Larger textile units are concentrated around Mexico City and Orizaba. India: Growth and Development of Cotton Textile Industry: India held world monopoly in the manufacturing of cotton textiles for about 3,000 years from about B.C. 1500 to AD. 1500. In the middle ages, Indian cotton textile products were in great demand in the Eastern and European markets. The muslins of Dhaka, chintzes of Masulipatnam, calicos of Calicut, baftas of Cam bay and gold-wrought cotton piece goods of Burhanpur, Surat and Vadodara acquired a worldwide celebrity by virtue of their quality and design. The first modern cotton textile mill was set up in 1818 at Fort Glaster near Kolkata. But this mill could not survive and had to be closed down. The first successful modern cotton textile mill was established in Mumbai in 1854 by a local Parsi entrepreneur C.N. Dewar. Shahpur mill in 1861 and Calico mill in 1863 at Ahmedabad were other landmarks in the development oflndian cotton textile industry.

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54 NSOU • CC-GR-10 The real expansion of cotton textile industry took place in 1870's. By 1875-76 the number of mills rose to 47 of which over 60 per cent were located in Mumbai city alone. The industry continued to progress till the outbreak of the First World War in 1914. The total number of mills reached 271 providing employment to about 2.6 lakh persons. The First World War, the Swadeshi Movement and the grant of fiscal protection favoured the growth of this industry at a rapid pace. Demand for cloth during the Second World War led to further progress of the industry. Consequently, the number of mills increased from 334 in 1926 to 389 in 1939 and 417 in 1945. Production of cloth also increased from 4,012 million yards in 1939-40 to 4,726 million yards in 1945-46. The industry suffered a serious setback in 1947 when most of the long staple cotton growing areas went to Pakistan as a result of partition. However, most of the cotton mills remained in India. Under such circumstances, India faced a severe crisis of obtaining raw cotton. The country had, therefore, to resort to large-scale imports of long staple cotton which was an extremely difficult task in view of the limited foreign exchange reserves. The only solution to this problem was to increase hectare-age and production of long staple cotton within the country. This goal was achieved to a great extent in the post partition era. Present Position: At present, cotton textile industry is largest organized modern industry of India. There has been a phenomenal growth of this industry during the last four decades. About 16 per cent of the industrial capital and over 20 per cent of the industrial labour of the country is engaged in this industry. The total employment in this industry is well over 15 million workers. There are at present 1,719 textile mills in the country, out of which 188 mills are in public sector, 147 in cooperative sector and 1,384 in private sector. About three- fourths were spinning mills and the remaining one-fourth composite mills. Apart from the mill sector, there are several thousand smal 1 factories comprising of 10 looms. NSOU • CC-GR-10 55 Some of them have just one loom. These are based on conventional hand loom in the form of cottage industry and comprise decentralized sector of this industry. The constitution of decentralized sector is much more than the organized sector. It has increased rapidly from a mere 19.31 per cent in 1950-51 to 58. 96 per cent in 1980-81 and made a sudden jump to 87.95 per cent in 1990-91. It gradually improved during the first half of 1990s and stood at 94.63 per cent in 2003-04. Production:

100%	**MATCHING BLOCK 34/74**	**SA**	GE 302.pdf (D109199360)

Cotton cloth is produced in three different sectors viz., I. Mills, 2. Power-looms and 3. Handlooms. Mills: The mill sector played a dominant role in cotton textile industry at the initial stage. But its importance was reduced drastically with the growth of

power looms and handloom. The share of mill sector in cotton cloth production came down from 80.69 per cent in 1950- 51 to only. Power looms: The decentralized power loom

100%	**MATCHING BLOCK 36/74**	**SA**	GE 302.pdf (D109199360)

sector plays a pivotal role in meeting the clothing needs of the country. The production of cloth as well as generation of employment has been rapidly increasing in

power loom

100%	**MATCHING BLOCK 35/74**	**SA**	GE 302.pdf (D109199360)

sector. This sector not only contributes significantly to the cloth production in the country but also provides employment to millions of people. The

power loom

91%	MATCHING BLOCK 37/74	SA	GE 302.pdf (D109199360)

industry produces a wide variety of cloth with intricate designs. The power loom sector accounts for about 63 per cent of the total cloth production in the country and contributes significantly to the export earnings.

87%	MATCHING BLOCK 38/74	SA	GE 302.pdf (D109199360)

The production of cloth as well as employment has been increasing in

the power loom sector. During 2002-03, the production of cloth in the decentralized power loom sector was 18,281 million sq. meters while the employment generation was 4.23 million. The corresponding figures estimate for 2003-04 were 17,071 million sg meter and 4.18 million respectively. Handlooms: The handloom sector provides

83%	MATCHING BLOCK 39/74	SA	GE 302.pdf (D109199360)

employment to over 65 lakh persons engaged in weaving and allied activities. The

production of handloom fabrics registered more than fifteen fold increase from 500 million sq metres in 1950-51 to 7,585 million sq metres in 2001-02.
56 NSOU ● CC-GR-10

95%	MATCHING BLOCK 40/74	SA	GE 302.pdf (D109199360)

This sector constitutes nearly 14 per cent of the total cloth produced in the country and also contributes substantially to the export earnings.

Table 27.4 shows that the production of spun yarn and cotton cloth

97%	MATCHING BLOCK 45/74	SA	GE 302.pdf (D109199360)

has increased considerably during the 53 years from 1950-51 to 2003-04. The production of spun yarn registered more than fourfold increase from 533 million kg in 1950-51 to 2,121 million kg in 2003-04. Although the total production of cotton cloth increased considerably, the share of mill sector has been drastically reduced. This is an indication of our efforts to decentralize the industry and create greater employment opportunities.

There are about 40 lakh handlooms and about 5 lakh power looms in the decentralized sector. Although they are widely distributed throughout the country, states of Tamil Nadu, Uttar Pradesh, Assam and Manipur account for nearly 50 per cent of the production capacity. The rest are scattered in Nagaland, West Bengal, Madhya Pradesh, Andhra Pradesh. Maharashtra, Kerala, Rajasthan, Haryana and Jammu and Kashmir. Power looms contribute an overwhelmingly large percentage of production of fabrics. Production of Cotton Cloth (Mill Cloth) in India, 2002-03 : State/Union Territory Production in Sq Percentage of all Mtr India production 1. Maharashtra 3,82,257 39.38 2. Gujarat 3,21,775 33.14 3. Tamil Nadu 64544 6.69 4. Punjab 55,784 5.75 5. Madhya Pradesh 47305 4.87 6. Uttar Pradesh 32386 334 7. Rajasthan 28384 2.92 8. Pondicherry 24357 2.51 9. Karnataka 7,222 0.74 10. Kerala 6342 0.66

NSOU ● CC-GR-10 57 Locational Factors: Several factors, like availability of raw cotton, market, transport, etc. play a key role in the localization of cotton textile industry. The significance of raw cotton is evident from the fact that 80 per cent of the industry is coterminous with the cotton growing tracts of the country. Some of the important centers such as Ahmedabad, Solapur, Nagpur, Coimbatore and Indore are located in the areas of large scale cotton cultivation. Mumbai is also not far away from the cotton producing areas of Maharashtra and Gujarat which have contributed a good deal in the localization and growth of cotton textile industry here. It is equally important to note that cotton is a pure raw material, in the sense that it does not lose much of its weight in the process of manufacturing and the slight loss in weight is more than compensated by the use of sizing materials. There is not much of difference between the cost of transporting raw cotton and finished cloth. Both can be transported with equal ease and without adding much to the total cost of production. Hence, this industry normally tends to be located at such centers which have favourable transport facilities with respect to market. In other words, it is primarily a market oriented industry. With tropical and sub-tropical climate, all parts of India provide vast market potential for cotton textile industry. West Bengal, Bihar, Uttar Pradesh, Kerala and Orissa do not grow cotton and still have large number of big centers where cotton textile industry has flourished well. Thus although in earlier stages of industrialization, cotton textile manufacturing was concentrated in Mumbai, it has witnessed great spatial spread and now covers almost the entire country. Since, it was a traditional cottage industry, cheap and skilled labour was readily available. The most notable feature of the distribution of the industry is that even within a state, the industry is localized within particular areas and regions, almost to the complete exclusion of others. Dispersal of industry from the old nuclei started after 1921 with railway lines penetrating into the peninsular region. New centers like Coimbatore, Madurai, Bangalore, Nagpur, Indore, Solapur and Yadodara were favourably located in respect to raw material, market and labour than places of original locations. This industry also reached some places with some additional advantages, such as nearness to coal (Nagpur), financial facilities (Kanpur) and wide market with port facilities (Kolkata).
58 NSOU ● CC-GR-10 Dispersal of cotton textile industry was further boosted with the development of hydroelectricity. The growth of this industry in Coimbatore, Madurai and Tirunelveli is largely due to the availability of hydroelectricity from Pykara dam. The industry also tended to shift from areas of high Jabour cost to those with low labour cost. The labour cost factor played a crucial role in establishing this industry at Madurai, Tirunelveli, and Coimbatore. Distribution: Although cotton textile mills are located in over 80 towns and cities of India, yet its larger concentration is found in Maharashtra, Gujarat, West Bengal and Uttar Pradesh. The spatial distribution of cotton textile industry in India. Cotton Textile Industry in India
NSOU ● CC-GR-10 59 Maharashtra :

100% **MATCHING BLOCK 41/74** W

Maharashtra excels all other states in the development of cotton textile industry.

It produces 39.38 per cent mill cloth and 10.79 per cent yam of India. About three lakh workers are engaged in this industry in Maharashtra. Mumbai is the largest centre in India having 63 mills out of Maharashtra's total of 122 mills. Mumbai is rightly called the Cotton polis of India. Mill Production of Cotton Yarn in India, 2002-03: State/Union Production Percentage Territory in Million of all India kilograms production 1. Tamil Nadu 968 44.46 2. Maharashtra 235 10.79 3. Punjab 203 9.32 4. Gujarat 176 8.08 5. Madhya Pradesh 98 4.51 6. Haryana 98 4.51 7. Andhra Pradesh 82 3.77 8. Rajasthan 78 3.58 9. Kamataka 66 3.03 10. Uttar Pradesh 46 2.12 11. H imachal Pradesh 43 1.97 Others 84 3.86 Total 2,177 100.00 Following are the main reasons of phenomenal growth of cotton textile industry in and around Mumbai. ? Mumbai enjoys humid climate whsich is helpful for this industry because thread does not break so frequently.

60 NSOU • CC-GR-10 ? Mumbai is a very important port which helps in import of machinery and long staple cotton and export of cloth. ? Cheap hydro-electricity is readily available from the nearby areas. ? The black-cotton soil in the hinterland of Mumbai provides cotton as the basic raw material. ? Cheap labour can be drawn from the surrounding areas. ? There is ready market for Mumbai products both in India and abroad. ? Mumbai is well-connected by a network of roads and railways which help in easy transportation of raw material and finished goods. ? Facilities for washing and dyeing also exist here. ? There is no dearth of capital inputs. ? Mumbai has the advantage of an early start. Apart from Mumbai, Solapur, Pune, Kolhapur, Satara, Wardha, Nagpur, Aurangabad, Amravati, Ako la, Sangli, Chaligaon, Miraz, Mander, Jalgaon, etc. are other centres of cotton textile industry in Maharashtra. Gujarat : Gujarat is the second largest producer of cotton textiles. This state accounts for over 33 per cent of the mill cloth and over 8 per cent of the yam production of the country. Ahmedabad is the largest centre where 73 out of 118 mills of Gujarat are located. Ahmedabad is the second largest centre of cotton textile industry after Mumbai. Following facilities are available to Ahmedabad : ? Ahmedabad lies near the main cotton belt of India and there is no problem of obtaining raw cotton. ? Climate is humid and is suited to this industry. ? Cheap power is readily available. ? Cheap and skilled labour is drawn from the nearby areas. ? Ahmedabad is served by a network of railways and roadways. ? Land at Ahmedabad is much cheaper as compared to that in Mumbai. ? Most of Ahmedabad mills produce cheap cloth which finds a ready market among the poor masses of India.

NSOU • CC-GR-10 61 The other important centres of Gujarat are Vadodara, Bharach, Surat, Rajkot, Porbandar, Maurvi, Bhavnagar, Viramgam, Sidhpur, Kelot, Kadi, etc. Madhya Pradesh : Cotton is locally grown. Coal provides necessary energy. Abundant cheap labour is available due to backward economy of the masses. Gwalior, Ujjain, Indore, Dewas, Ratlam, Jabalpur, Bhopal, etc. are important centers. Tamil Nadu : Among the southern states, Tamil Nadu is an important cotton textile producer. Although Tamil Nadu produces only about 6 per cent of the mill cloth of India, the state excels all other states in the production of yarn and accounts for over 44% of the total yarn production of the country. Coimbatore is the most important centre having 200 mills out of Tamil Nadu's 439 mills and is known as Manchester of South India. But Tamil Nadu's mills are of smaller size and give comparatively less production. Other important centers are Chennai (10 mills), Madurai, Tirunelveli, Tirucchchirappalli, Salem, Perambur, Tuticorin, etc. West Bengal : Kolkata is the most important centre of Cotton textile industry in West Bengal. It enjoys facilities of a port, humid climate, coal from Raniganj, local labour high density of population (for demand) and dyeing and washing facilities. But Kolkata suffers from the disadvantage of being away from the main cotton- producing arks of India. The other important centres are Haora, Murshidabad, Hugli and Sirampur etc. Uttar Pradesh : Most of cotton textile industry has developed in the western part of Uttar Pradesh. Kanpur is the largest centre and is known as Manchester of Uttar Pradesh. This city has 10 out of 52 cotton textile mills of the state. Other important centers are Moradabad, Varanasi, Agra, Bareilly, Aligarh, Modinagar, Saharanpur, Rampur, Etawah, Lucknow, Mirzapur, etc. Other cotton textile producing states are Andhra Pradesh, Kerala, Bihar, Rajasthan, Punjub, Harayana and Karnataka.

62 NSOU • CC-GR-10 7.4

89% **MATCHING BLOCK 42/74** **W**

Iron and Steel Industry The growth and development of iron and steel industry is a reflection of global economy. The iron and steel industry depicts a changing nature in its growth and production pattern. America, Western Europe and Japan accounted for nearly two-third of the world's steel production. But gradually the spatial pattern has changed and attention has now shifted to the developing regions. Towards the end of the last century, the growth of steel production in countries like China, South Korea, Brazil and India has changed the entire pattern of steel production in the world. Now main producers of iron and steel in the world are China, Japan, USA, Russia, Germany, South Korea, Brazil, Ukraine, India, France, Italy and Great Britain. The other steel-producing countries are South Africa, Australia, Austria, Netherlands, Czech Republic, Romania, Spain, Belgium, Sweden, etc. Table I 0.1 indicates the production of iron and steel in

major countries of the world.

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100%	MATCHING BLOCK 43/74	W

China is the leading producer of iron and steel in the world, which accounts for about 23.9 per cent production of pig iron and 17 per cent of crude steel of the world's production. Japan is the second largest producer with 14.7 per cent pig iron and 13.9 per cent crude steel production of the world. USA once the highest producer now ranks third in the world followed by Russia. India's position is 9th in the iron and steel production and its production of pig iron and crude steel accounts for 3.9 and 3.6 per cent respectively.

The spatial distribution pattern of iron and steel industry in major countries of the world is as follows: China:

97%	MATCHING BLOCK 44/74	W

Since 1973, growth of steel production in China was spectacular and within a span of 15 years China was able to increase its production of crude steel to 217 percent. In that period consumption increased 300 per cent. This growth rate clearly reveals the rapid pace of industrialization that is now going on in China. The iron and steel industry is concentrated in Anshan, Wuhan and Paotow triangle. The biggest iron and steel factory was established in the Chinese mainland at Anshan in Manchuria by Japanese, but was greatly expanded by the Chinese with Russian help. Other iron and steel production centres in Manchuria are Fushun, Penki, Shenyang, Harphin and Kirin. NSOU ● CC-GR-10 63 For Wuhan plants, ore is obtained from Taylh, i.e., 130 km away, and coal from Pingtinghan to the north of Yangtze River. The Wuhan steel plant is also in process of expansion. Other less extensive new steel plants are being created in Siangtan (Hunan), Tientsin, Tangshan, Nanking, Shanghai, etc.

Major Iron and Steel Industry

97%	MATCHING BLOCK 48/74	SA	GE 302.pdf (D109199360)

in World At present, China has following important areas of iron-steel industry: ? Southern Manchuria is the largest steel plant of China at Anshan and other plants at Pensihu and Mukden. ? Shansi is also an old region of iron and steel production. In this region Taiyuan has been developed as a major steel centre. ? The Lower Yangtze Valley : In this region Hankow, Shanghai, Hanyang and Chungking are the main centres of iron and steel industry. ? Other centres are located at Paotow, Chinling Chen, Canton, Singtao and Huangsih. Japan : In spite of the shortage of raw material (iron and coal), Japan has become one of the leading steel producers of the world. After China, Japan is the second largest producer of pig iron and crude steel in the world. Yawata, the first steel plant was built in 1901 by government. Yawata is a major centre of heavy industry with about one fifth of Japan's steel capacity. Kamaishi in Honshu and Muroran in Hokkaido are small tidewater plants. 64

NSOU ● CC-GR-10 The number of large-scale plants directly connected with regional mineral resources and those plants are only in Kamaishi, Kosaka, Osarizawa, Hassei (Akita), Hosokura (Miyagi) and Fujine (Iwate). Over half of the Japan's steel capacity is concentrated near the major port cities of Himeji, Kobe-Osaka and Tokyo-Yokohama areas of South Central Honshu. Almost all the iron and steel plants of Japan are situated near tidewater. These steel plants, at or near tidewater, are thus able to draw raw materials from many parts of the world and similarly to ship finished products.

Ouriginal by Turnitin

100%	MATCHING BLOCK 46/74	W

In Japan, large-scale concentration of iron and steel industry has occurred in the following regions : • The Tokyo-Yokohama Region : It is having all facilities required for the growth of iron-steel industry. The reclamation of Tokyo Bay provided large, extensive plane land for steel manufacturing units. The Tokyo-China region is the main area in which steel industrial units have been developed at Hitachi and North Tokyo. • Nagoya Region : It contributes about 20 per cent of the Japanese steel production. This region had witnessed a massive growth of industries within the period 1950-60. • Osaka-Kobe Region : At the head of the Osaka Bay, a highly industrialised area known as the Kinki has developed. The port of Osaka is the main centre. Other centres of this region are Amagaski, Kobe, Hemegi, Sakai and Wakayama. • Fukuoka-Yamaguchi Region : It is located in the extreme south of Japan within Kyushu and westernmost end of Honshu. The first government steel plant was established at Yawata in 1901. Kita- Kyushu is another notable iron and steel centre of this region. • Oka-Yamaha Region : It is a new industrial region situated in between Osaka-Kobe and Hiroshima.

NSOU ● CC-GR-10 65 •

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98%	MATCHING BLOCK 47/74	W

Hokkaido Region : The main centre of this region is Murroran. A fairly big sized iron and steel industry has developed here depending upon local coal and iron ore. The most striking feature in the locational pattern of Japan's steel plants is that they are situated either on the Bay-Coast or on some canal or river. This is because of the fact that most of the Japanese steel plants depend upon outside raw material. Another feature is that they are located in the heart of great industrial districts which provide ready market for finished steel. In fact, localisation of iron and steel industry in Japan is market-oriented. United States of America : Once USA was the highest producer of iron and steel but now its rank is third in the world, next to China and Japan. In the US first iron and steel plant was established in 1629 at Massachusetts. During last 380 years or so the US steel industry has undergone through several changes. This change has not only occurred in growth and production pattern but also in localization pattern. The major iron and steel regions in the USA are as follows: • Appalachian or Pittsburgh Region : The most important of all the regions is the northern Appalachian region of western Pennsylvania and eastern Ohio. This district contains about 42.5 per cent of the blast furnace capacity of the country and its centre, Pittsburgh, is the second greatest centre of steel industry in the world. The mills in this region are located almost exclusively in the narrow valleys of the headwater streams of the Ohio River, including the upper reaches of the Ohio itself. The region, often known as the Pittsburg-Youngstown region, includes several districts. The Pittsburgh district consists of industries located in the valleys of the Ohio, Monongahela, and Allegheny, within 60 km of Pittsburgh. The Youngstown or the 'valley' districts consist of industries in the valleys of the Shenango and the Mahoning rivers. Wheeling, Johnstown, Stenhenville and Beaver Falls are other important steel- producing centres. The chief disadvantage of the region is its remoteness from the sources of iron ore supplies, which come from the Lake Superior region partly by rail and partly by water. 66 NSOU ● CC-GR-10 • Lake Region : The lake region falls into : (a) The Lake Erie ports; Detroit Cleveland and Buffalo, etc.; (b) The centers near the head of Lake Michigan, Chicago-Gary or Calument district; and (c) The Lake Superior region, Duluth. These districts represent a somewhat different adjustment to the three factors in the localisation of the industry, coal, iron and market. The Lake Erie ports are nearer to the Appalachian coal, but farther from the iron ore than the Duluth region. The Michigan region is midway between the two. One important advantage that all these districts enjoy over the Pittsburg region is that, owing to their location on the lake shores, one extra handling of iron ore is eliminated. On the other hand, these centres are located a little away from the market. Duluth, for example, has in its immediate hinterland the forest, farm, and the ranching country, with little demand for iron and steel goods. Detroit is the largest steel consuming centre in the USA particularly because of its automobile industry. • Atlantic Seaboard Region : On the Atlantic Seaboard, it is only the Middle Atlantic region 8',Jew York, Philadelphia and Baltimore, etc. are important. The chief advantage that this region enjoys is in respect of its location, both in relation to the tidewater, and the proximity to the large industrial centres of the East. Its location near the centre of the great manufacturing region of the Atlantic Seaboard, the region of the densest population, and of the most intense industrial development in North America, is the most remarkable. The Middle Atlantic region is the only major region in which the production of pig iron and steel is notably greater, in proportion, than the iron ore consumed, because of the relatively larger amount of scrap available in this highly industrialized region. There are many steel mills in this region which operate without blast furnaces, depending both on scrap and pig iron imported from other areas, particularly the Northern Appalachian region. • South Appalachian : In the Southern Appalachians, in Alabama, however, large deposits of these raw materials are found in closer proximity than anywhere else in North America if not the world. While

NSOU ● CC-GR-10 67

96%	MATCHING BLOCK 49/74	SA	GE 302.pdf (D109199360)

the ore is of low grade and requires shaft mining, much of the rock is lime and the ore rs, therefore, self-fluxing. The region lacks, however, large industrial centres in the neighborhood and has, therefore, a considerable amount of surplus pig iron which goes to the North. •

97%	MATCHING BLOCK 51/74	SA	GE 302.pdf (D109199360)

Western Region: This region extends from Colorado in the interior to the California on the west. Among the steel region in the USA, this is a new region. The first steel mill, although had been setup in 1882 at Pueblo. Later on steel industries were developed at Fontana in California and Provo at Utah. For these plants, iron ore is obtained from Wyoming and coal from Colorado. Russia-Ukraine (erstwhile USSR) : Prior to disintegration in 1991, USSR was the leading steel-producing country of the world. Now also Russia and Ukraine are important iron and steel producers of the world. Russia ranks 4th in the production of pig iron and crude steel, while Ukraine stands 8th in world ranking. In the post-revolution period, the Soviet steel industry had achieved a remarkable expansion. During the Second World War, however, the Soviet iron and steel industry was affected badly. Most of the large production centres were either destroyed or damaged. However, soon the country recovered and by 1975 became the largest producer of iron and steel in the world. The four important iron- and steel-producing regions are: • Ural Region : It lies on both sides of the Urals. The major steel centres of this region are - Magnitogorsk, Chelyabink, Nizhnitagil, Sverdlovsk, Serov, Perm, Orsk, etc. Magnitogorsk is the largest steel-producing centre of Russia. • Kuznetsk or Kuzbas Region : It is located in the north of the Alai Mountains and south of Tomsk. This steel region is coal-based. The supply of iron ore is from the Ural region. Novokuznetsk is the leading steel centre of this region. • Moscow Region : Important centres of iron and steel in this region are Tula, Lipetsk, Cherepovetsk and Gorky. 68 NSOU ● CC-GR-10 • Others : Other regions are isolated and developed in various parts. These are Baikal, St. Petersburg, Lower Amer valley and Pacific coastal region. Ukraine : Now, Ukraine has 8th position in world s production of iron and steel. In this region all the raw materials, i.e., iron ore, coal, limestone, manganese are available for steel production. A dense network of railways and cheap water transport facilitate the growth and development of iron and steel industry, The main centres of iron and steel plants are Krivoirog, Kerch, Zhdanow, Tagarerog, Zaporozhye, Pittsburgh, Dniepropetrovsk, etc. Other notable steel-producing centres are Tbilisi, Tashkent and Bogovat in Uzbekistan and Tamir Tan in Kazakhstan.

Countries Production (in crore tons)

83%	MATCHING BLOCK 52/74	SA	GE 302.pdf (D109199360)

Pig iron Crude steel China 131.23 128.5 Japan 80.5 105.4 USA 47.9 102.0 Russia 43.3 55.5 Germanv 27.3 41.7 South Korea 24.8 43.4 Brazil 27.7 27.8 Ukraine 25.7 31.7 India 21.3 26.9 France 13.6 20.0 ltalv 10.9 26.6 Great Britain 10.9 16.1

Source : World Bureau of Metal Statistics-2018

NSOU ● CC-GR-10 69

100%	MATCHING BLOCK 50/74	W

Germany : Before World War I, Germany was the second largest iron and steel producer in the world. It was the largest exporter of steel goods in the world. German iron and steel industry was handicapped since after the war of 1914 by the loss of ore, coal and productive capacity.

Germany, however, made a remarkable recovery within a few years, and in spite

98%	MATCHING BLOCK 61/74	SA	GE 302.pdf (D109199360)

of her depleted resources she produced in 1939 more than the 1913 production of steel. In 1937 she had established the great Heimann Goering Steel Works at Salzgitter to utilise the grade ores in its Harz Mts. The division of Germany was the main cause of lower status in terms of iron and steel production. But after re-unification of East and West Germany in 1990, the countty is now one of the leading steel-producing countries in the world and ranks 5th in the world with an annual production of27.3 crore tons of pig iron and 41.7 crore tons of crude steel. The most important centre of iron and steel industry in Germany is the Rhenish-Westphalia, contributing more than 80 per cent of the steel produced in Germany, and 85 per cent of pig iron. It manufactures a wide variety of specialities. Other regions of importance are the Siegerland Hessen-Nassau, Northern and Central Germany, Saxony, and South Germany. The greatest centre is Essen in the Ruhr valley where the world famous works of Krupp are situated. South Korea : South Korea is the 6th leading country of the world in iron and steel production. It is the third Asian country after China and Japan which produces high-grade steel. Its annual production is 24.8 crore tons of pig iron and 43.4 crore tons of crude steel. Brazil : Brazil is the 7th ranking country in iron and steel production in the world. Its annual production is 27.7 crore tons of pig iron and 27.8 crore tons of steel. The development of the production of steel in Brazil has been spectacular. Since 1973, production of steel has witnessed more than 300 per cent increase. The consumption of steel within the country is very low. 70 NSOU ● CC-GR-10 Therefore, Brazil is able to export bulk of her steel production. Most of the steel industries are located around Sao-Paulo and Curumba. Brazil possesses vast amount of iron ore. The largest of these deposits is located near Minas-Gerraes. Another large steel plant is located at Santa Catarina. Most of the mills obtain energy from hydel-power plants. India : India has a long history of the use of iron and steel. However, it was only after the first decade of the 20th century that manufacture of iron and steel as a modern industry made a beginning in this country. It was in 1911 that India's first iron and steel plant - the Tata Iron and Steel Company Ltd. (TISCO) was set up in Jamshedpur in Bihar in private collaboration with a US firm. Nearly three and a half decades later another plant was launched at Burnpur in neighbouring Bengal - the Indian Iron and Steel Company Ltd. (IISCO) — with British participation. At the commencement of Five-Year Plans (1951) there were three steel plants located at Jamshedpur, Asansol and Bhadravati. Not only capacity of these plants was increased but six integrated plants in public sector have been established at Durgapur, Rourkela, Bhilai, Bokaro, Vishakhapatnam and Salem, Apart from these more than 140 mini steel plants have also been set

82%	MATCHING BLOCK 63/74	SA	GE 302.pdf (D109199360)

up to meet the growing internal demand. India contains largest iron ore deposits in the world and also has coal reserves, therefore, having very good prospects of further growth of iron and steel industry.

97%	MATCHING BLOCK 53/74	W

Some of the major Iron and Steel Plants of India are as follows : Tata Iron and Steel Company (TISCO) : This is the oldest iron and steel centre of India. It is a private sector enterprise. It was established in 1907 by Jamshedji Tata at Sakchi in Singhbhum district of Jharkhand. Later on, it was renamed as Jamshedpur after Jamshedji. It started producing pig iron in 19 I 1 and steel in 1912. The plant initially had capacity of producing 1.21 million tonnes of pig iron and 1.1 million tonnes of steel per annum. This capacity has been enhanced to 3.9 million tonnes of pig iron, 2 million tonnes of ingot steel and 3 million tonnes of saleable steel. Currently it produces about 3 million tonnes of saleable steel. Following facilities are available to this centre : NSOU ● CC-GR-10 71 ? High grade haematite iron ore is available from Noamundi mines of Singhbhum in Jharkhand and Gurumahisani mines of Mayurbhanj in Orissa. These mines are located at a distance of 75-100 km from Jamshedpur. ? Coal is available from Jharia and Raniganj. Coal mines

are located at a distance of 160

97%	MATCHING BLOCK 54/74	W

to 200 km from Jamshedpur. ? Manganese comes from Joda mines of Kenduj har district in Orissa. ? Dolomite, limestone and fire clay used as flux material are available from Sundargarh district of Orissa. ? Kolkata, located at a distance of 250 km, provides port facilities and its industrialised hinderland provides market for the products. ? Sufficient water for cooling purposes is obtained from Subarnarekha River. In addition to this, the storage dam on Kharkai River also provides water. ? Jamshedpur is well connected with Kolkata, Mumbai and Chennai by road and rail and enjoys good transport facilities. ? Densely populated regions of Jharkhand, Bihar and Orissa provide cheap labour. Major part of labour is drawn from tribal areas of Chota Nagpur plateau. Indian Iron and Steel Company (IISCO): Three plants at Kulti, Hirapur and Bumpur in West Bengal were set up in 1864, 1908 and 1937 respectively. These plants have been merged together and are known as Indian Iron and Steel Company (IISCO). It was brought under government control and management in July 1972. The three plants are linked by Kolkata-Asansol railway line. Hirapur plant produces pig iron which is sent to Kulti for making steel. The rolling mills are located at Bumpur. IISCO enjoys the following advantages : ? Iron ore is available from Guna mines in Singhbhum district of Jharkhand located at a distance of 285 km. Some iron ore is also obtained from Mayurbhanj area of Orissa. ? It used to receive coal from Jharia, located at a distance of 137 km but now the power from the Damodar Valley Corporation is extensively used. ? Dolomite and limestone are obtained from Sundargarh district of Orissa which is 327 km away. Limestone is also available from Gangpur and Paraghat areas of Orissa. 72

NSOU ● CC-GR-10 ? Rail
and road links connect it to Kolkata which is just 200 km away. ? Cheap labour is readily available from the neighbouring areas. ? IISCO has annual capacity of producing IO

95%	MATCHING BLOCK 55/74	W

lakh tonnes of steel. Currently it produces over 4 lakh tonnes of pig iron, more than 3.5 lakh tonnes of crude steel and around 3.8 lakh tonnes of saleable steel. The Visweswaraya Iron and Steel Ltd : It was established as Mysore Iron and Steel Company (MISCO) in 1923 by the erstwhile state of Mysore. It is located at Bhadravati on the banks of river Bhadravati in Shimoga district of Karnataka. This plant was brought under state control in 1962 and was renamed as Visveswaraya Iron and Steel Ltd. after the name of great engineer Dr. Yisweswaraya. This plant has got a capacity of 1.38 lakh tonnes of steel. There are plans to raise its capacity to two lakh tonnes. This centre enjoys the following advantages. ? Bhadravati valley is 13 km wide as a result of which enough land is available. ? High grade haematite iron ore is brought from Kemmangundi mines in Chikmaglur which is just 40 km away. ? At the time of the setting up of the plant in 1923 the charcoal obtained from the forest-wood was used for smelting because coal was not available. Now it uses hydroelectric power obtained from Sharavati Power Project. ? Limestone is available from Bhundigudajust 25 km away. ? Shimoga and Chitradurga supply manganese. These areas are just 50 km away. ? Dolomite and chromite are also available within a radius of 45-50 km. ? It lies on the main Birn-Shirnoga railway line and makes use of railway facilities. In order to increase the production of iron and steel, the Government of India established The Hindustan Steel Limited in public sector. Consequently, three plants under the public sector, i.e. Bhilai, Rourkela and Durgapur came into operation during the Second Five Year Plan. Capacity of each plant was fixed at IO lakh tonnes of steel which was expanded during the Third Five Year Plan and a proposal of setting up a steel plant at Bokaro was also made. NSOU ● CC-GR-10 73 Bhilai : Bhilai iron and steel centre was set up in Durg district of Chhattisgarh in 1957 with the technical and financial support of the then Soviet Union. It started production in 1959. Its initial capacity was

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96%	MATCHING BLOCK 56/74	W

lakh tonnes which has been raised to 52 lakh tonnes. Durg happens to be a backward area and the purpose of setting this plant was to bring prosperity to this area. This plant produced 41.87 lakh tonnes_ of crude steel, 38.32 lakh tonnes of saleable steel and 2.43 lakh tonnes of pig iron in 1996- 97. It enjoys following geographical advantages: ? It procures rich haematite iron ore from Dalli-Rajhara range which is 80 km south of Bhilai. ? Coal is obtained from Korba and Kargali fields of Chhattisgarh located at 225 km away. Bokaro and Jharia (720 km) also supply coal. ? Limestone comes from Nandini mines hardly 24 km away. ? Bhandara of Maharashtra and Balaghat of Madhya Pradesh supply manganese. ? The Korba Thermal Power station is the main source of power. ? It is connected with Kolkata-Nagpur railway line. ? Dolomite comes from Bilaspur. ? Cheap labour is available from the nearby areas. Rourkela : Plant of Hindustan Steel Limited at Rourkela is situated in the Sundargarh district of Orissa It was set up with the help of the then West German firm, Krupps and Demang, during tte Second Five Year Plan (West Germany and East Germany have united to form one country now). It became operative in 1959. It produced 12.40 lakh tonnes of crude steel, 11.80 lakh tonnes of saleable steel and 0.54 lakh tonnes of pig iron in 1996-97. This plant has the following facilities for its successful operation: ? This plant uses iron ore obtained from Sundargarh and Keonjhar districts. These iron ore sources are located within a distance of77 km from the site of the plant. 74 NSOU ● CC-GR-10 ? Coal is obtained from Jharia coalfields located at a distance of 225 km and Talcher, located at a distance of 169 km. ? Hydro-electric power is obtained from Hirakud Power Project, located at a distance of 150km. ? The plant receives manganese from Barajmda, dolomite from Baradwar and limestone from Pumapani. These materials are located within a radius of 222 km in Orissa. ? It is located on the main Nagpur-Kolkata railway line and enjoys facilities of railway transport. ? Kolkata provides the port facilities and its hinterland serves as market. Durgapur : This plant of The Hindustan Steel Ltd. is located at Durgapur in

Paschim

96%	MATCHING BLOCK 57/74	W

Bardhaman district of West Bengal. It was set up in 1959 with the help of the United Kingdom. The production started in 1962. It has a total capacity of 35 lakh tonnes. It produced 12.45 lakh tonnes of crude steel, I 0.93 lakh tonnes of saleable steel and 1.14 lakh tonnes of saleable pig iron in 1996-97. The Alloy Steel Plant at Durgapur has a capacity to produce 1.6 lakh tonnes of ingot steel which has been expanded to 2. lakh tonnes of crude steel. The following geographical factors favour its location and growth. ? Iron ore comes from Boiani mines. Mayurbhanj also supplies iron ore. These areas are located within a radius of 320 km. ? Coal comes from Jharia and Raniganj. ? Limestone is obtained from Birmitrapur in Sundargarh and manganese from Keonjhar district of Orissa. ? Dolomite is supplied by Birmitrapur. ? Hydroelectricity is available from Damodar Valley Corporation. ? Plenty of water is available from Durgapur Barrage built across Damodar River. ? The Kolkata-Asansol railway line links it with other parts of the country. ? Cheap labour is readily available from the surrounding areas.

NSOU ● CC-GR-10 75

98%	MATCHING BLOCK 58/74	W

Bokaro : A new public sector company, the Bokaro Steel Ltd. was formed in 1964 to erect a steel plant with the collaboration of the earthwhile Soviet Union at Bokaro near the confluence of the Bokaro and Damodar rivers in Hazaribagh district of Jharkhand. It is the second plant set up with the Soviet help. It started production in 1972. Its initial capacity was 10 lakh tonnes which was raised to 40 lakh tonnes. There are plans to raise its capacity to I 00 lakh tonnes making it the largest iron and steel making centre in India. It produced 36.44 lakh tonnes of crude steel, 30.46 lakh tonnes of saleable steel and 2.6 lakh tonnes of pig iron in 1996-97. This achievement has been made possible due to following few geographical factors: ? It receives iron ore from Kiriburu mine in Orissa. ? Coal is obtained from Jharia coalfields located at a distance of 65 km. ? Limestone comes from Palamu district of Jharkhand. ? Hydroelectricity is obtained from Damodar Valley Corporation. ? Kolkata is just 300 km from here and provides port facilities. Three more steel plants were planned during the Fourth Five-Year Plan in order to meet the growing requirement of steel. These plants are located at Salem in Tamil Nadu, Vishakhapatnam in Andhra Pradesh and Vijayanagar in Karnataka. The Salem Steel Plant: The plant has been set up at Salem in the Salem district of Tamil Nadu. The plant has the advantage of rich iron ore and limestone, which is readily available in the adjoining areas. It also enjoys the facilities of cheap power, charcoal and vast market. The iron ore available here has low sulphur and phosphorus content and is suitable for producing special grade iron and steel. The plant started commercial production in 1982. Its capacity was 32 thousand tonnes of stainless steel sheets in the beginning. This capacity was doubled in 1991 with the addition of another rolling mill. This capacity was further raised to 80 thousand tonnes of saleable steel in 1995-96. Today the Salem Steel Plant is a major producer of world class stainless steel and is in a position to export stainless steel to some of the advanced countries such as the USA, Mexico, Australia and some countries of South-East Asia. 76 NSOU ● CC-GR-10 In order to cater to the growing demand for coinage of the Indian Government Mints, the management had also set up a blanking facility in 1993 with a capacity of 3,000 tonnes per annum. It also commissioned a hot rolling facility in November, 1995 which has state- of-the-art technology with high level of automation. This plant produced 48 thousand tonnes of saleable steel in 1995-96. Vijayanagar Steel Plant : This plant has been set up at Tomagal near Hospet in Bellary district of Karnataka. It has the installed capacity of 30 lakh tonnes. The production of mild steel will be its special feature. This plant enjoys the following facilities: ? Iron ore is obtained from Hospet region located in close proximity. ? Coal comes from Kanhan valley in Chhattisgarh and Singareni coal fields in Andhra Pradesh. ? Good quality limestone and dolomite is available at a distance of about 200 km. ? Water and power requirements are met by the Tungabhadra hydel project located at a distance of about 36 km from the plant. Another steel plant

at Paradwip is fast coming up.

97%	MATCHING BLOCK 59/74	W

Vishakhapatnam Steel Plant (VSP): This integrated steel plant has a unique location on the sea port. In fact, it is the first shore based steel plant in the country. Although the foundation stone of the plant was laid in 1972, the construction work could not start in the real sense till February 1982 when Rashtriya !spat Nigam Limited was incorporated as a public sector company to implement the construction of the plant. The

project has been completed in two stages: the first stage was completed by March 1992 and the second and final stage by July 1992. This is the most sophisticated modern integrated steel plant in the country. Though the production commenced in 1991-92, l993-94 was the first full year of integrated operation.

93%	MATCHING BLOCK 60/74	W

In the year 1997-98, this plant produced 32.14 lakh tonnes of hot metal, 25.4 lakh tonnes of liquid steel, 22.5 lakh tonnes of saleable steel and 7.7 lakh tonnes of pig NSOU ● CC-GR-10 77 iron. It is a major export oriented steel plant and takes full advantage of its coastal location. In 1995-96, it exported 10.23 lakh tonnes of iron and steel worth Rs. 702 crore, mainly to China and south-east Asian countries.

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Currently holding 67th rank among 80 largest steel makers on the globe, as certified by the Brussels- based International Iron and Steel Institute, VSP is smooth- sailing towards reaching its goal of turning into a 'world class company in steel industry'; as a result of the effective turnaround strategy adopted by its management for the last couple of years. Buoyed by such a strong performance the VSP now intends to accelerate on the expansion trajectory. Presently it

90%	MATCHING BLOCK 64/74	SA	GE 302.pdf (D109199360)

is the second largest producer of iron and steel in the

country and the present annual capacity of three million tonnes of liquid steel can be raised to 5 million by 2006-07 and to 10 million tonnes by 2010.

45%	MATCHING BLOCK 65/74	SA	Sweta Kumari_LSW_P.201_Sup. Dr Sachchidanand S ... (D143465367)

The plant management intends to go in for massive upgradation of technology and skill of its personnel which will be required if the natural gas from the Krishna- Godavari basin is to be utilised to cut down

cost. Import of metallurgical coal from Australia can be reduced considerably if proper arrangements for utilising natural gas from Krishna- Godavari basin are made. The natural gas requirement is placed at one billion cubic metres (BCM) a year
and negotiations are in progress with the Reliance Group in this connection.

96%	MATCHING BLOCK 62/74	W

The plant has the following advantages : ? The coastal location facilitates for import of coal and export of iron and steel. ? It is well connected to coal fields of Damodar valley in Jharkhand. Metallurgical coal is imported from Australia which meets about 70 per cent power requirements. ? The plant has a bright future with respect to its energy requirements because there are plans to replace coal imported from Australia by natural gas from the Krishna-Godavari basin. ? High quality rich iron ore deposits are available in the Bailadila area of Chhattisgarh. ? Most of the requirements of limestone, dolomite and manganese are met by supplies from Chhattisgarh; Madhya Pradesh and Orissa. 78

NSOU • CC-GR-10 Location of Iron and Steel Industry 7.5 Concept of Manufacturing Region Industries are unevenly distributed in India because the factors affecting industrial location are not the same everywhere. Industries denote as manufacturing regions. Industries tend to concentrate in a few pockets because of certain favourable factors. The area or zones having concentration of industries are known as industrial region. Geographers and specialists in other allied fields have made several attempts to delineate industrial regions of India making use of different criteria. One of the first attempts was made by Trewartha and Brunet in 1944 using employment figures. R.L. Singh recognized ten regions based on empirical observation. They are (i) Hugli, (ii) Mumbai, (iii) Ahmedabad, (iv) The north-western extending from Ghaziabad to Amritsar, (v) Lucknow-Kanpur, (vi) Bangalore-Madras (vii) Quilon-Coimbatore, (viii) Madurai (ix) Dalmiapuram and (x) Digboi-Dibrugarh. Dr. B.N. Sinha (1972) has classified industrial regions into following three categories : ? Major Industrial Region is identified on the basis of a minimum daily factory working force of 1.5 lakh. ? Minor Industrial Region must have minimum of 25,000 working labour force.
NSOU • CC-GR-10 79 ? Manufacturing District has a working labour force of less than 25,000. A. Major Manufacturing Regions-India : Following are the major industrial regions of India o Mumbai-Pune Industrial Region. o Hugli Industrial Region. o Bangalore-Tamil Nadu Industrial Region. o Gujarat Industrial Region. o Chotanagpur Industrial Region. o Yishakhapatnam-Guntur Industrial Region. o Gurgaon-Delhi-Meerut Industrial Region. o Kollam-Thiruvananthapuram Industrial Region. B. Minor Manufacturing Region: o

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73%	MATCHING BLOCK 66/74	SA	GE 102.pdf (D106041755)

Ambala-Amritsar in Haryana-Punjab o Saharanpur-Muzaffarnagar-Bijnaur in Uttar Pradesh. o Indore-Dewas-Ujjain in

Madhya Pradesh. o Jaipur-Ajmer in rajasthan. o Kholapur-South kannada in Maharashtra-Karnataka. o Northen Malaber in Kerala. o Middle Malabar in Kerala. o Adilabad-Nizamabad in Andhra Pradesh. o Allahabad-Yaranasi-Mirzapur in Uttar Pradesh. o Bhojpur-Munger in Bihar. o Durg-Raipur in Chhattisgarh. o Bilaspur-Korba in Chhattisgarh. o Brahmaputra valley in Assam.

80 NSOU ● CC-GR-10 C. Manufacturing Districts: 1. Kanpur, 2. Hyderabad, 3. Agra, 4. Agra, 5. Gwalior, 6. Bhopal, 7. Lucknow, 8. Jalpaiguri, 9. Cuttack, 10. Gorakhpur, 11. Aligarh, 12. Kota, 13. Purnia, 14. Jabalpur, 15. Bareilly. Industrial regions of India 7.6 Special Economic Zones (SEZs) The Special Economic Zones Policy was announced in April 2000 with the objective of making the Special Economic Zone, an engine for economic growth, supported by quality infrastructure and an attractive fiscal package both at the Central and State level with a single window clearance. The SEZ concept recognizes the issues related to holistic economic development and provides for development of self-sustaining Industrial Townships so that the increased economic activity does not create pressure on the existing infrastructure. A special economic zone (SEZ) is an area in which the business and trade laws are different from the rest of the country. SEZs are located within a country's national borders, and their aims include increased trade balance, employment, increased investment, job creation and effective administration. To encourage businesses to set up in the zone, financial policies are introduced. These policies typically encompass investing, taxation, trading, quotas, customs and labour regulations. Additionally, companies may be offered tax holidays, whereupon establishing themselves in a zone, they are granted a period of lower taxation. The creation of special economic zones by the host country may be motivated by the desire to attract foreign direct investment (FDI). The benefits a company gains by being in a special economic zone may mean that it can produce and trade goods at a lower price, aimed at being globally competitive.

NSOU ● CC-GR-10 81 Asia's first EPZ (Export Promotion Zone) was set up in Kandla in 1965. Seven more zones were set up thereafter. However,

the zones were not able to emerge as effective infrastructure for export promotion on account

80%	MATCHING BLOCK 67/74	SA	GE 102.pdf (D106041755)

of the multiplicity of controls and clearances, the absence of world-class infrastructure and an unstable fiscal regime.

While correcting the shortcomings of the EPZ model, some new features were incorporated in the Special Economic Zones (SEZs) Policy announced in April 2000. To install confidence in investors and signal the Government's commitment to a stable SEZ policy regime and with a view to impart stability to the SEZ regime and thereby generating greater economic activity and employment through the establishment of SEZs, a comprehensive Special Economic Zones Act, 2005, was passed by in May, 2005 and received Presidential assent on the 23rd of June, 2005. The SEZ Act, 2005, supported by

57%	MATCHING BLOCK 68/74	SA	GE 102.pdf (D106041755)

SEZ Rules, came into effect on 10th February, 2006, providing simplification of procedures and single window clearance on matters relating to Central

and State governments. As a result of this Act and Rules coming into force, it was envisaged that the SEZs would attract a large flow of foreign and domestic investment in infrastructure and production capacity leading to generation of additional economic activity and creation of employment opportunities. The main objectives of the SEZ Act are: ? generation of additional economic activity; ? promotion of exports of goods and services; ? promotion of investment from domestic and foreign sources; ? creation of employment opportunities; and ? development of infrastructure facilities. Current status of approvals for setting up of Special Economic Zones: Seven Export Processing Zones set up by the Central Government at Kandla (Gujarat), Santa Cruz (Maharashtra), Cochin (Kerala), Noida (U.P.), Chennai (Tamil Nadu), Falta (West Bengal) and Visakhapatnam (Andhra Pradesh), were converted to SEZs on announcement of the SEZ Policy. Another EPZ set up in the private sector in Surat was also converted to an SEZ. In addition to these, 11 more SEZs were set up by the State Governments/private sector during the period 2000-2005 in the States of West Bengal (2), Gujarat (1), Madhya Pradesh (1), Uttar Pradesh (1), Rajasthan (2) and Tamil Nadu (4) after the coming into force of the SEZ Act, 2005. On 10th February 2006, 583 formal approvals have been granted for setting up of
82 NSOU ● CC-GR-10 Special Economic Zones, out of which 380 SEZs have been notified and are in various stages of operation. A total of 154 SEZs are exporting. There is some concentration in certain states, the fact that the approved SEZs are spread over 20 States and 3 Union Territories indicates that these are not confined to any particular region. State-wise distribution of SEZs as on 21.02.2012 is shown in the following table. The total land area involved in the formally approved SEZs including notified SEZs is around 44,966 Ha that is not more than 0.013% of the total land area of India. The six major sectors of IT/ITES, Hardware etc., Textiles and Apparel (including Wool), Pharma and Chemicals, Biotech, Engineering and Multiproducts account for bulk (82%) of the SEZ formal approvals granted so far. IT/ITES /Electronic Hardware/ Semiconductor is the single most important segment accounting for about 61% of the total formal approvals followed by Biotech and Engineering SEZs. More than half of the 583 formal approvals issued so far have reached the stage of notified SEZs. This ratio is the highest in Pharma/ Chemicals sector (90%) followed very closely by engineering sector (70%). Sector-wise details of formal approval, in-principle approvals and notified SEZs as on 21.2.2012 is shown in the following table. State-wise Distribution of approved Special Economic Zone (As on 21.02.2012) State Formal In-principle Notified Exporting Approvals approvals SEZs SEZs Andhra Pradesh 109 6 76 37 Chandigarh 2 0 2 2 Chhattisgarh 2 l 1 0 Delhi 3 0 0 0 Dadra & Nagar 2 0 I 0 Goa 7 0 3 0 Gujarat 47 6 30 16 Haryana 46 3 35 3 Jharkhand 1 0 1 0
NSOU ● CC-GR-10 83 State Formal In-principle Notified Exporting Approvals approvals SEZs SEZs Kamataka 61 1 38 20 Kerala 28 0 20 6 Madhya 14 2 5 1 Maharashtra 103 14 63 18 Nagaland 2 0 1 0 Orissa 10 0 5 1 Pondicherry 1 1 0 0 Punjab 8 0 2 1 Rajasthan 10 1 9 4 Tamil Nadu 69 6 55 31 Uttarpradesh 34 1 21 8 Uttarakhand 2 0 1 0 West Bengal 22 3 11 6 Total 583 45 380 154 Source: Department of Commerce Sector-wise Distribution of approved Special Economic Zone (As on 21.2.2012) Sector Formal In-principle Notified Exporting Approvals approvals SEZs SEZs Aviation/Aerospace/Copper 2 1 1 3 IT/ITES/EH/Semiconductor 354 1 233 88 Textiles/Apparel/Wool 18 1 12 5 Pharma/chemicals 23 3 20 8 Petrochemicals/perro. 4 1 2 0 Multi-Product 24 16 15 17 Building product/material 1 2 1 2
84 NSOU ● CC-GR-10 Sector Formal In-principle Notified Exporting Approvals approvals SEZs SEZs Beach & mineral/metals 2 0 2 0 Bio-tech 31 0 20 2 Engineering 21 1 17 9 Multi-Services/Services 16 3 9 1 Metallurgical Engineering 1 0 0 1 Electronic prod/ind 3 0 3 1 Auto and related 3 1 1 1 Footwear/Leather 7 0 5 2 Gems and Jewellery 12 3 6 3 Power/Alternate energy/Solar 3 1 3 1 FTWZ 13 4 6 2 Metal/Stain. Steel/Alum/foundry 8 2 4 0 Food Processing 5 0 4 3 Non-Conventional Energy 6 0 4 2 Plastic Products 0 2 0 0 Handicrafts 5 0 3 2 Agro 6 2 5 0 Port-based multi-product 8 0 2 1 Airport based multi-product 4 0 0 0 WritingandPrintingPaperMills 2 0 1 0 Strategic Manufacturing 0 1 0 0 Granite Processing and 1 0 1 0 Industries Total 583 45 380 154 Source: Department of Commerce

NSOU ● CC-GR-10 85 7.7 Technology Parks A landscaped development usually comprising of high specification office space as well as residential and retail developments, designed to encourage localization of high technology companies such as information technology, software development etc., thereby giving each the benefit of economies of scale. Usually, technology parks are located outside the inner city areas as these are quite land intensive in nature. Technology parks are designed to facilitate the production and commercialization of advanced technologies by forging synergies among research centers, education institutions, and technology-based companies. Tenants of technology parks are usually small companies at an early development stage pursuing an ambitious growth strategy based on the incubation of new ideas. To facilitate the successful adaptation and take-up of these ideas in the market place, the technology park provides: ? Cooperation in Research and Development with scientific research institutes and laboratories; ? Financial consulting and assistance in obtaining venture capital; ? Professional, technical, administrative and legal assistance; ? Information and telecommunications services; ? Supportive business infrastructure. The Software Technology Parks (STP) Scheme is instituted by the Department of Electronics of the government of India as an autonomous organization (Software Technology Parks of India - STPI). Its objective is to promote export of computer software. The scheme provides for preferential export and import regime and includes approximately 450 software units operating in software technology parks. It is oriented to the development and export of computer software using data communication links or physical media and export of professional services. Many major cities of India including the cities of Bangalore, Chennai, Hyderabad, Trivandrum, Kanpur, Bhubaneswar, Kolkata, Mumbai, Nagpur, Warangal, Kakinada, Lucknow, Pune, Surat, Tirupati, Vijayawada and Yisakhapatnam have IT parks.
86 NSOU ● CC-GR-10 Map of Technology Parks in India 7.8 Summary Thus in macroeconomics, the secondary sector of the economy describes the role of manu- facturing. It encompasses

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industries that produce a finished, usable product or are involved in construction.

NSOU ● CC-GR-10 87 Unit 8 ? Tertiary Activities : Transport, Trade and Service Structure 8.1 Objective 8.2 Introduction 8.3 Transportation 8.4 Trade 8.5 Service 8.6 Summary 8.1 Objective The learner will learn about the tertiary activities in an economy in this unit and their importance. 8.2 Introduction Tertiary activities include all the services other than primary and secondary activities. Tertiary production involves the service sector rather than tangible goods. This work refers to a range of personal and business services involving a rapidly growing share of the labour force in highly developed countries. Rental clerks, barbers, beauticians and secretaries all fall into the personal and business service categories as a group and they have been described as 'pink-collar' workers. Salient features of tertiary activities: Intangibility: Services are intangible and insubstantial, they cannot be touched, gripped, handled, looked at, smelled, and tasted. Thus, there is neither potential nor need for transport, storage or stocking of services. Furthermore, a service can be (re)sold or owned by somebody, but it cannot be turned over from the service provider to the service consumer. Solely, the service delivery can be commissioned to a service provider who must generate and render the service at the distinct request of an authorized service consumer. Inventory (Perishability): Tertiary activities have little or no tangible components and therefore cannot be stored for a future use. Services are produced and consumed during the same period of time. Inseparability: The service provider is indispensable for service delivery as he

88 NSOU ● CC-GR-10 must promptly generate and render the service to the requesting service consumer. In many cases the service delivery is executed automatically but the service provider must preparatory assign resources and systems and actively keeps up appropriate service delivery readiness and capabilities. Additionally, the service consumer is inseparable from service delivery because he is involved in it from requesting it up to consuming the rendered benefits. Examples: The service consumer must sit in the hair dresser's shop & chair or in the plane & seat; correspondingly, the hair dresser or the pilot must be in the same shop or plane, respectively, for delivering the service. Inconsistency (Variability): Each service is unique. It is one-time generated, rendered and consumed and can never be exactly repeated as the point in time, location, circumstances, conditions, current configurations and/or assigned resources are different for the next delivery, even if the same service consumer requests the same service. Many services are regarded as heterogeneous or lacking homogeneity and are typically modified for each service consumer or each new situation. Involvement: One of the most important Characteristics of services is the participation of the client/customer in the service delivery process. A client/customer has the opportunity to get the services modified according to specific requirement. Each of these characteristics is retractable and their inevitable coincidence complicates the consistent service conception and makes service delivery a challenge in each and every case. Proper service marketing requires creative visualization to effectively evoke a concrete image in the service consumer's mind. From the service consumer's point of view, these characteristics make it difficult, or even impossible, to evaluate or compare services prior to experiencing the service delivery. Mass generation and delivery of services is very difficult. This can be seen as a problem of inconsistent service quality. Both inputs and outputs to the processes involved providing services are highly variable, as are the relationships between these processes, making it difficult to maintain consistent service quality. For many services there is labor intensity as services usually involve considerable human activity, rather than a precisely determined process; exceptions include utilities. Human resource management is important. The human factor is often the key success factor in service economies. It is difficult to achieve economies of scale or gain dominant market share. There are demand fluctuations and it can be difficult to forecast demand. Demand can vary by season, time of day, business cycle, etc. There is consumer involvement as most service provision requires a high degree of interaction between service consumer and service provider. There is a customer-based relationship for
NSOU ● CC-GR-10 89 creating long-term business relationships. Accountants, attorneys, and financial advisers maintain long-term relationships with their clients for decades. These repeat consumers refer friends and family, helping to create a client-based relationship. 8.3 Transportation Modes of Transport: Transportation is the movement of goods and people from place to place communication, the movement of ideas from place to place, is also a type of transportation From the standpoint of value, there are two types of transportation. The first is economic transportation by which goods and people are carried for the purpose of economic profit. Such transportation is a change in place utility- the value of commodity is worth more after it has been transported from region of production to that of consumption. Transportation accounts for increase in value by moving commodities to location of demand. Non-transportation includes all movements which are carried on for some purpose other than economic profit. Recreational travel and military logistics are two examples. The significance of transportation in economic geography cannot be overemphasizing. In its own right transportation is an important geographic element- a spatial variable by which regions can be delimited and their characteristics studied and in terms of which relationships can be analyzed, such as relationship among route location, traffic flow and other phenomena. In addition, organized transportation is a geographic factor- an influence on the location of other economic activities. Without means of transport there would be no commercial coal mining, no commercial surplus production and no commercial lumbering or fishing. In fact, without commercial transportation, the world's economy would remain at subsistence level and regional specialization yielding exchangeable surpluses would be impossible. Transportation involves two aspects: (a) a vehicle or unit of conveyance and (b) a medium upon which to move. The form of one transport mode differs from that of another because of technological difference between them. The necessary requirements of any mode of transport are : (1) route, (2) vehicle, (3) motive power and (4) terminal. Route: All modes of transport require some of route, the way, course or tract on which to operate. Both roads and railways, the basic forms of land transport cannot

90 NSOU ● CC-GR-10 take place without the construction of suitable routes ways. Rail transport requires a more specific route in the form of special tract and other operational infrastructure like signaling equipments etc. sea and air transport are free from construction of route ways and can be operated in a natural environment. The inland water transport requires the construction of canals. The construction of pipelines involves heavy initial investment and maintenance. Vehicle : There is requirement for the conveyance of persons or goods by any means of transport. As a result of man's increased technological knowledge and expertise and his demand for increased speed and improved carrying capacity, there is an ever-increasing complexity in the character of vehicles. The animal driven vehicles are still popular, so is the bicycle. The auto vehicle has now become an internal part of our transport system. The railway locomotive, ships and aero-planes are the principal vehicles serving the entire world community. There is a variation in the carrying capacity of different vehicles. Motive power : Motive power is necessary to drive the vehicle. There are two main sources of power for transport: coal and oil. The invention of system engine and harnessing of stream power affect the forms of transport to a great extent. With this development transport became available on a mass basis. The air transport is exclusively based on oil products for their source of power. The use of electric driven engines in railways has enhanced the speed. The cost of motive power is a determining factor for the user. Air transport is the most expensive of all forms of transport. Terminal : The terminal provides access to the transport route or network. It is also a point to which motion ends. In rail transport, the terminus is the station at the end of the line. For bus, the bus stop is the terminal. The terminals are designed according to the mode of transport, their location, capacity and importance in relation to overall transport network. The sea terminals are very complex. There are ports with their docks, wharves, warehouse, customs offices etc. For air terminals, there are arrangements for the take off and landing of aircraft. Means and modes of transport : Modes and means are interrelated and integral part of any transport system. Transportation can be classified on the basis of power, route and vehicle. On the basis of power, the significant categories are (i) man and animal power used as a force in transportation; (ii) mechanical power in the form of force driving automobiles, trains, ships, aeroplanes etc. and (iii) physical power like wind or running water facilitating movement of goods. The classification on the basis
NSOU ● CC-GR-10 91 of nature of routes are (i) the land routes including transportation by path or tract, road, rail and pipeline (ii) water routes including inland and oceanic routes and (iii) air routes. Similarly, according to mode of transport, it can be classified into (i) man and animal, (ii) wheeled vehicles driven either by man or animal, (iii) automobiles, (iv) railways and (v) ship or plane. Roads: A road is a symbol of motion. In the reconstruction of a region, roads play a positive role. Roads are the veins and arteries of a country through which every improvement circulates. No other form of transport is able to provide such a comprehensive door-to-door or origin to-destination services nor does any other mode have such an extensive route network. Road transport also provides a feeder or connection with other modes. Road transport is important for its flexibility. Motor vehicle can supply services over public highways on even or uneven terrain or on poor roads. Traffic in "small" can be sent daily and easily be road service, for example milk, eggs, vegetables etc. Now every country of the world is having a dense network of roads. The efficiency of a road depends on maintaining a surface on which wheels will run without obstruction. The relative cost of road as compared with rail transport depends on - (i) the length of the haul, (ii) possibility of obtaining return loads, (iii) the liability of the goods carried to damage or pilferage, (iv) the case of commodity to be transported, (v) the volume of traffic offering and (vi) the service rendered. In the present state of economy, roads are most suitable means of transport. Railways: Railways are a product of the industrial revolution and afterwards become a predominant mode of inland transport. Railways solved two important needs: (i) the economic carriage by land of materials in bulk and bulky commodities and (ii) the relatively rapid movement of large numbers of people and goods. The rails always revolve around its fixed tract. This provides guidance for the wheels and also enables very heavy loads to be carried. There are national and international railways. Some intercontinental railways are also in function. The trains are powered either by diesel oil or electricity. In recent years, in order to achieve increased speeds, a continuous welded tract has replaced the traditional rails. The design of carriage units has promoted a better ride for passengers. The main advantage of rail is the movement heavy, bulky goods, mineral ores etc. Because of heavy capital investment, the railway must be used up to capacity. Capacity depends on a combination of train load, average speed and the frequency of the service.

92 NSOU • CC-GR-10 Transport cost curves for three transport modes Ocean Transport : The Sea offers a ready-made carriages way for ships which requires no maintenance. Ships can travel within a limited number of constraints, because of tloatability and reduced friction; ocean vessels are capable of carrying far greater loads and weights than can be handled by train. Ships try to keep certain lanes because of (i) physical conditions and (ii) economic considerations. The Suez and Panama canals have revolutionize the pattern of sea trade. The Red Sea-Suez- Mediterranean route has become the most important sea route in the world. Ocean shipping has now become a landmark in heavy load transportation between all parts of the world. Inland Waterways : Inland movement by water is undertaken by either natural waterways (river) or artificial waterways (canals). Such movement is governed by depth, width and direction of waterways and by such physical impediments as rapids, waterfalls, swiftness of flow and seasonal freezing. The principal disadvantages of inland waterways are (i) rivers may involve devious journeys and may flow in the wrong direction; (ii) navigable rivers may be interrupted by falls or rapids; (iii) change in river levels and winter freezing may cause discontinued services; and (iv) canal construction involves heavy capital investment and regular maintenance. Six major navigable systems of inland waterways are - the rivers of the western and Central Europe, the Volga-Don system, the North American rivers, the Amazon system, the Panama-Paraguay system and Chinese waterways. Airways : Air communication belongs to the twentieth century. Air routes are theoretical and aircrafts are not tied to the surface. All transport is controlled by terminals and prevailing weather conditions. Air routes are determined by: (i) adequate NSOU • CC-GR-10 93

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ground facilities for operation; and (ii) availability of traffic for economic working. Air transport is still

very costly and this limits its use. It

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is best suited for the carriage of commodities which are low in bulk but high in value.

Air services are two main kinds: (i) short-distance services operating within a country, called domestic service; (ii) long-distance services like trans-continental and trans oceanic flights, called international services. There is a worldwide network of air routes providing very good and speedy transport services. Pipelines: A pipeline is a line or conduit of pipe of variable diameter and length and traditionally used for carrying liquid or gas from a point of supply to a point of consumption. The first successful pipeline made of cate iron was laid down in Pennsylvania (USA) in 1865. Total nearly half a million kilometers of oil pipeline exist in the world together with a small distance of natural gas pipeline. Pipelines require maintenance against external rusting and internal corrosion. Pipeline are used for transporting - (i) liquids and gases; (ii) solids in suspension; (iii) solids by pneumatic pressure and (iv) materials enclosed in capsules. 8.4 Trade The positive impact of national and international trade on economic growth has been widely documented from both a theoretical and empirical point of view. To this respect, it has been argued that openness is important for growth because it generates channels for technology diffusion, which makes possible for less developed countries to import productivity gains from overseas. The literature on trade and growth has paid special attention to technological spillovers as channels of diffusion. Developing countries learn from imported technology and also from technological progress embodied in imported goods. This learning increases domestic stock of knowledge and, hence, domestic productivity and growth. Thus, one could argue that the greater the trade volume (imports and exports) is, the more knowledge can be potentially accumulated. However, the access to lower prices may also constitute a way of importing foreign productivity gains. Technological progress makes possible to produce goods of increasing quality at each time lower costs. Thus, there is also a trade benefit from having access to more productive intermediate and capital goods at a lower cost than their opportunity cost. Therefore, international trade can potentially play a crucial role in fueling economic growth of less developed countries. In other words, it can become one of the engines of growth for a country. But, going a step further might a stagnant economy import sustained growth by trading? An affirmative answer would be an argument in favour of views on trade as a way to escape from poverty. If this is the case, what are the

94 NSOU ● CC-GR-10 mechanisms through which trade could transmit sustained growth? The above discussion seems to suggest that trade could operate via trade volume and/or via prices, even in absence of diminishing returns in production and technological spillovers, trade leads to a stable world income distribution. This is because countries that accumulate capital faster than the world average undergo declining terms of trade, which restrains incentives for further accumulation. At long-run, the terms of trade become constant and countries grow at the same rate. Though they were not directly interested with the transmission of sustained growth through trade, their model also has the implication that trade can emerge as an engine of growth for stagnant economies. Diewert and Morrison (1986) aimed at developing an empirical method for properly measuring the contribution of factor inputs to output growth of open economies. They proved, with an empirical model based on index numbers. As indicated at the beginning of this section, the casuality going from trade to growth is a well-established empirical result. Ekholm and Sodersten (2002) emphasized the importance of considering income-terms of trade when analyzing the relationship between trade and growth. Regarding the second mechanism of transmission, the growth regressions by Barro (1991) showed that the economic growth is significantly positively related to the terms of trade. 8.5 Service The service sector produces intangible goods, more precisely services instead of goods. It comprises various service industries including warehousing and truck transportation services, information sector services, commodities, securities and other investment services, professional, technical and scientific services, waste management services, health care and social assistance services, and arts, entertainment, and recreation services. Service sector are considered more advanced than industrial or agricultural economies. The service sector, also known as the tertiary sector, is the third tier in the three sector economy. Instead of the product production, this sector produces services like advice, experience and discussion. Examples of service sector jobs include housekeeping, tours, nursing and teaching. By contrast, individuals employed in the industrial or manufacturing sectors produce tangible goods, such as cars, clothes or equipment.

NSOU ● CC-GR-10 95 Among the countries that place heavy emphasis on the service sector, the United States, the United Kingdom, Australia and China rank among the top. In the United States, the Institute for Supply Management (ISM) produces a monthly index that details the general state of business activity in the service sector. This index is regarded as a metric for the overall economic health of the country because approximately two- thirds of U.S. economic activity occurs in the service sector. According to the International Monetary Fund (IMF) and the CIA World Factbook, the following countries are the largest by service or tertiary output as of 2016 : Rank Name of Country Tertiary output 1 United States $14.76 billion 2 China $5.7 billion 3 Japan $3.5 billion 4 Germany $2.4 billion 5 United Kingdom $2.1 billion 6 France $1.9 billion 7 Italy $1.4 billion 8 Brazil $1.3 billion 9 Canada $I.I billion 10 India $1.0 billion Source : World Fact book, 2016 The service sector, though classified as the third economic sector, is responsible for the largest portion of the economy's business activity. Businesses in this sector are rapidly placing more focus on what is becoming known as the "knowledge economy," or the ability to surpass competitors by understanding what target customers want and need, and operate in a way that meets those wants and needs quickly with minimal cost.

96 NSOU ● CC-GR-10 Technology, specifically information technology systems, is shaping the way businesses in the service sector operate. In nearly all industries within the sector, businesses institute technology to bolster production, increase speed and efficiency and cut down on the number of employees required for operation. This cuts down on costs and improves incoming revenue streams. The services sector is not only the dominant sector in India's GDP, but has also attracted significant foreign investment flows, contributed significantly to exports as well as provided large-scale employment. India's services sector covers a wide variety of activities such as trade, hotel and restaurants, transport, storage and communication, financing, insurance, real estate, business services, community, social and personal services, and services associated with construction. 8.6 Summary In a nutshell, it can be said that the tertiary sector involves the provision of services to other businesses as well as to final consumers. The goods may be transformed in the process of providing the service. However, the focus is on people by interacting with them and serving the customers rather than transforming the physical goods.

NSOU ● CC-GR-10 97 Unit 9 ?

Agricultural Systems: Case Studies of Tea Plantation in India and Mixed Farming in Europe

Structure 9.1 Objective 9.2 Introduction 9.3 Case studies of tea plantation in India 9.4 Case studies of mixed farming in Europe 9.5 Summary 9.1 Objective ● This unit will deal with the agricultural systems specially the tea plantation in India and mixed farming of Europe. ● Role of tea industry in the national economy. 9.2 Introduction Agricultural system is a resource management strategy to achieve economic and sustained agricultural production to meet diverse requirements of farm livelihood while preserving resource base and maintaining a high level of environment quality (Lal and Miller 1990). Agricultural system is a set of agro economic activities that are interrelated and interact with themselves in a particular agrarian setting. It is a mix of farm enterprises to which farm families allocate its resources in order to efficiently utilize the existing enterprises for increasing the productivity and profitability of the farm. These farm enterprises are crop, livestock, aquaculture, agro forestry and agri-horticulture (Sharma et al 1991). 9.3 Case Studies of Tea Plantation in India Tea as a drink is unique; it cheers but does not inebriate. It is a favourite drink to all – rich or poor throughout the world. Its copper brown colour casts a hypnotic spell on its drinker who likes tea also for its excellent flavor. The Asian countries- China, India, Japan, Ceylon and Indonesia are leading growers of tea while U.K, U.S.A, U.S.S.R., Canada and France are the leading importers. Millions of people all over India are engaged in the tea trade in various ways-in 98 NSOU ● CC-GR-10 plantation, manufacturing, blending, packing, export of tea. A host of ancillary industries linked with the tea plantation and manufacturing again support millions of people. Tea Industry supports to employment generation, contribution of national income, development in infrastructure in and around tea estate area, influence to other industries like plywood, fertilizer. Evolution of the Tea Industry in India : India is considered as one of the native homes of the tea plant. The indigenous tea plant growing in a wild condition in Assam was first discovered about 1820. It is also said that the late Major Bruce was the first person who actually discovered the tea plant in India in 1823. The attention of the East India Company was directed to it and after some enquiries an experimental tea garden was started by the Company in 1835. After working it for five years. The East India Company made it over to the Assam Company - The first Indian tea company. There was very little progress in the tea industry during the next twelve years. China was the only supplier of tea to Europe up to the end of the eighteenth century. According to reports, cultivation of tea in India started after 1833 when the Chinese Government refused to renew the agreement granting the East India Company the rights or monopoly of British trades with China. It may be mentioned that the East India Company was granted a monopoly of British trade with China for a period of twenty years from 1813. A Committee was appointed by Lord William Bentinck, the Government General of India in 1834 to study a plan for the accomplishments of the introduction of tea culture in India and for the superintendence of its execution. The establishment of the tea industry in India was undoubtedly due to a great extent to the appointment of the committee. The committee which consisted of eleven Englishmen and two Indians issued a circular describing the conditions favourable for tea growing and suggested to the Government to collect relevant data regarding tea production wherever this might be available. In 1835 the Secretary to the Committee was sent to China to collect tea seeds. The Secretary despatched the seeds from China which reached Calcutta later in the same year. According to reports a person named Captain Jenkins had obtained same specimens of indigenous tea plants from Sadia, Assam. The seedlings from these weeds were identified at the Calcutta Botanical Garden as identical with the Chinese plants. Having established a successful industry in Assam's Brahmaputra valley, the feasibility' of growing tea in the entire range of foot hills of the Himalayas and other parts of India was explored. By 1863, 78 plantations were established in Kumaon,

NSOU ● CC-GR-10 99 Dehra Dun, Garhwal, Kangra Valley and Kulu. After the transfer of the present Darjeeling district to the East India Company in 1835 and initial trials in the 1840s, commercial plantations were started in Darjeeling in the 1850s and by 1874, 113 gardens covering 18,888 acres of tea were opened and production touched 3.9 million pounds. In order to surmount the problems the industry was facing labour and law and order issues, communication, the need to expand markets and the packaging of tea the Indian Tea Association was formed in 1881 and the United Planters Association of Southern India (UPASI)was formed in 1895. In 1853. India exported 183.4 tons of tea. By 1870, that figure had increased to 6,700 tons and by 1885, it was 35,274 tons. Today, India is one of the world's largest producers of tea with 13,000 gardens and a workforce of more than 2 million people involved in its production. Major tea producing regions in India (Source: Tea Association of India) Trends of tea production and export in India : PRODUCTION * INDIAN TEA * DISTRICTWISE (M.Kg)(Source: Tea Board) During December Upto December (+) / (–) in 2018 Jan - Dec District/State over 2017 2018 2017 2018 2017 During Upto 2017 2016 Assam Valley 13.57 25.94 628.20 627.98 -12.37 0.22 627.98 618.34 Cachar 2.01 3.11 48.78 47.19 -1.10 1.59 47.19 51.18 Total Assam 15.58 29.05 676.98 675.17 -13.47 1.81 675.17 669.52 Dooars 9.93 12.85 222.63 219.58 -2.92 3.05 219.58 204.47 Terai 7.95 11.60 155.52 161.72 -3.65 -6.20 161.72 143.70 Darjeeling 0.11 0.12 7.72 3.21 -0.01 4.51 3.21 8.13 Total WB 17.99 24.57 385.87 384.51 -6.58 1.36 384.51 356.30

100 NSOU ● CC-GR-10 Diff, 18-17 2017 2018 Others 1.21 1.35 30.25 27.43 -0.14 2.82 27.43 28.69 Total North India 34.78 54.97 1,093.10 1,087.11 -20.19 5.99 1,087.11 1,054.51 Tamil Nadu 12.89 10.89 155.32 166.90 2.00 -11.58 166.90 146.04 Kerala 5.79 5.05 58.02 62.35 0.74 -4.33 62.35 61.40 Karnataka 0.50 0.48 5.19 5.40 0.02 -0.21 5.40 5.41 Total South India 19.18 16.42 218.53 234.65 2.76 -16.12 234.65 212.85 All India 53.96 71.39 1,311.63 1,321.76 -17.43 -10.13 1,321.76 1,267.36 INDIAN TEA EXPORTS (Source: Tea Board) January-December April Dec : 2018-19 / 2017-18 M Kg Rs Cr Rs/Kg $/Kg M Kg Rs Cr Rs/Kg North 150.36 3515.88 233.83 3.41 109.00 2649.92 243.11 South 98.75 1616.49 163.70 2.39 74.89 1235.13 164.93 All India 249.11 5132.37 206.03 3.01 183.89 3885.05 211.27 North 157.69 3480.93 220.75 3.38 119.26 2676.97 224.47 South 94.20 1506.66 159.94 2.45 72.09 1140.59 158.22 All India 251.89 4987.59 198.01 3.04 191.35 3817.56 199.51 North -7.33 34.95 13.09 0.03 -10.26 -27.05 18.6 South 4.6 109.8 3.8 -0.1 · 2.80 94.54 6.7 All India -2.8 144.78 8.02 0.0 -7.46 67.49 11.76 Source: Indian Tea Association Exports of Tea

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India is one of the leading exporters of tea in the world. 18.38 percent of India's tea is

available for export while the rest is consumed in the country. With the progress of literacy, industrialization and urbanization the consumption of tea is increasing in the country. Due to the fast rising internal consumption and also because of lack of co-ordination among the various tea producing countries, in regard to their exports, it has not been NSOU ● CC-GR-10 101 possible for India to export more than an average level of 241.11 m. kgs. in a year. Though tea may be sold by private treaty and forward contracts either in the countries of origin or consumption the majority of sales are affected in the established tea markets of the world by public auction. Sales of tea : Indian tea is exported to Russia (45.07 M Kg), UK (15.34 M Kg), Kazakhstan (10.75 M Kg), UAE (20.94 M Kg), Iran (30.60 M Kg), Pakisthan (15.83 M Kg) USA (I 0.46 M Kg) and more 16 countries in abroad. Russia is the biggest in\ternational centre for auction of tea outside the exporting countries. DESTINATIONWISE TEA EXPORTS FROM INDIA (Calendar Year) (Source : Tea Board) January to December Century 2018 2017 +/- M Kg Rs Crs Rs/Kg S/Kg M Kg Rs Crs Rs/Kg S/Kg M Kg Rs/Kg Russia 45.07 704.48 156.31 2.29 47.56 767.19 161.31 2.47 -2.49 -5.00 Kazakhstan 10.75 200.63 186.63 2.73 11.00 201.70 183.36 2.78 -0.25 3.27 Ukraine 3.61 56.07 155.32 2.27 4.00 59.25 148. 13 2.26 -0.39 7.19 TOTAL CIS 61.10 994.55 162.77 2.38 64.00 1056.95 165.15 2.52 -2.90 -2.37 UK 15.34 333.14 217.17 3.18 16.58 330.03 199.05 3.07 -1.24 18.12 Netherlands 3.76 134.55 357.85 5.23 4.15 94.63 228.02 3.54 -0.39 129.82 Germany 8.91 243.89 273.73 4.00 10.93 255.59 233.84 3.60 -2.02 39.88 Australia 2.19 82.82 378.17 5.53 2.91 104.94 360.62 5.55 -0.72 17.55 Island 2.13 96.83 454.60 6.65 2.55 98.04 384.47 6.03 -0.42 70.13 Poland 5.87 101.60 173.08 2.53 6.22 99.12 159.36 2.44 -0.35 13.73 USA 10.46 325.12 310.82 4.55 14.16 383.24 270.65 4.12 -3.70 49.17 UAE 20.94 424.22 202.59 2.96 19.38 388.34 200.38 3.08 1.56 2.21 Iran 30.60 781.19 255.29 3.73 29.57 749.99 253.63 3.92 1.03 1.66 Canada 1.62 53.51 330.31 4.83 2.53 70.37 278.14 4.30 -0.91 52.17 China 10.22 174.72 170.96 2.50 8.52 148.27 174.03 2.71 1.70 -3.07

102 NSOU ● CC-GR-10 Saudi Arabia 4.56 112.71 247.17 3.62 4.31 103.73 240.67 3.72 0.25 6.50 ARE 11.36 163.19 143.65 2.10 11.02 136.74 124.08 1.89 0.34 19.57 Bangladesh 3.20 41.90 130.94 1.92 2.41 29.58 122.74 1.89 0.79 8.20 Afghanistan 0.76 16.03 210.92 3.08 0.98 16.36 166.94 2.57 -0.22 43.98 Kenya 0.38 6.83 179.74 2.63 1.16 16.37 141.12 2.10 -0.78 38.62 Japan 3.52 144.48 410.45 6.00 3.63 145.24 400.11 6.27 -0.11 10.34 Srilanka 3.97 54.04 136.12 1.99 4.05 54.33 134.15 2.05 -0.08 1.97 Singapore 1.06 26.22 247.36 3.62 0.51 14.22 278.82 4.20 0.55 -31.47 Pakistan 15.83 154.71 97.73 1.43 14.73 142.44 96.70 1.51 1.10 1.03 Others 31.33 666.12 212.61 3.11 27.61 549.97 198.87 3.05 3.72 13.75 Total Exports 249.11 5132.37 206.03 3.01 251.91 4987.59 197.99 3.04 -2.80 8.04 North India 150.36 3815.88 233.83 3.41 157.69 3480.93 220.75 3.38 -7.33 13.09 South India 98.75 1616.5 163.70 2.39 94.2 1506.66 159.94 2.45 4.55 3.75 Source: Indian Tea Association Problems and Suggestions : A number of problems have to be tackled carefully for the reorganization and redevelopment of the Indian Tea Industry. They include: (i) increasing production and improvement in quality, (ii) marketing and (iii) labour among other. Production : Increase in production of tea considerably depends upon (i) extension of acreage under tea, (ii) and increase in yield. Extension in acreage would considerably depend upon clearing bushes and jungles which occupy vast tracts in tea plantations. Production of tea can only be increased when the yield per acre is increased. Increase in yield will considerably depend upon provision of irrigation facilities, addition of fertilizers and replacement of old bushes by newer ones. Water has not only to be provided in some tea growing areas but the excess of water has also to be pumped out where necessary. Better quality seeds and clones improve the quality of the tea plant and the yield. Marketing : Methods of marketing affect the prices of tea. The pnmary marketing of tea should be regulated effectively in order to ensure fair price to producers. It may be

NSOU ● CC-GR-10 103 mentioned in this connection that the present system of bidding does not ensure best price to the producer. This age long system of selling tea should be discontinued. The Tea Trading Corporation of India has been formed for making packet and instant teas both at home and abroad. Ineffective promotional efforts have been responsible for the steady decline of India's share in the Western markets. Indian blends should be launched in the international markets and as far as possible Indian teas should be sold to foreign buyers through the Tea Trading Corporation and not through auctions. Small gardens play important roles in the production of tea. This representation in various administrative and policy making bodies on tea trade and industry is considered desirable. Labour Problems : Productivity in tea plantations can only increase when tea production per labour is increased. Incentives have to be provided to individual workers for inducing them to be more efficient in their performances. Such incentives may be financial or non- financial. The need for providing better housing facilities is widely felt. The labourers in tea gardens have to be provided with approved types of houses. True, housing subsidies provided to labourers help them considerably to build their houses. Both the funds available for remodeling the older houses are inadequate. Medical facilities provided to tea garden workers also include maternity benefits to the workers. Other welfare measures that have been taken in some tea gardens in India include education, games and sports and library facilities. The big tea plantations can alone provide these facilities. The smaller plantations cannot provide such facilities for want of funds. Efforts have to be directed to extend such facilities for increasing the efficiency of labour in the tea plantations in India. Wage problem in plantations also deserves careful consideration. Problems of wage have been tackled by different employers according to recommendations of the Wage Board. A uniform policy in task and wages for labour has yet to be evolved far better functioning of the tea plantations in India. 9.4 Mixed Farming in Europe Mixed farming involves the cultivation of crops and rearing of animals in the same farming areas. Crops and animals occur in various combinations in different places, but the role of crops is particularly crucial in that they provide multiple roles as feed for animals, as cash crops and as food supplies for farm families. But the

104 NSOU ● CC-GR-10 main source of revenue is livestock, especially beef cattle and hogs. Mixed farming is an important type of commercial agriculture in USA, Canada, Ireland, Ukraine, Russia, South Africa, Argentina, Australia, and New Zealand. Major Characteristics: • Temperate as well as Mediterranean climate areas are suitable for mixed farming. • A system of crop rotation is practiced in many places in which different crops are planted in successive years. Each type of crop adds different nutrients to the soil. The fields become more efficient and naturally replenish themselves with these nutrients. • Crops are grown mainly to the internal demand of the farm. Fodder crops are more important than others. Different fodder crops are maize, oat and soyabean. Maize and soyabeans are also used as food crops. In USA, maize is known as corn and it is the most important crop under mixed farming. Corn is mainly used for fattening the beef cattle. • Unlike commercial grain farming, mixed farming in North America and Western Europe primarily depends on the domestic market. High demand for livestock products (e.g. beef) in the big cities of these two continents is the motivating factor for the development mixed farming. But the mixed farming in Argentina, Australia and New Zealand is largely dependent on export. • Modern method of farming are adopted to increase the productivity and to reduce the cost of production. • Mixed farming in many places is developed in the sparsely populated areas. So, it is not a labour intensive farming. But skilled labourers are required for the livestock farming and these labourers are not always easily available. • This farming generates the opportunities of employment both directly and indirectly. Indirect employment may include crop trading, meat processing and other allied activities. Study on Mixed farming in Europe: European farming has been driven by the objective to increase food production. The global market, in particular the availability of cheap inputs (mineral fertilizers, animal feed), has introduced the logic of economies of scale. The intensification of farming systems was associated with specialization of farms and regions, leading to a
NSOU ● CC-GR-10 105 separation of livestock and cash crop production. Crops and livestock could optimize resource efficiency in Mixed Farming System (MFS) as a possible alternative to specialization. Using crops and grasslands for animal feeding and in return organic manure for fertilization, MFS could recycle nutrients more efficiently than specialized systems. It could thus theoretically limit negative environmental impacts while maintaining agricultural production and diversifying sources of incomes. From the 1950s and until the late 70s, the objective of producing more food drove European farming policy. Both global agricultural markets and agricultural policies enhanced efficiency in producing more of a same product, e.g. favouring economies of scale through intensification, enlargement and specialization. The availability of cheap mineral fertilizers and animal feed allowed farms to specialize either into cash crop or livestock production. Crop and livestock production have become increasingly decoupled both geographically and managerially resulting in many livestock units becoming heavily reliant on bought-in feedstuffs and straw and specialized arable units on purchased fertilizer. High prices and subsidies favoured cash crops where the soil-climatic conditions were favourable. The first pillar of the Common Agricultural Policy (CAP) helped investments to modernize agriculture such as irrigation and land management actions, which favoured the intensification and specialization of cash crop production in some European regions. The increased economic competition between production areas led to the regional concentration of livestock too, especially in the areas where the infrastructure and supply chain organization favoured agglomeration economy. The protectionist agricultural policies of the EU and the communist countries guaranteed stable product prices and incomes, reducing the economic risk of specialization. Although the EU farm policy evolved towards an open-market policy (e.g. removing price subsidies, market interventions and production quota systems), specialization is still enhanced. As a result of the logic of economies of scale and/or agglomeration, farm size increased all over the EU, whereas the agricultural workforce tended to decline. Among the causes that explain this evolution, literature points to the opportunity cost of labour as a main driver. Favourable opportunities for labour outside agriculture (and higher wages) increased abandonment; farm enlargement (of the remaining farms) favoured specialization and simplification of practices. Although specialization has obvious advantages for farmers, it also has a major downside. Due to the withdrawal of market intervention policies, market volatility has increased, causing high income risk for specialized farms. All over Europe, specialized crop farms have problems maintaining organic matter content and soil fertility. Straw has continued to be

106 NSOU ● CC-GR-10 transported from arable areas to intensive livestock production systems but manure has not been returned due to issues such as cost and transport. The use of inputs, such as fertilizers and pesticides, has helped to overcome the need for rotations to build fertility and control weeds, pests and diseases, but is now facing serious economic and environmental limits. At the same time, high livestock density regions are facing water pollution due to an excess of manure and a high reliance on inputs, in particular on protein for feed. These current challenges result in a renewed interest of research and policymakers in the MFS as a suitable alternative to specialization to limit environmental impacts of farming. Despite the renewed interest in MFS, these systems are facing a number of barriers and are still declining in Europe representing about 14% of agricultural systems all over EU. The share of MFS varies across European countries, with a larger share in Eastern countries of the EU. The level of specialization depends on economic context, labour availability and pedo- climatic conditions. Mixed Farming System (MFS) and sustainability : It is essential to recognize that "one size does not fit all" and that land capability plays an important role in the relative efficiency of MFS and specialized farming systems. On poorer lands, the management options are more limited, particularly because of issues such as slope and soil depth and climate. In such circumstances mixed farming may be able to provide self-sufficiency but a low conversion of inputs to outputs. In areas where the land is of good quality but is limited in availability for production, then very intensive specialized systems may be more efficient, at least in the short term, The infrastructures and services available in the area can also provide opportunities for MFS, for example, the presence of a specialist harvesting tractor would allow a farmer to experiment with diversified cropping without having to invest in new machinery. MFS potentially allow better use of resources (e.g. energy, nutrients, land) than specialized systems. They also show higher potential in adapting to climate variations. Technical efficiency is usually defined as the conversion of inputs into outputs, but here we acknowledge both the efficiency of use of purchased inputs and the use of natural resource (e.g. soil and water). Compared to specialized systems, in MFS improvements in efficiency are linked to the degree of synergy between components. The degree of synergies between crops and livestock depends on the skills and motivations of the farmer. Two main pillars for technical efficiency in MFS should be considered: i) diversifying crop rotations both for sale and animal feeding sources while limiting external inputs and; ii) recycling animal manure to fertilise crops. Considering these two pillars, a wide diversity of practices could be of interest Integration between crops and livestock in MFS can produce direct benefits
NSOU ● CC-GR-10 107 such as using unharvested crop residues to provide grazing. The integration between components can also have indirect benefits such as maintaining habitat for biodiversity. Increases in technical efficiency and improved synergies between enterprises could lower reliance on external inputs. Compared to MFS, specialization shows benefits when there is low or no integration between components. It is important to consider technical efficiency separately from intensity. Any discussion about innovation and fail factors needs to take into account the overall aim of a sustainable MFS. A further challenge in any discussion of technical efficiency of MFS is the large number of potential combinations of crops and livestock and their interaction with the pedo- climatic conditions. Different crops covering the soils the whole year would limit soil erosion and nitrate leaching to water while providing organic matter. Some cover crops could be considered as double-purpose enabling some flexibility to the system. If needed, the cover crop could be dedicated to livestock feeding (being grazed or hayed). If not, the cover crops could be left on the soil to provide organic matter. Integrating alternative crops in the crop rotations, in particular legume-cereal crops or grazed legumes as main crops or in between two cash crops would be an adapted solution. Manure management practices could be explored to adapt the frequency of application and type of manure according to the local soil and climate and considering the crop rotation. Agricultural Area under Mixed Farming in Europe
108 NSOU ● CC-GR-10 9.5 Summary Tea is an evergreen perennial plant and they are natural hybrids of different races. It is cultivated in more than 56 countries of the world. Being an important plantation crop in India, the tea industry is one of the finest agro—based industries providing employment to million of people in the rural areas. Mixed farming involving both growing of crops and raising of livestock is also an important agricultural system prevailing in the European countries.

NSOU ● CC-GR-10 109 Unit 10 ? Transnational Sea-routes, Railways, Highways with Reference to India Structure 10.1 Objective 10.2 Introduction 10.3 Transnational Sea-routes in India 10.4 Railways in India 10.5 Highways in India 10.6 Summary 10.1 Objective The learners will know about the different transnational sea-routes, highways, railways in India. 10.2 Introduction Movement of the goods and services can be over three important domains of our earth i.e. land, water and air. Based on these, transport can also be classified into land, water and air transport. Today, the world has been converted into a large village with the help of efficient and fast moving transport. Transport has been able to achieve this with the help of equally developed communication system. Today, India is well-linked with the rest of the world despite its vast size, diversity and linguistic and socio-cultural plurality. Railways, airways, water ways, newspapers, radio, television, cinema and internet, etc. have been contributing to its socio-economic progress in many ways. The trades from local to international levels have added to the vitality of its economy. It has enriched our life and addd substantially to growing amenities and facilities for the comforts of life. 10.3 Transnational Sea-routes In India Waterways are the cheapest means of transport. They are most suitable for carrying heavy and bulky goods. It is a fuel-efficient and environment friendly mode of transport, With a long coastline of 7,516.6 km, India is dotted with 12 major and 187 notified non-majors ports. These major ports along with their transitional sea-routes have been handling 95 per cent of India's foreign trade.

110 NSOU ● CC-GR-10 Kandla Port situated at the head of Gulf of Kuchchh has been developed as a major port to cater to the needs of western and north western parts of the country and also to reduce the pressure at Mumbai port. The port is specially designed to receive large quantities of petroleum and petroleum products and fertilizer. The offshore terminal at Vadinar has been developed to reduce the pressure at Kandla port. Demarcation of the boundary of the hinterland would be difficult as it is not fixed over space. In most of the cases, hinterland of one port may overlap with that of the other. Mumbai is a natural harbour and the biggest p011 of the country. The port is situated closer to the general routes from the countries of Middle East, Mediterranean countries, North Africa, North America and Europe where the major share of country's overseas trade is carried out. The port is 20 km long and 6-10 km wide with 54 berths and has the country's largest oil terminal. M.P., Maharashtra, Gujarat, U.P. and parts of Rajasthan constitute the main hinterlands of Mumbai ports. The main transitional routes from the po1t are- a. Cape Town-Mumbai (2550 Nautical Miles) b. Zanzibar-Mumbai (2550 Nautical Miles) c. Aden-Mumbai (1660 Nautical Miles) d. Karachi-Mumbai (500 Nautical Miles) e. Colombo-Mumbai (1890 Nautical Miles) Jawaharlal Nehru Port at Nhava Sheva was developed as a satellite port to relieve the pressure at the Mumbai port. It is the largest container port in India. Marmagao Port, situated at the entrance of the Zuari estuary, is a natural harbour in Goa. It gained significance after its remodelling in 1961 to handle iron-ore exports to Japan. Construction of Konkan railway has considerably extended the hinterland of this port. Karnataka, Goa, Southern Maharashtra constitute its hinterland. New Mangalore Port is located in the state of Karnataka and caters to the needs of the export of iron-ore and iron-concentrates. It also handles fertilisers, petroleum products, edible oils, coffee, tea, wood pulp, yarn, granite stone, molasses, etc. Karnataka is the major hinterland for this port. Kochchi Port situated at the head of Vembanad Kayal, popularly known as the "Queen of the Arabian Sea," is also a natural harbour. This port has an advantageous location being close to the Suez-Colombo route. It caters to the needs of Kerala, southernKarnataka and south western Tamil Nadu. Kolkata Port is located on the Hugli river, 128 km inland from the Bay of Bengal. Like the Mumbai port, this port was also developed by the British. Kolkata had the initial advantage of being the capital of British India. The port has lost its significance considerably on account of the diversion of exports to the other ports such as

NSOU ● CC-GR-10 111 Vishakhapatnam. Transitional sea-routes from Kolkata port are- a. Kolkata-Yangon (790 Nautical Miles) b. Kolkata-Penang (1350 Nautical Miles) c. Kolkata-Colombo (1250 Nautical Miles) d. Kolkata- Chennail (780 Nautical Miles) Paradwip and its satellite port, Haldia. Kolkata port is also confronted with the problem of silt accumulation in the Hugli river which provides a link to the sea. Its hinterland covers U.P., Bihar, Jharkhand, West Bengal, Sikkim and the north-eastern states. Apart from this, it also extends ports facilities to our neighbouring land- locked countries such as Nepal and Bhutan. Haldia Port is located I 05 km downstream from Kolkata. It has been constructed to reduce the congestion at Kolkata port. It handles bulk cargo like iron ore, coal, petroleum, petroleum products and fertilisers, jute, jute products, cotton and cotton yarn, etc. Paradwip Port is situated in the Mahanadi delta, about I 00 km from Cuttack. It has the deepest harbour specially suited to handle very large vessels. It has been developed mainly to handle large-scale export of iron-ore. Orissa, Chhattisgarh and Jharkhand are the parts of its hinterland. Visakhapatnam Port in Andhra Pradesh is a land-locked harbour, connected to the sea by a channel cut through solid rock and sand. An outer harbour has been developed for handling iron-ore, petroleum and general cargo. Andhra Pradesh and Telangana are the main hinterland for this port. Chennai Port is one of the oldest ports on the eastern coast. It is an artificial harbour built in 1859. It is not much suitable for large ships because of the shallow waters near the coast. Tamil Nadu and Pondicherry are its hinterland. The major sea transitional routes from Chennai are- a. Chennai-Yangon (1020Nautical Miles) b. Chennai-Port Blair (700 Nautical Miles) c. Chennai-Penang (1300 Nautical Miles) Ennore, a newly developed port in Tamil Nadu, has been constructed 25 km north of Chennai to relieve the pressure at Chennai port. Tuticorin Port was also developed to relieve the pressure of Chennai port. It deals with a variety of cargo including coal, salt, food grains, edible oils, sugar, chemicals and petroleum products. Another two sea routes are Nagappattinarn-Penang (1270 Nautical Miles) and Port Blair-Yangon (390 Nautical Miles)
112 NSOU ● CC-GR-10 Transitional Sea-Routes in India 10.4 Railways Railways are the principal mode of transportation for freight and passengers in India. Railways also make it possible to conduct multifarious activities like business, sightseeing, pilgrimage along with transportation of goods over longer distances. Apart from an important means of transport the Indian Railways have been a great integrating force for more than 150 years. Railways in India bind the economic life of the country as well as accelerate the development of the industry and agriculture.Indian Railways (IR) is the fourth largest railway network in the world by size, with 67,368-kilometre (41,861 mi) route. The Indian Railway is now reorganized into 18 zones. The distribution pattern of the Railway network in the country has been largely influenced by physiographic, economic and administrative factors. The northern plains with their vast level land, high population density and rich agricultural resources provided the most favourable condition for their growth. However, a large number of rivers requiring construction of bridges across their wide beds posed some obstacles. In the hilly terrains of the peninsular region, railway tracts are laid through low hills, gaps or tunnels. The Himalayan mountainous regions too are unfavourable for the construction of railway lines due to high relief, sparse population and lack of economic opportunities. Likewise, it was difficult to lay railway lines on the sandy plain of western Rajasthan, swamps of Gujarat, forested tracks of Madhya

NSOU ● CC-GR-10 113 Pradesh, Chhattisgarh, Odisha and Jharkhand. The contiguous stretch of Sahyadri could be crossed only through gaps or passes (Ghats). In recent times, the development of the Konkan railway along the west coast has facilitated the movement of passengers and goods in this most important economic region of India. It has also faced a number of problem such as sinking of track in some stretches and land Slides. Today, the railways have become more important in our national economy than all other means of transport put together. Routes are electrified with 25 KV AC electric traction while thirty three percent of them are double or multi-tracked. In its runs more than 20,000 passenger trains daily, on both long-distance and suburban routes, from 7,349 stations across India. In the freight segment, run more than 9,200 trains daily. As of March 2017, IR's rolling stock consisted of 277,987 freight wagons, 70,937 passenger coaches and 11,452 locomotives. IR owns locomotive and coach-production facilities at several locations in India. The world's eighth-largest employer, it had 1.308 million employees as of March 2017. In the year ending March 2018, IR carried 8.26 billion passengers and transported 1.16 billion tonnes of freight. In the fiscal year 2017-18, IR is projected to have revenue of 1.874 trillion (US$26 billion), consisting of 1.175 trillion (US$16 billion) in freight revenue and 501.25 billion (US$7.0 billion) in passenger revenue, with an operating ratio of 96.0 percent. 10.5 Roadways India has a road network of over 5,903,293 kilometres (3,668,136 mi), the second largest road network in the world. At 1.70 km of roads per square kilometre of land, the quantitative density of India's road network is higher than that of Japan (0.91) and the United States (0.989888) to, and far higher than that of China (0.46), Brazil (0.18) or Russia (0.08). Adjusted for its large population, India has approximately 4.63 km of roads per 1000 people. However, qualitatively India's roads are a mix of modern highways and narrow, unpaved roads, and are being improved. The length of national highways in India has increased from 70,934 km in 2010-11 to 101,011 km in 2015-16. India had completed and placed in use over 28,900 kilometres of recently built 4 or 6-lane highways connecting many of its major manufacturing centres, commercial and cultural centres. According to Ministry of Road Transport and Highways, as of March 2016, India had about 1,01,011 kilometers of national highways and expressways, plus another I, 76,166 kilometers of state highways. According to 2009 estimates by Goldman Sachs, India will need to invest US$1.7 trillion on infrastructure
114 NSOU ● CC-GR-10 projects before 2020 to meet its economic needs, a part of which would be in upgrading India's road network. The investment in national highways increased from 14,095.87 crore (US$2.0 billion) in 2005-06 to 98,988.06 crore (US$ l 4 billion) in 2015-16. During the same period the total investment in national highways was 476,589.37 crore (US$66 billion). The Government of India is attempting to promote foreign investment in road projects. Foreign participation in Indian road network construction has attracted 45 international contractors and 40 design/engineering consultants, with Malaysia, South Korea, United Kingdom and United States being the largest players. Golden Quadrilateral Super Highways : The government has launched a major road development project linking Delhi-Kolkata-Chennai-Mumbai and Delhi by six-lane Super Highways. The North-South corridors linking Srinagar (Jammu & Kashmir) and Kanyakumari (Tamil Nadu), and East-West Corridor connecting Silcher (Assam) and Porbander (Gujarat) are part of this project. The major objective of these Super Highways is to reduce the time and distance between the mega cities of India. These highway projects are being implemented by the National Highway Authority of India (NHAI). National Highways: National Highways link extreme parts of the country. These are the primary road systems and are laid and maintained by the Central Public Works Department (CPWD). A number of major National Highways run in North-South and East-West directions. State Highways: Roads linking a state capital with different district headquarters are known as State Highways. These roads are constructed and maintained by the State Public Works Department (PWD) in State and Union Territories. District Roads: These roads connect the district headquarters with other places of the district. These roads are maintained by the Zila Parishad. Other Roads: Rural roads, which link rural areas and villages with towns, are classified under this category. These roads received special impetus under the Pradhan Mantri Grameen
NSOU ● CC-GR-10 115 Highways in India
116 NSOU ● CC-GR-10 Sadak Yojana. Under this scheme special provisions are made so that every village in the country is linked to a major town in the country by an all season motorable road. 10.6 Summary The transnational sea-routes railways etc provide an excellent network worldwide to caten to the movement of goods, vehicles, and people throughout the world. This has enriched the communication system worldwide.

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NSOU ● CC-GR-10 117 Unit 11 ?International Agreements and Trade Blocks: GATT and OPEC Structure 11.1 Objective 11.2 Introduction 11.3 International Agreements-GATT 11.4 Trade Blocks-OPEC 11.5 Summary 11.1 Objective The learners will learn about the different types of international agreements and trade blocks. 11.2 Introduction Export tax is common, which has effects that are symmetrical to those of an import tax. An export tax, in the face of a fixed world price, discourages exports and directs supplies back onto the home market, pushing down the domestic price. Exports are often subsidized. For example, governments use taxpayers' money to give low-interest loans to exporters, engage in advertising and export promotion on behalf of exporters and give tax relief based on the value of goods or services each firm exports. Lower prices of exports due to subsidy likely to benefit consumers and harm producers of importing countries; the governments of importing countries have a good reason to protect their producers from unfair competition. They do retaliate by imposing a tariff against exporters which is widely known as countervailing duties. Higher domestic prices of importing countries as a result of countervailing duties suppose to protect the domestic producers. GATT/WTO does proscribe export subsidies as "unfair competition" and allow importing countries to retaliate with protectionist countervailing duties. The net effect of the subsidy plus countervailing duty together determines the world welfare. Advocates of strategic trade policy support granting subsidies to strategic industries/ firms. This form of subsidy is different from the infant industry argument for protection. Countries may predominate in the export of certain products because they had firms that were foremost in technology and able to attain first-mover advantages in industries that would support only a few firms because of substantial economies of scale. Government should use subsidies to support promising firms in emerging industries

118 NSOU ● CC-GR-10 and should provide this support until the domestic firms establish first-mover advantage in the world market. Both home market protection and export subsidies are advocated. For example the United States of America supports Boeing and a number of European countries support Airbus. 11.3 International Agreements- GATT General Agreement on Tariffs and Trade (GATT) have been enormously successful over the last 50 years at reducing tariff and other trade barriers among an ever-increasing number of countries. This led to the establishment of the General Agreement on Tariffs and Trade (GATT) in 1948 a treaty whereby 23 member countries agreed to a set of rules to govern trade with one another and maintained reduced import tariffs for other members. The GATT treaty did not provide for a formal institution, but a small GATT Secretariat, with a limited institutional apparatus, was eventually headquartered in Geneva to administer various problems and complaints that might arise among members. Over the next 40 years, GATT grew in membership and in its success at reducing barriers to trade. GATT members regularly met in what came to be known as negotiating rounds. These rounds were primarily focused on negotiating further reductions in the maximum tariffs that countries could impose on imports from other GA TT members. Several problems had surfaced with the GA TT apparatus- Firstly, the dispute resolution mechanism of GATT was not functioning as effectively as had been hoped. Countries with long standing disagreements were unable to reach any sort of resolution on a number of issues, ranging from government subsidies for exports to regulations regarding foreign direct investment. Secondly, a number of commodities, most importantly, agricultural products and textiles, were widely exempt from GATT disciplines. Thirdly, it was widely believed that certain forms of administered trade protection anti dumping duties, voluntary export restraints, and countervailing duties were restricting trade and distorting trade patterns in many important sectors. Fourthly, trade in services was expanding rapidly and GATT had no rules regarding trade in services. Fifthly, countries that produced intellectual property movies, computer programs, patented pharmaceuticals were becoming increasingly frustrated by the lack of intellectual property protection in many developing nations. TRIPS and TRIMS Play important role in Trade Related Intellectual Property Rights and Trade Related Investment Measuses in developed and developing countries.

NSOU ● CC-GR-10 119 Lastly, the rules regardi g trade-related investment measures for example, domestic purchase requirements for plants built from foreign direct investment were hotly disputed. To address these problems, a new round of trade negotiations the Uruguay Round was launched in 1986. The goals of the Uruguay Round were far more ambitious than in previous rounds. It sought to introduce major reforms into how the world trading system would function. The treaty negotiated during the Uruguay Round, the GATT treaty of l994, established the WTO the international institution to govern trade that was first visualized by the attendees of the Bretton Woods Conference 50 years earlier. The new GATT treaty provided for an entirely new and different dispute resolution mechanism to eliminate the gridlock of the old system. Furthermore, the Uruguay Round expanded GATT's authority to new areas agreements regarding trade in textiles, agriculture. services, and intellectual property were major achievements. Finally, new sets of rules regarding administered protection came into effect with the creation of the WTO in 1995. It is relatively young for an international institution, it has its origins in the Bretton Woods Conference at the end of World War II. At this conference, finance ministers from the Allied nations gathered to discuss the failings of World War I's Versailles Treaty and the creation of a new international monetary system that would support post war reconstruction, economic stability, and peace. The Bretton Woods Conference produced two of the most important international economic institutions of the postwar period:

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the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development (the World Bank). 11.4

Trade Block- The Organization Of The Petroleum Exporting Countries (OPEC) OPEC is an intergovernmental organization of 14 nations, founded in 1960 in Baghdad by the first five members (Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela), and headquartered since 1965 in Vienna, Austria. As of September 2018, the then 14 member countries accounted for an estimated 44 percent of global oil production and 81.5 percent of the world's "proven" oil reserves, giving OPEC a major influence on global oil prices that were previously determined by the so called "Seven Sisters" grouping of multinational oil companies. Objectives of the organization are- ? Coordinate and unify the petroleum policies of its member countries; ? Ensure the stabilization of oil markets, in order to secure an efficient, economic and regular supply of petroleum to consumers;
120 NSOU ● CC-GR-10 ? A steady income to producers; ? A fair return on capital for those investing in the petroleum industry. ? A significant provider of information about the international oil market. The effect can be particularly strong when wars or civil disorders lead to extended interruptions in supply. In the 1970s, restrictions in oil production led to a dramatic rise in oil prices and in the revenue and wealth of OPEC, with long-lasting and far- reaching consequences for the global economy. In the 1980s, OPEC began setting production targets for its member nations; generally, when the targets are reduced, oil prices increase. This has occurred most recently from the organization's 2008 and 2016 decisions to trim oversupply. Economists often cite OPEC as a textbook example of a cartel that cooperates to reduce market competition, but one whose consultations are protected by the doctrine of state immunity under international law. However, the influence of OPEC on international trade is periodically challenged by the expansion of non-OPEC energy sources and by the recurring temptation for individual OPEC countries to exceed production targets and pursue conflicting self-interests. Current member countries in OPEC : As of January 2019, OPEC has 14 member countries: five in the Middle East (Western Asia), seven in Africa, and two in South America. According to the U.S. Energy Information Administration (EIA), OPEC's combined rate of oil production (including gas condensate) represented 44 percent of the world's total in 2016, and OPEC accounted for 81.5 percent of the world's "proven" oil reserves. Approval of a new member country requires agreement by three-quarters of OPEC's existing members, including all five of the founders. In October 20 I 5, Sudan formally submitted an application to join but it is not yet a member. Qatar left OPEC on 1 January 2019, after joining the organization in 1961, to focus on natural gas production, of which it is the world's largest exporter in the form of liquefied (LNG). 11.5 Summary The formation of OPEC marked a turning point toward national sovereignty over natural resources, and OPEC decisions have come to play a prominent role in the global oil market and international relations.

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NSOU ● CC-GR-10 121 Suggested Readings Alvarez-Albelo, C.D. et al. 'The International Trade as the Sole Engine of Growth for an Economy" a published on line journal. Spain, pp.2-6. Chatterjee, K.(2015), Basics of Economic geography, Concept Publishing Company (P) Ltd., New Delhi, pp. 4- 5, pp.39-42, pp. 51-55, pp. 64-65, pp. 68-74, pp. 117-126, pp. 142-144, pp. 167-170. Chaudhuri, M.R. (1978), The Tea Industry in India, Indian Economic Geographic Studies, Oxford Book and Stationery Co., Kolkata, p. 1, pp.3-4, p.9, p. 16, pp. 18-21, pp. 34- 37, pp. 38-39, pp. 41-43. Crowley. M.A. (2013), An introduction to the WTO and GATT. Federal Reserve Bank of Chicago. U.S.A. pp. 1-3. Maira, A. (2014), Jobs. Growth. and Industrial Policy, Economic & Political Weekly,Vol XLIX No. 34. pp. 35- 39. Mitra, A. (2000), Resource Studies, Sreedhar Publishers, Calcutta,

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pp.1-2. Khullar, D.R.(2006), India- a Comprehensive Geography. Kalyani Publishers,			

Kolkata. pp. 798-804, p. 823. NSOU Study Material. (2007), Economic Geography, paper-3. Group- A, pp.3-4, p.42. https://www.researchgate.net/publication/32363 1827_Information_Economic_Man_ Assumption_Concept_Definition_and_Comparison/download, processed on 28.01.2019. http://commerce.gov.in /publications/pdli'CHAPTER_5.pdf,processed on O 1.04.2019. https://ec.europa.eu/eip/agriculture/sites/agri-eip/files /fg16_minipaper5_finaldraft_ 2016_en.pdf, processed on 03.04.2019. https://ec.europa.eu/agriculture/sites/agriculture /files/fadn/documents/mixed_en. pdf, processed on 03.04.2019. http://www.hillagric.ac.in/edu/coa/agronomy /lect/agron-4711/Lecture%201 %20Farming%20system%20scope%20importance%20and%20concept.pdf, processed on 08.04.2019

122 NSOU ● CC-GR-10 Questions Unit-1

Meaning and approaches to Economic Geography, New Economic Geography 1. Define Economic Geography 2. Illustrate the scope and content of Economic Geography 3. What do you mean by regional approach in Economic Geography? 4. Differentiate between regional and systematic approach in Economic Geography 5. Describe the characteristics of activity approach. 6. Elucidate the basic objectives of Economic Geography 7. Explain the main themes of different approaches in Economic Geography 8. Highlight the new trends in Economic Geography 9. Identify the areas of global trends in

Economic Geography Unit-2 Concept in Economic Geography : Goods and Services, Production, Exchange and consumption 1.

Explain the concept of goods. 2. What are the different kinds of goods? 3. What do you mean by services? 4. What are the types of services? 5. What is meant by consumption? 6. Write a short note on production. 7. Give a brief description on exchange. 8. Identify the relationship between goods and consumptions. 9. Describe the linkage among goods, production and services. 10.How do goods and services, production exchange and consumption depend on each other? Unit-3 Concept of Economic Man 1. Elaborate the concept of economic man? 2. Write a short note on economic man. NSOU ● CC-GR-10 123 3. What is the significance of economic man? 4. How do economic man perform develop mental activities? Unit-4 Economic Distance and Transport cost. 1. Explain the concept of economic distance. 2. What are the types of Transport cost? 3. Differentiate between fixed and variable cost. 4. What is marginal cost? 5. Explain terminal cost? 6. Briefly highlight the comparative cost on transport modes. 7. What is comparative cost advantage? 8. Mention the infrastructural facilities for transport development. Unit-5 Concept and clarification of Economic activities 1. What are the characteristics of primary activities? 2. Examine the sceondary activities. 3. What is the basic concept of tertiary sector? 4. Mention two objectives of Quaternary activities. 5. What is called 'Think Tank'? 6. What are the difference between primary and secondary activities? 7. How do secondary activities link with primary activities? 8. Explain the relationship among different economic activities. 9. Clarify economic activities with suitable examples. 10.Explain the concept of economic activities with specific examples. Unit-6

Factors affecting location of economic activity with special reference to agriculture (Von Thunen) and Industry (Weber). 1. What is location rent? 2. Describe briefly economic rent.

124 NSOU ● CC-GR-10 3. What are the concentric zones in Von Thunen Model? 4. Highlight the assumptions of Weber Theory. 5. What is 'Locational triangle'? 6. What is Isotim? 7. Define Isodapane. 8. What do you mean by 'Material Index'? 9. Examine the role of critical Isodapane on industrial location. 10.Illustrate Von Thunen's model on agricultural activities and bring out its relevance in present day context. 11.Critically analyse the industrial location theory of weber and find out its relevance in present day context. 12.Explain 'Least cost Approach' in industrial location with suitable examples. Unit-7 Primary activities : Subsistence and commercial agriculture, forestry, fishing and mining. 1.

What is the meaning of subsistence Farming? 2. Describe characteristic features of commercial farming. 3. How do you differentiate commercial fishing from domestic fishing? 4. Why mining is called robber industry? 5. Examine the economic importance of foresting? 6. Explain the role of subsistence agriculture on rural development. 7. How is commercial agriculture related with economic development? 8. What is renewable resource? 9. Give examples of non-renewable resources. 10.State on negative environmental impact & mining and excesive fishing. Unit 8

Secondary Activities : manufacturing (cotton textile, iron and steel), concept of Manufacturing regions, special economic zones and technology parks. 1.

What do you mean by 'Manufacturing industry'? 2. Name the major manufacturing regions of India. 3. What is special economic zone (SEZ) 4. Give an idea on 'Technology Parks'. 5. Why cotton textile industry is called 'Food loose industry'? NSOU ● CC-GR-10 125 6. What are the factors for marine growth of cotton textile industry in New England neguir? 7. What are the causes of migration of cotton textile industries Towards senthern regions of U.S.A.? 8. Analyse the locational factors for development of cotton textile industries in western region of India. 9. What are the factors for growth and progress of iron and steel industry in Japan? 10.Account for the concentration of iron and steel industry in eastern part of India. Unit-9 Tertiany Activities : Transport, Trade and Service. 1. What do you mean by Tertiary activities? 2. What are the different types of Trade? 3. Which mode of Transport is suitable for heavy loaded goods in international Trade? 4. What are the purposes of pipe line Transport? 5. What are the demerits of road Transport? 6. What is 'Out Sourcing'? 7. Write a short note on intra and international trade. 8. How GDP growth is related with trade and service? 9. Good network & Transport system leads to economic development of a region. 10.Bring out the relationship among

Transport, trade and services. Unit-10 Agricultural Systems : Case studies of tea plantation in India and mixed farming in Europe. 1.

Define plantation. 2. What do you mean by mixed farming? 3. What is the difference between plantation and mixed farming? 4. Write a short note on export of Indian tea. 5. What are the major tea producing regions in India? 6. Examine the growth of tea industry and its recent trend in India. 7. Most of European countries are famous for mixed farming —elucidate.

126 NSOU ● CC-GR-10 8. Explain how mixed farming is related with economic development. 9. Mention the salient features of plantation. 10.Name the European countries where mixed farming is practised. Unit-11 Transnational sea-routes, railways, highways with reference to India. 1. What do you mean by Transnational sea-routes? 2. Write the name of Transnational sea-routes from Mumbai pert. 3. What is 'Golden quadrilateral'? 4. What are east-west and north-south corridors? 5. How do railways and roadways network promote intra-regional transport? 6. What is the importance of Transnational sea routes for international trade? 7. Name the major railway routes across India. 8. Mention the important highways across India. Unit-12 International agreements and Trade blocks : GATT and OPEC. 1. What do you mean by Trade blocks? 2. What is GATT? 3. What is OPEC? 4. What is the significance of economic and political blocks? 5. What is Liberalization? 6. What is TRIPS? 7. Define TRIMS. 8. Why OPEC was formed? 9. What is Privatization? 10.What is Globalization? 11.Write a short note on impact of ATJ on Indian economy.

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128 NSOU ● CC-GR-10 Notes

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Submitted text	As student entered the text in the submitted document.
Matching text	As the text appears in the source.

1/74	SUBMITTED TEXT	20 WORDS	97%	MATCHING TEXT	20 WORDS

of goods and services. Whenever possible the goal is to develop generalizations and theories to account for these spatial variations.

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2/74	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

E.W. Zimmermann pointed out that “Economic Geography deals with the economic life of man with relation to environment.”

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3/74	SUBMITTED TEXT	27 WORDS	100%	MATCHING TEXT	27 WORDS

Economic Geography involves consideration of the geographical and other factors which influence man’s productivity, but only in limited depths, so far as they are connected with production and trade”.

SA GE 302.pdf (D109199360)

4/74	SUBMITTED TEXT	10 WORDS	87%	MATCHING TEXT	10 WORDS

Rawat Publication, Kolkata. Khullar, D.R.(2006), India- a Comprehensive Geography. Kalyani Publishers,

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5/74	SUBMITTED TEXT	18 WORDS	91%	MATCHING TEXT	18 WORDS

of goods and services. The goal is to develop generalizations and theories to account for these spatial variations.

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6/74	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

The primary sector of the economy extracts or harvests products from the earth.

SA GE 302.pdf (D109199360)

7/74	SUBMITTED TEXT	14 WORDS	82%	MATCHING TEXT	14 WORDS

include agriculture (both subsistence and commercial), mining, forestry, farming, grazing, hunting, fishing and quarrying.

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8/74	SUBMITTED TEXT	32 WORDS	95%	MATCHING TEXT	32 WORDS

The secondary sector of the economy includes industries that produce a finished, usable product or are involved in construction. This sector generally takes the output of the primary sector and manufactures finished goods.

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9/74	SUBMITTED TEXT	53 WORDS	100%	MATCHING TEXT	53 WORDS

is often divided into light industry and heavy industry. Many of these industries consume large quantities of energy and require factories and machinery to convert raw materials into goods and products. They also produce waste materials and waste heat that may cause environmental problems or cause pollution. The secondary sector supports both the primary and tertiary sector.

SA GE 302.pdf (D109199360)

10/74	SUBMITTED TEXT	36 WORDS	96%	MATCHING TEXT	36 WORDS

field is an important source for engineering job opportunities. Among developed countries, it is an important source of well-paying jobs for the middle class to facilitate greater social mobility for successive generations on the economy. This sector

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11/74	SUBMITTED TEXT	19 WORDS	60%	MATCHING TEXT	19 WORDS

raw materials, the process of manufacturing, the resultant product and the markets. So, the locational preference will also differ. 5.3

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12/74	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

costs. Transport costs are a monetary measure of what the transport provider must pay to produce transportation services.

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13/74	SUBMITTED TEXT	21 WORDS	92%	MATCHING TEXT	21 WORDS

the horse and wagon. ? Transportation costs are directly proportional to distance and are borne entirely by the farmers who ship all

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14/74	SUBMITTED TEXT	27 WORDS	94%	MATCHING TEXT	27 WORDS

city is the market for surplus products from the hinterland and receives products from no other area. ? The hinterland ships its surpluses to no other market except

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15/74	SUBMITTED TEXT	22 WORDS	72%	MATCHING TEXT	22 WORDS

The isodapane is a line of total transport cost. The isodapane is found by summing the isotims at a location. Once the

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16/74	SUBMITTED TEXT	17 WORDS	91%	MATCHING TEXT	17 WORDS

The difference between the capitalistic and socialistic economy, institutional factors and entrepreneurial decisions were not taken seriously

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17/74	SUBMITTED TEXT	21 WORDS	93%	MATCHING TEXT	21 WORDS

failed to consider the space problem, energy crisis and problems of civic amenities. The assumption of perfect competition in the concept of Weber’

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18/74	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS

The primary sector of the economy extracts or harvests products from the earth.

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19/74	SUBMITTED TEXT	34 WORDS	100%	MATCHING TEXT	34 WORDS

is an ideal condition. In the long run it is very difficult to sustain perfect competition in the region. Competition and price fluctuation in the economy is a natural phenomenon. Weber failed to recognize that. 5.5

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20/74	SUBMITTED TEXT	16 WORDS	90%	MATCHING TEXT	16 WORDS

include agriculture (both subsistence and commercial), mining, forestry, farming, grazing, hunting and gathering, fishing, and quarrying.

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21/74	SUBMITTED TEXT	32 WORDS	83%	MATCHING TEXT	32 WORDS

vital not only for the economy but also for the sustenance of the human race. One can say that primary economic activities form the 'building block' of other economic activities. 44

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22/74	SUBMITTED TEXT	31 WORDS	90%	MATCHING TEXT	31 WORDS

Cotton is the world's most important natural fiber. In the year 2007, the global yield was 25 million tons from 35 million hectares cultivated in more than 50 countries. There are three stages

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Japan has to import almost all of the raw materials needed

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24/74	SUBMITTED TEXT	77 WORDS	92%	MATCHING TEXT	77 WORDS

textile industry. The pioneer attempts to set up industries were made around cotton growing tracts of Nobi and Kanto regions. Now the major textile centres are located at Chukyo, NSOU ● CC-GR-10 49 Hanshin, Toyama, Kyushu and Keihin and also at Osaka and Nagoya. Spatially, majority of the cotton mills are located within the northern half of Japan. The bulk of the textile goods are produced in following regions: ? The Kwanto Plain, ? Nagowa, ? The Kinki Plain, and ? Along the Northern Coast. As

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25/74	SUBMITTED TEXT	37 WORDS	100%	MATCHING TEXT	37 WORDS

As the industry became more and more export-oriented, textile establishment gradually shifted towards coasts. At the beginning of the decade of I 990s, old obsolete mills closed down their productions. The new mills with updated machineries came into

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26/74	SUBMITTED TEXT	58 WORDS	95%	MATCHING TEXT	58 WORDS

Most of the Japanese textile mills are now using the latest technologies. The priority was given to reduce the cost of production. Soon, Japan became the exporter of not only textile products but also the textile machines. At present, a healthy competition is discernible between small scale sectors and the big industrial estates of textile industry. China: This is one of the

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27/74	SUBMITTED TEXT	22 WORDS	78%	MATCHING TEXT	22 WORDS
overall decrease of consumption of cotton goods in UK, loss of overseas market and emergence of new textile-producing nations like China, Japan,				overall decrease of consumption of cotton goods, loss of overseas market and emergence of new textile-producing countries like China, India, Japan,	

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28/74	SUBMITTED TEXT	20 WORDS	82%	MATCHING TEXT	20 WORDS

Since very old days, weaving and spinning were normal practices of village weavers. Most of the output was contributed by

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29/74	SUBMITTED TEXT	30 WORDS	91%	MATCHING TEXT	30 WORDS

of textile goods. The history of cotton textile industry in Germany is quite old. Initially, the industry was set up depending upon imported cotton. Most of the industries were developed along

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30/74	SUBMITTED TEXT	92 WORDS	100%	MATCHING TEXT	92 WORDS

United Kingdom: The Industrial Revolution in the 18th century gave the impetus to the development of cotton textile industry in Great Britain. The subsequent invention of spinning machines encouraged the growth. The humid climate and local skilled labour helped a lot during the initial period of development. The cotton textile industry in the United Kingdom attained such a high fame that at end of 19th century the country became the undisputed leader of the cotton textile industry. The early centres were developed around Scottish lowlands, Nottingham, Ireland and Lancashire. Gradually, Lancashire became the most developed textile centre in the world.

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31/74	SUBMITTED TEXT	11 WORDS	100%	MATCHING TEXT	11 WORDS

Germany: Germany is one of the leading producers of cotton textile.

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32/74	SUBMITTED TEXT	90 WORDS	99%	MATCHING TEXT	90 WORDS

Of course, among all the textile-producing centres, Shanghai was most important. At one stage, this region produced more than 70 per cent of the Chinese textile production. The emergence of different textile centres lowered the relative importance of Shanghai, but it still maintains dominating role in textile industry. The adjacent Hankow region now produces huge amount of textile products. The Wushan integrated textile plants contribute significant amount of cotton products. The Canton textile units were set up very recently. As the plants are modern, output of textile goods per worker is very high in this region.

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33/74	SUBMITTED TEXT	27 WORDS	82%	MATCHING TEXT	27 WORDS

The textile industry in France was developed on imported cotton, particularly from USA. The industry is concentrated in the north-eastern industrial re-gions. The major textile-producing centres are Belford, Kolman,

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Cotton cloth is produced in three different sectors viz., I. Mills, 2. Power-looms and 3. Handlooms. Mills: The mill sector played a dominant role in cotton textile industry at the initial stage. But its importance was reduced drastically with the growth of

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sector. This sector not only contributes significantly to the cloth production in the country but also provides employment to millions of people. The

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36/74	SUBMITTED TEXT	27 WORDS	100%	MATCHING TEXT	27 WORDS

sector plays a pivotal role in meeting the clothing needs of the country. The production of cloth as well as generation of employment has been rapidly increasing in

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37/74	SUBMITTED TEXT	33 WORDS	91%	MATCHING TEXT	33 WORDS

industry produces a wide variety of cloth with intricate designs. The power loom sector accounts for about 63 per cent of the total cloth production in the country and contributes significantly to the export earnings.

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The production of cloth as well as employment has been increasing in

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39/74	SUBMITTED TEXT	13 WORDS	83%	MATCHING TEXT	13 WORDS

employment to over 65 lakh persons engaged in weaving and allied activities. The

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40/74	SUBMITTED TEXT	22 WORDS	95%	MATCHING TEXT	22 WORDS

This sector constitutes nearly 14 per cent of the total cloth produced in the country and also contributes substantially to the export earnings.

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41/74	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS
Maharashtra excels all other states in the development of cotton textile industry.			Maharashtra excels all other states in the development of cotton textile industry.		

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42/74	SUBMITTED TEXT	140 WORDS	89%	MATCHING TEXT	140 WORDS

Iron and Steel Industry The growth and development of iron and steel industry is a reflection of global economy. The iron and steel industry depicts a changing nature in its growth and production pattern. America, Western Europe and Japan accounted for nearly two-third of the world's steel production. But gradually the spatial pattern has changed and attention has now shifted to the developing regions. Towards the end of the last century, the growth of steel production in countries like China, South Korea, Brazil and India has changed the entire pattern of steel production in the world. Now main producers of iron and steel in the world are China, Japan, USA, Russia, Germany, South Korea, Brazil, Ukraine, India, France, Italy and Great Britain. The other steel-producing countries are South Africa, Australia, Austria, Netherlands, Czech Republic, Romania, Spain, Belgium, Sweden, etc. Table I 0.1 indicates the production of iron and steel in

iron and steel industrial belts of the world The growth and development of iron and steel industry is a reflection of global economy. The iron and steel industry depicts a changing nature in its growth and production pattern. In the mid-1970s, the relatively developed countries of North.America, Western Europe and Japan accounted for nearly two-third of the world's steel production. But gradually the spatial pattern has changed and attention has now shifted to the developing regions. Towards the end of the last century, the growth of steel production in countries like China, South Korea, Brazil and India has changed the entire pattern of steel production in the world. Now main producers of iron and steel in the world are China, Japan, USA, Russia, Germany, South Korea, Brazil, Ukraine, India, France, Italy and Great Britain. The other steel-producing countries are South Africa, Australia, Austria, Netherlands, Czech Republic, Romania, Spain, Belgium, Sweden, etc. It becomes clear that China is the leading producer of iron and steel in

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43/74	SUBMITTED TEXT	92 WORDS	100%	MATCHING TEXT	92 WORDS

China is the leading producer of iron and steel in the world, which accounts for about 23.9 per cent production of pig iron and 17 per cent of crude steel of the world's production. Japan is the second largest producer with 14.7 per cent pig iron and 13.9 per cent crude steel production of the world. USA once the highest producer now ranks third in the world followed by Russia. India's position is 9th in the iron and steel production and its production of pig iron and crude steel accounts for 3.9 and 3.6 per cent respectively.

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44/74	SUBMITTED TEXT	153 WORDS	97%	MATCHING TEXT	153 WORDS
Since 1973, growth of steel production in China was spectacular and within a span of 15 years China was able to increase its production of crude steel to 217 percent. In that period consumption increased 300 per cent. This growth rate clearly reveals the rapid pace of industrialization that is now going on in China. The iron and steel industry is concentrated in Anshan, Wuhan and Paotow triangle. The biggest iron and steel factory was established in the Chinese mainland at Anshan in Manchuria by Japanese, but was greatly expanded by the Chinese with Russian help. Other iron and steel production centres in Manchuria are Fushun, Penki, Shenyang, Harphin and Kirin. NSOU ● CC-GR-10 63 For Wuhan plants, ore is obtained from Taylh, i.e., 130 km away, and coal from Pingtinghan to the north of Yangtze River. The Wuhan steel plant is also in process of expansion. Other less extensive new steel plants are being created in Siangtan (Hunan), Tientsin, Tangshan, Nanking, Shanghai, etc.				Since 1973, growth of steel production in China was spectacular and within a span of 15 years China was able to increase its production of crude steel to 217 percent. In that period consumption increased 300 per cent. This growth rate clearly reveals the rapid pace of industrialisation that is now going on in China. The iron and steel industry is concentrated in Anshan, Wuhan and Paotow triangle. The biggest iron and steel factory was established in the Chinese mainland at Anshan in Manchuria by Japanese, but was greatly expanded by the Chinese with Russian help. Other iron and steel production centres in Manchuria are Fushun, Penki, Shenyang, Harphin and Kirin. For Wuhan plants, ore is obtained from Taylh, i.e., 130 km away, and coal from Pingtinghan to the north of Yangtze River. The Wuhan steel plant is also in process of expansion. Other less extensive new steel plants are being created in Siangtan (Hunan), Tientsin, Tangshan, Nanking, Shanghai, etc. 14	

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45/74	SUBMITTED TEXT	61 WORDS	97%	MATCHING TEXT	61 WORDS
has increased considerably during the 53 years from 1950-51 to 2003-04. The production of spun yarn registered more than fourfold increase from 533 million kg in 1950-51 to 2,121 million kg in 2003-04. Although the total production of cotton cloth increased considerably, the share of mill sector has been drastically reduced. This is an indication of our efforts to decentralize the industry and create greater employment opportunities.					

SA GE 302.pdf (D109199360)

46/74	SUBMITTED TEXT 177 WORDS	100% MATCHING TEXT 177 WORDS
	In Japan, large-scale concentration of iron and steel industry has occurred in the following regions : • The Tokyo-Yokohama Region : It is having all facilities required for the growth of iron-steel industry. The reclamation of Tokyo Bay provided large, extensive plane land for steel manufacturing units. The Tokyo-China region is the main area in which steel industrial units have been developed at Hitachi and North Tokyo. • Nagoya Region : It contributes about 20 per cent of the Japanese steel production. This region had witnessed a massive growth of industries within the period 1950-60. • Osaka-Kobe Region : At the head of the Osaka Bay, a highly industrialised area known as the Kinki has developed. The port of Osaka is the main centre. Other centres of this region are Amagaski, Kobe, Hemegi, Sakai and Wakayama. • Fukuoka-Yamaguchi Region : It is located in the extreme south of Japan within Kyushu and westernmost end of Honshu. The first government steel plant was established at Yawata in 1901. Kita- Kyushu is another notable iron and steel centre of this region. • Oka-Yamaha Region : It is a new industrial region situated in between Osaka-Kobe and Hiroshima.	In Japan, large-scale concentration of iron and steel industry has occurred in the following regions: The Tokyo-Yokohama Region: It is having all facilities required for the growth of iron-steel industry. The reclamation of Tokyo Bay provided large, extensive plane land for steel manufacturing units. The Tokyo-China region is the main area in which steel industrial units have been developed at Hitachi and North Tokyo. Nagoya Region: It contributes about 20 per cent of the Japanese steel production. This region had witnessed a massive growth of industries within the period 1950-60. Osaka-Kobe Region: At the head of the Osaka Bay, a highly industrialised area known as the Kinki has developed. The port of Osaka is the main centre. Other centres of this region are Amagaski, Kobe, Hemegi, Sakai and Wakayama. 15 Fukuoka-Yamaguchi Region: It is located in the extreme south of Japan within Kyushu and westernmost end of Honshu. The first government steel plant was established at Yawata in 1901. Kita-Kyushu is another notable iron and steel centre of this region. Oka-Yamaha Region: It is a new industrial region situated in between Osaka-Kobe and Hiroshima.

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47/74	SUBMITTED TEXT 674 WORDS	98% MATCHING TEXT 674 WORDS

Hokkaido Region : The main centre of this region is Murroran. A fairly big sized iron and steel industry has developed here depending upon local coal and iron ore. The most striking feature in the locational pattern of Japan's steel plants is that they are situated either on the Bay-Coast or on some canal or river. This is because of the fact that most of the Japanese steel plants depend upon outside raw material. Another feature is that they are located in the heart of great industrial districts which provide ready market for finished steel. In fact, localisation of iron and steel industry in Japan is market-oriented. United States of America : Once USA was the highest producer of iron and steel but now its rank is third in the world, next to China and Japan. In the US first iron and steel plant was established in 1629 at Massachusetts. During last 380 years or so the US steel industry has undergone through several changes. This change has not only occurred in growth and production pattern but also in localization pattern. The major iron and steel regions in the USA are as follows: • Appalachian or Pittsburgh Region : The most important of all the regions is the northern Appalachian region of western Pennsylvania and eastern Ohio. This district contains about 42.5 per cent of the blast furnace capacity of the country and its centre, Pittsburgh, is the second greatest centre of steel industry in the world. The mills in this region are located almost exclusively in the narrow valleys of the headwater streams of the Ohio River, including the upper reaches of the Ohio itself. The region, often known as the Pittsburg-Youngstown region, includes several districts. The Pittsburgh district consists of industries located in the valleys of the Ohio, Monongahela, and Allegheny, within 60 km of Pittsburgh. The Youngstown or the 'valley' districts consist of industries in the valleys of the Shenango and the Mahoning rivers. Wheeling, Johnstown, Stenhenville and Beaver Falls are other important steel- producing centres. The chief disadvantage of the region is its remoteness from the sources of iron ore supplies, which come from the Lake Superior region partly by rail and partly by water. 66 NSOU ● CC-GR-10 • Lake Region : The lake region falls into : (a) The Lake Erie ports; Detroit Cleveland and Buffalo, etc.; (b) The centers near the head of Lake Michigan, Chicago-Gary or Calument district; and (c) The Lake Superior region, Duluth. These districts represent a somewhat different adjustment to the three factors in the localisation of the industry, coal, iron and market. The Lake Erie ports are nearer to the Appalachian coal, but farther from the iron ore than the Duluth region. The

Hokkaido Region: The main centre of this region is Murroran. A fairly big sized iron and steel industry has developed here depending upon local coal and iron ore. The most striking feature in the locational pattern of Japan's steel plants is that they are situated either on the Bay-Coast or on some canal or river. This is because of the fact that most of the Japanese steel plants depend upon outside raw material. Another feature is that they are located in the heart of great industrial districts which provide ready market for finished steel. In fact, localisation of iron and steel industry in Japan is market-oriented. 3. United States of America: Once USA was the highest producer of iron and steel but now its rank is third in the world, next to China and Japan. In the US first iron and steel plant was established in 1629 at Massachusetts. During last 380 years or so the US steel industry has undergone through several changes. This change has not only occurred in growth and production pattern but also in localisation pattern. The major iron and steel regions in the USA are as follows: Appalachian or Pittsburgh Region: The most important of all the regions is the northern Appalachian region of western Pennsylvania and eastern Ohio. This district contains about 42.5 per cent of the blast furnace capacity of the country and its centre, Pittsburgh, is the second greatest centre of steel industry in the world. The mills in this region are located almost exclusively in the narrow valleys of the headwater streams of the Ohio River, including the upper reaches of the Ohio itself. The region, often known as the Pittsburg-Youngstown region, includes several districts. The Pittsburgh district consists of industries located in the valleys of the Ohio, Monongahela, and Allegheny, within 60 km of Pittsburgh. The Youngstown or the 'valley' districts consist of industries in the valleys of the Shenango and the Mahoning rivers.Wheeling, Johnstown, Stenhenville and Beaver Falls are other important steel-producing centres. The chief disadvantage of the region is its remoteness from the sources of iron ore supplies, which come from the Lake Superior region partly by rail and partly by water. Lake Region: The lake region falls into: (a) The Lake Erie ports; Detroit, Cleveland and Buffalo, etc.; (b) The centres near the head of Lake Michigan, Chicago-Gary or Calument district; and 16 (c) The Lake Superior region, Duluth. These districts represent a somewhat different adjustment to the three factors in the localisation of the industry, coal, iron and market. The Lake Erie ports are nearer to the Appalachian coal, but farther from the iron ore than the Duluth region. The Michigan region is midway between the two. One

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Michigan region is midway between the two. One important advantage that all these districts enjoy over the Pittsburg region is that, owing to their location on the lake shores, one extra handling of iron ore is eliminated. On the other hand, these centres are located a little away from the market. Duluth, for example, has in its immediate hinterland the forest, farm, and the ranching country, with little demand for iron and steel goods. Detroit is the largest steel consuming centre in the USA particularly because of its automobile industry. • Atlantic Seaboard Region : On the Atlantic Seaboard, it is only the Middle Atlantic region 8',Jew York, Philadelphia and Baltimore, etc. are important. The chief advantage that this region enjoys is in respect of its location, both in relation to the tidewater, and the proximity to the large industrial centres of the East. Its location near the centre of the great manufacturing region of the Atlantic Seaboard, the region of the densest population, and of the most intense industrial development in North America, is the most remarkable. The Middle Atlantic region is the only major region in which the production of pig iron and steel is notably greater, in proportion, than the iron ore consumed, because of the relatively larger amount of scrap available in this highly industrialized region. There are many steel mills in this region which operate without blast furnaces, depending both on scrap and pig iron imported from other areas, particularly the Northern Appalachian region. • South Appalachian : In the Southern Appalachians, in Alabama, however, large deposits of these raw materials are found in closer proximity than anywhere else in North America if not the world. While

important advantage that all these districts enjoy over the Pittsburg region is that, owing to their location on the lake shores, one extra handling of iron ore is eliminated. On the other hand, these centres are located a little away from the market. Duluth, for example, has in its immediate hinterland the forest, farm, and the ranching country, with little demand for iron and steel goods.Detroit is the largest steel consuming centre in the USA particularly because of its automobile industry. Atlantic Seaboard Region: On the Atlantic Seaboard, it is only the Middle Atlantic region (New York, Philadelphia and Baltimore, etc.) that is important. The chief advantage that this region enjoys is in respect of its location, both in relation to the tidewater, and the proximity to the large industrial centres of the East. Its location near the centre of the great manufacturing region of the Atlantic Seaboard, the region of the densest population, and of the most intense industrial development in North America, is the most remarkable. The Middle Atlantic region is the only major region in which the production of pig iron and steel is notably greater, in proportion, than the iron ore consumed, because of the relatively larger amounts of scrap available in this highly industrialised region.There are many steel mills in this region which operate without blast furnaces, depending both on scrap and pig iron imported from other areas, particularly the Northern Appalachian region. South Appalachian: In the Southern Appalachians, in Alabama, however, large deposits of these raw materials are found in closer proximity than anywhere else in North America if not the world. While

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48/74	SUBMITTED TEXT	157 WORDS	97%	MATCHING TEXT	157 WORDS

in World At present, China has following important areas of iron-steel industry: ? Southern Manchuria is the largest steel plant of China at Anshan and other plants at Pensihu and Mukden. ? Shansi is also an old region of iron and steel production. In this region Taiyuan has been developed as a major steel centre. ? The Lower Yangtze Valley : In this region Hankow, Shanghai, Hanyang and Chungking are the main centres of iron and steel industry. ? Other centres are located at Paotow, Chinling Chen, Canton, Singtao and Huangsih. Japan : In spite of the shortage of raw material (iron and coal), Japan has become one of the leading steel producers of the world. After China, Japan is the second largest producer of pig iron and crude steel in the world. Yawata, the first steel plant was built in 1901 by government. Yawata is a major centre of heavy industry with about one fifth of Japan's steel capacity. Kamaishi in Honshu and Muroran in Hokkaido are small tidewater plants. 64

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49/74	SUBMITTED TEXT	45 WORDS	96%	MATCHING TEXT	45 WORDS

the ore is of low grade and requires shaft mining, much of the rock is lime and the ore rs, therefore, self-fluxing. The region lacks, however, large industrial centres in the neighborhood and has, therefore, a considerable amount of surplus pig iron which goes to the North. •

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50/74	SUBMITTED TEXT	47 WORDS	100%	MATCHING TEXT	47 WORDS

Submitted text	Matching text
Germany : Before World War I, Germany was the second largest iron and steel producer in the world. It was the largest exporter of steel goods in the world. German iron and steel industry was handicapped since after the war of 1914 by the loss of ore, coal and productive capacity.	Germany: Before World War I, Germany was the second largest iron and steel producer in the world. It was the largest exporter of steel goods in the world. German iron and steel industry was handicapped since after the war of 1914 by the loss of ore, coal and productive capacity.

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51/74	SUBMITTED TEXT	356 WORDS	97%	MATCHING TEXT	356 WORDS

Western Region: This region extends from Colorado in the interior to the California on the west. Among the steel region in the USA, this is a new region. The first steel mill, although had been setup in 1882 at Pueblo. Later on steel industries were developed at Fontana in California and Provo at Utah. For these plants, iron ore is obtained from Wyoming and coal from Colorado. Russia-Ukraine (erstwhile USSR) : Prior to disintegration in 1991, USSR was the leading steel-producing country of the world. Now also Russia and Ukraine are important iron and steel producers of the world. Russia ranks 4th in the production of pig iron and crude steel, while Ukraine stands 8th in world ranking. In the post-revolution period, the Soviet steel industry had achieved a remarkable expansion. During the Second World War, however, the Soviet iron and steel industry was affected badly. Most of the large production centres were either destroyed or damaged. However, soon the country recovered and by 1975 became the largest producer of iron and steel in the world. The four important iron- and steel-producing regions are: • Ural Region : It lies on both sides of the Urals. The major steel centres of this region are - Magnitogorsk, Chelyabink, Nizhnitagil, Sverdlovsk, Serov, Perm, Orsk, etc. Magnitogorsk is the largest steel-producing centre of Russia. • Kuznetsk or Kuzbas Region : It is located in the north of the Alai Mountains and south of Tomsk. This steel region is coal-based. The supply of iron ore is from the Ural region. Novokuznetsk is the leading steel centre of this region. • Moscow Region : Important centres of iron and steel in this region are Tula, Lipetsk, Cherepovetsk and Gorky. 68 NSOU ● CC-GR-10 • Others : Other regions are isolated and developed in various parts. These are Baikal, St. Petersburg, Lower Amer valley and Pacific coastal region. Ukraine : Now, Ukraine has 8th position in world s production of iron and steel. In this region all the raw materials, i.e., iron ore, coal, limestone, manganese are available for steel production. A dense network of railways and cheap water transport facilitate the growth and development of iron and steel industry, The main centres of iron and steel plants are Krivoirog, Kerch, Zhdanow, Tagarerog, Zaporozhye, Pittsburgh, Dniepropetrovsk, etc. Other notable steel-producing centres are Tbilisi, Tashkent and Bogovat in Uzbekistan and Tamir Tan in Kazakhstan.

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52/74	SUBMITTED TEXT	30 WORDS	83%	MATCHING TEXT	30 WORDS

Pig iron Crude steel China 131.23 128.5 Japan 80.5 105.4 USA 47.9 102.0 Russia 43.3 55.5 Germanv 27.3 41.7 South Korea 24.8 43.4 Brazil 27.7 27.8 Ukraine 25.7 31.7 India 21.3 26.9 France 13.6 20.0 Italv 10.9 26.6 Great Britain 10.9 16.1

SA GE 302.pdf (D109199360)

53/74	SUBMITTED TEXT	173 WORDS	97%	MATCHING TEXT	173 WORDS

Some of the major Iron and Steel Plants of India are as follows : Tata Iron and Steel Company (TISCO) : This is the oldest iron and steel centre of India. It is a private sector enterprise. It was established in 1907 by Jamshedji Tata at Sakchi in Singhbhum district of Jharkhand. Later on, it was renamed as Jamshedpur after Jamshedji. It started producing pig iron in 19 I 1 and steel in 1912. The plant initially had capacity of producing 1.21 million tonnes of pig iron and 1.1 million tonnes of steel per annum. This capacity has been enhanced to 3.9 million tonnes of pig iron, 2 million tonnes of ingot steel and 3 million tonnes of saleable steel. Currently it produces about 3 million tonnes of saleable steel. Following facilities are available to this centre : NSOU ● CC-GR-10 71 ? High grade haematite iron ore is available from Noamundi mines of Singhbhum in Jharkhand and Gurumahisani mines of Mayurbhanj in Orissa. These mines are located at a distance of 75-100 km from Jamshedpur. ? Coal is available from Jharia and Raniganj. Coal mines

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54/74	SUBMITTED TEXT	270 WORDS	97%	MATCHING TEXT	270 WORDS

SUBMITTED TEXT

to 200 km from Jamshedpur. ? Manganese comes from Joda mines of Kenduj har district in Orissa. ? Dolomite, limestone and fire clay used as flux material are available from Sundargarh district of Orissa. ? Kolkata, located at a distance of 250 km, provides port facilities and its industrialised hinderland provides market for the products. ? Sufficient water for cooling purposes is obtained from Subarnarekha River. In addition to this, the storage dam on Kharkai River also provides water. ? Jamshedpur is well connected with Kolkata, Mumbai and Chennai by road and rail and enjoys good transport facilities. ? Densely populated regions of Jharkhand, Bihar and Orissa provide cheap labour. Major part of labour is drawn from tribal areas of Chota Nagpur plateau. Indian Iron and Steel Company (IISCO): Three plants at Kulti, Hirapur and Bumpur in West Bengal were set up in 1864, 1908 and 1937 respectively. These plants have been merged together and are known as Indian Iron and Steel Company (IISCO). It was brought under government control and management in July 1972. The three plants are linked by Kolkata-Asansol railway line. Hirapur plant produces pig iron which is sent to Kulti for making steel. The rolling mills are located at Bumpur. IISCO enjoys the following advantages : ? Iron ore is available from Guna mines in Singhbhum district of Jharkhand located at a distance of 285 km. Some iron ore is also obtained from Mayurbhanj area of Orissa. ? It used to receive coal from Jharia, located at a distance of 137 km but now the power from the Damodar Valley Corporation is extensively used. ? Dolomite and limestone are obtained from Sundargarh district of Orissa which is 327 km away. Limestone is also available from Gangpur and Paraghat areas of Orissa. 72

MATCHING TEXT

to 200 km from Jamshedpur.(iii) Manganese comes from Joda mines of Kendujhar district in Orissa.(Dolomite, limestone and fire clay used as flux material are available from Sundargarh district of v) Kolkata, located at a distance of 250 km, provides port facilities and its industrialised hinterland provides market for the products.(vi) Sufficient water for cooling purposes is obtained from Subanarekha River. In addition to this, the storage dam on Kharkai River also provides water.(vii) Jamshedpur is well connected with Kolkata, Mumbai and Chennai by road and rail and enjoys good transport facilities.(viii) Densely populated regions of Jharkhand, Bihar and Orissa provide cheap labour. Major part of labour is drawn from tribal areas of Chota Nagpur plateau. 2. Indian Iron and Steel Company (IISCO): Three plants at Kulti, Hirapur and Bumpur in West Bengal were set up in 1864, 1908 and 1937 respectively. These plants have been merged together and are known as Indian Iron and Steel Company (IISCO).It was brought under government control and management in July 1972. The three plants are linked by Kolkata-Asansol railway line. Hirapur plant produces pig iron which is sent to Kulti for making steel. The rolling mills are located at Bumpur. IISCO enjoys the following advantages:(i) Iron ore is available from Guna mines in Singhbhum district of Jharkhand located at a distance of 285 km. Some iron ore is also obtained from Mayurbanj area of Orissa.(It used to receive coal from Jharia, located at a distance of 137 km but now the power from the Damodar Valley Corporation is extensively used.(Dolomite and limestone are obtained from Sundargarh district of Orissa which is 327 km away. Limestone is also available from Gangpur and Paraghat areas of Orissa. (

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55/74	SUBMITTED TEXT	339 WORDS	95%	MATCHING TEXT	339 WORDS

lakh tonnes of steel. Currently it produces over 4 lakh tonnes of pig iron, more than 3.5 lakh tonnes of crude steel and around 3.8 lakh tonnes of saleable steel. The Visweswaraya Iron and Steel Ltd : It was established as Mysore Iron and Steel Company (MISCO) in 1923 by the erstwhile state of Mysore. It is located at Bhadravati on the banks of river Bhadravati in Shimoga district of Karnataka. This plant was brought under state control in 1962 and was renamed as Visveswaraya Iron and Steel Ltd. after the name of great engineer Dr. Yisweswaraya. This plant has got a capacity of 1.38 lakh tonnes of steel. There are plans to raise its capacity to two lakh tonnes. This centre enjoys the following advantages. ? Bhadravati valley is 13 km wide as a result of which enough land is available. ? High grade haematite iron ore is brought from Kemmangundi mines in Chikmaglur which is just 40 km away. ? At the time of the setting up of the plant in 1923 the charcoal obtained from the forest-wood was used for smelting because coal was not available. Now it uses hydroelectric power obtained from Sharavati Power Project. ? Limestone is available from Bhundigudajust 25 km away. ? Shimoga and Chitradurga supply manganese. These areas are just 50 km away. ? Dolomite and chromite are also available within a radius of 45-50 km. ? It lies on the main Birn-Shirnoga railway line and makes use of railway facilities. In order to increase the production of iron and steel, the Government of India established The Hindustan Steel Limited in public sector. Consequently, three plants under the public sector, i.e. Bhilai, Rourkela and Durgapur came into operation during the Second Five Year Plan. Capacity of each plant was fixed at IO lakh tonnes of steel which was expanded during the Third Five Year Plan and a proposal of setting up a steel plant at Bokaro was also made. NSOU ● CC-GR-10 73 Bhilai : Bhilai iron and steel centre was set up in Durg district of Chhattisgarh in 1957 with the technical and financial support of the then Soviet Union. It started production in 1959. Its initial capacity was

lakh tonnes of steel. Currently it produces over 4 lakh tonnes of pig iron, more than 3.5 lakh tonnes of crude steel and around 3.8 lakh tonnes of saleable steel. 3. The Visweswaraya Iron and Steel Ltd: It was established as Mysore Iron and Steel Company (MISCO) in 1923 by the erstwhile state of Mysore. It is located at Bhadravati on the banks of river Bhadravati in Shimoga district of Karnataka. This plant was brought under state control in 1962 and was renamed as Visveswaraya Iron and Steel Ltd. after the name of great engineer Dr. Visweswaraya. This plant has got a capacity of 1.38 lakh tonnes of steel. There are plans to raise its capacity to two lakh tonnes. This centre enjoys the following advantages.(i) Bhadravati valley is 13 km wide as a result of which enough land is available.(High grade haematite iron ore is brought from Kemmangundi mines in Chikmaglur which is just 40 km away.(At the time of the setting up of the plant in 1923 the charcoal obtained from the forest-wood was used for smelting because coal was not available. Now it uses hydroelectric power obtained from Sharavati Power Project.(iv) Limestone is available from Bhundiguda just 25 km away.(v) Shimoga and Chitradurga supply manganese. These areas are just 50 km away.(vi) Dolomite and chromite are also available within a radius of 45-50 km.(vii) It lies on the main Bim- Shimoga railway line and makes use of railway facilities. In order to increase the production of iron and steel, the Government of India established The Hindustan Steel Limited in public 21 sector. Consequently, three plants under the public sector, i.e. Bhilai, Rourkela and Durgapur came into operation during the Second Five Year Plan. Capacity of each plant was fixed at 10 lakh tonnes of steel which was expanded during the Third Five Year Plan and a proposal of setting up a steel plant at Bokaro was also made. 4. Bhilai: Bhilai iron and steel centre was set up in Durg district of Chhattisgarh in 1957 with the technical and financial support of the then Soviet Union. It started production in 1959. Its initial capacity was 10

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56/74	SUBMITTED TEXT	349 WORDS	96%	MATCHING TEXT	349 WORDS

Submitted text:

lakh tonnes which has been raised to 52 lakh tonnes. Durg happens to be a backward area and the purpose of setting this plant was to bring prosperity to this area. This plant produced 41.87 lakh tonnes_ of crude steel, 38.32 lakh tonnes of saleable steel and 2.43 lakh tonnes of pig iron in 1996- 97. It enjoys following geographical advantages: ? It procures rich haematite iron ore from Dalli-Rajhara range which is 80 km south of Bhilai. ? Coal is obtained from Korba and Kargali fields of Chhattisgarh located at 225 km away. Bokaro and Jharia (720 km) also supply coal. ? Limestone comes from Nandini mines hardly 24 km away. ? Bhandara of Maharashtra and Balaghat of Madhya Pradesh supply manganese. ? The Korba Thermal Power station is the main source of power. ? It is connected with Kolkata-Nagpur railway line. ? Dolomite comes from Bilaspur. ? Cheap labour is available from the nearby areas. Rourkela : Plant of Hindustan Steel Limited at Rourkela is situated in the Sundargarh district of Orissa It was set up with the help of the then West German firm, Krupps and Demang, during tte Second Five Year Plan (West Germany and East Germany have united to form one country now). It became operative in 1959. It produced 12.40 lakh tonnes of crude steel, 11.80 lakh tonnes of saleable steel and 0.54 lakh tonnes of pig iron in 1996-97. This plant has the following facilities for its successful operation: ? This plant uses iron ore obtained from Sundargarh and Keonjhar districts. These iron ore sources are located within a distance of77 km from the site of the plant. 74 NSOU ● CC-GR-10 ? Coal is obtained from Jharia coalfields located at a distance of 225 km and Talcher, located at a distance of 169 km. ? Hydro-electric power is obtained from Hirakud Power Project, located at a distance of 150km. ? The plant receives manganese from Barajmda, dolomite from Baradwar and limestone from Pumapani. These materials are located within a radius of 222 km in Orissa. ? It is located on the main Nagpur-Kolkata railway line and enjoys facilities of railway transport. ? Kolkata provides the port facilities and its hinterland serves as market. Durgapur : This plant of The Hindustan Steel Ltd. is located at Durgapur in

Matching text:

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57/74 SUBMITTED TEXT 171 WORDS	96% MATCHING TEXT 171 WORDS
Bardhaman district of West Bengal. It was set up in 1959 with the help of the United Kingdom. The production started in 1962. It has a total capacity of 35 lakh tonnes. It produced 12.45 lakh tonnes of crude steel, I 0.93 lakh tonnes of saleable steel and 1.14 lakh tonnes of saleable pig iron in 1996-97. The Alloy Steel Plant at Durgapur has a capacity to produce 1.6 lakh tonnes of ingot steel which has been expanded to 2. lakh tonnes of crude steel. The following geographical factors favour its location and growth. ? Iron ore comes from Boiani mines. Mayurbhanj also supplies iron ore. These areas are located within a radius of 320 km. ? Coal comes from Jharia and Raniganj. ? Limestone is obtained from Birmitrapur in Sundargarh and manganese from Keonjhar district of Orissa. ? Dolomite is supplied by Birmitrapur. ? Hydroelectricity is available from Damodar Valley Corporation. ? Plenty of water is available from Durgapur Barrage built across Damodar River. ? The Kolkata-Asansol railway line links it with other parts of the country. ? Cheap labour is readily available from the surrounding areas.	Bardhaman district of West Bengal. It was set up in 1959 with the help of the United Kingdom. The production started in 1962. It has a total capacity of 35 lakh tonnes. It produced 12.45 lakh tonnes of crude steel, 10.93 lakh tonnes of saleable steel and 1.14 lakh tonnes of saleable pig iron in 1996-97.The Alloy Steel Plant at Durgapur has a capacity to produce 1.6 lakh tonnes of ingots steel which has been expanded to 2. lakh tonnes of crude steel. The following geographical factors favour its location and growth.(i) Iron ore comes from Bolani mines. Mayurbhanj also supplies iron ore. These areas are located within a radius of 320 km.(ii) Coal comes from Jharia and Raniganj.(iii) Limestone is obtained from Birmitrapur in Sundargarh and manganese from Keonjhar district of Orissa.(iv) Dolomite is supplied by Birmitrapur.(Hydroelectricity is available from Damodar Valley Corporation.(vi) Plenty of water is available from Durgapur Barrage built across Damodar River.(The Kolkata-Asansol railway line links it with other parts of the country.(viii) Cheap labour is readily available from the surrounding areas. 22 7.

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58/74	SUBMITTED TEXT	515 WORDS	98%	MATCHING TEXT	515 WORDS

Submitted text:

Bokaro : A new public sector company, the Bokaro Steel Ltd. was formed in 1964 to erect a steel plant with the collaboration of the eartwhile Soviet Union at Bokaro near the confluence of the Bokaro and Damodar rivers in Hazaribagh district of Jharkhand. It is the second plant set up with the Soviet help. It started production in 1972. Its initial capacity was 10 lakh tonnes which was raised to 40 lakh tonnes. There are plans to raise its capacity to I 00 lakh tonnes making it the largest iron and steel making centre in India. It produced 36.44 lakh tonnes of crude steel, 30.46 lakh tonnes of saleable steel and 2.6 lakh tonnes of pig iron in 1996-97. This achievement has been made possible due to following few geographical factors: ? It receives iron ore from Kiriburu mine in Orissa. ? Coal is obtained from Jharia coalfields located at a distance of 65 km. ? Limestone comes from Palamu district of Jharkhand. ? Hydroelectricity is obtained from Damodar Valley Corporation. ? Kolkata is just 300 km from here and provides port facilities. Three more steel plants were planned during the Fourth Five-Year Plan in order to meet the growing requirement of steel. These plants are located at Salem in Tamil Nadu, Vishakhapatnam in Andhra Pradesh and Vijayanagar in Karnataka. The Salem Steel Plant: The plant has been set up at Salem in the Salem district of Tamil Nadu. The plant has the advantage of rich iron ore and limestone, which is readily available in the adjoining areas. It also enjoys the facilities of cheap power, charcoal and vast market. The iron ore available here has low sulphur and phosphorus content and is suitable for producing special grade iron and steel. The plant started commercial production in 1982. Its capacity was 32 thousand tonnes of stainless steel sheets in the beginning. This capacity was doubled in 1991 with the addition of another rolling mill. This capacity was further raised to 80 thousand tonnes of saleable steel in 1995-96. Today the Salem Steel Plant is a major producer of world class stainless steel and is in a position to export stainless steel to some of the advanced countries such as the USA, Mexico, Australia and some countries of South-East Asia. 76 NSOU ● CC-GR-10 In order to cater to the growing demand for coinage of the Indian Government Mints, the management had also set up a blanking facility in 1993 with a capacity of 3,000 tonnes per annum. It also commissioned a hot rolling facility in November, 1995 which has state- of-the-art technology with high level of automation. This plant produced 48 thousand tonnes of saleable steel in 1995-96. Vijayanagar Steel Plant : This plant has been set up at Tomagal near Hospet in Bellary district of Karnataka. It has the installed capacity

Matching text:

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of 30 lakh tonnes. The production of mild steel will be its special feature. This plant enjoys the following facilities: ? Iron ore is obtained from Hospet region located in close proximity. ? Coal comes from Kanhan valley in Chhattisgarh and Singareni coal fields in Andhra Pradesh. ? Good quality limestone and dolomite is available at a distance of about 200 km. ? Water and power requirements are met by the Tungabhadra hydel project located at a distance of about 36 km from the plant. Another steel plant	the installed capacity of 30 lakh tonnes. The production of mild steel will be its special feature. This plant enjoys the following facilities:(i) Iron ore is obtained from Hospet region located in close proximity.(ii) Coal comes from Kanhan valley in Chhattisgarh and Singareni coal fields in Andhra Pradesh.(iii) Good quality limestone and dolomite is available at a distance of about 200 km.(iv) Water and power requirements are met by the Tungabhadra hydel project located at a distance of about 36 km from the plant. 10. Vishakhapatnam Steel Plant (

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59/74 SUBMITTED TEXT 68 WORDS	97% MATCHING TEXT 68 WORDS
Vishakhapatnam Steel Plant (VSP): This integrated steel plant has a unique location on the sea port. In fact, it is the first shore based steel plant in the country. Although the foundation stone of the plant was laid in 1972, the construction work could not start in the real sense till February 1982 when Rashtriya !spat Nigam Limited was incorporated as a public sector company to implement the construction of the plant. The	Vishakhapatnam Steel Plant (VSP): This integrated steel plant has a unique location on the sea port. In fact, it is the first shore based steel plant in the country. Although the foundation stone of the plant was laid in 1972, the construction work could not start in the real sense till February 1982 when Rashtriya Ispat Nigam Limited was incorporated as a public sector company to implement the construction of the plant. In the

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60/74 SUBMITTED TEXT 70 WORDS	93% MATCHING TEXT 70 WORDS
In the year 1997-98, this plant produced 32.14 lakh tonnes of hot metal, 25.4 lakh tonnes of liquid steel, 22.5 lakh tonnes of saleable steel and 7.7 lakh tonnes of pig NSOU ● CC-GR-10 77 iron. It is a major export oriented steel plant and takes full advantage of its coastal location. In 1995-96, it exported 10.23 lakh tonnes of iron and steel worth Rs. 702 crore, mainly to China and south-east Asian countries.	In the year 1997-98, this plant produced 32.14 lakh tonnes of hot metal, 25.4 lakh tonnes of liquid steel, 22.5 lakh tonnes of saleable steel and 7.7 lakh tonnes of pig iron. It is a major export oriented steel plant and takes full advantage of its coastal location. In 23 1995-96, it exported 10.23 lakh tonnes of iron and steel worth Rs.702 crore, mainly to China and south-east Asian countries.

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61/74	SUBMITTED TEXT	473 WORDS	98%	MATCHING TEXT	473 WORDS

of her depleted resources she produced in 1939 more than the 1913 production of steel. In 1937 she had established the great Heimann Goering Steel Works at Salzgitter to utilise the grade ores in its Harz Mts. The division of Germany was the main cause of lower status in terms of iron and steel production. But after re-unification of East and West Germany in 1990, the countty is now one of the leading steel-producing countries in the world and ranks 5th in the world with an annual production of27.3 crore tons of pig iron and 41.7 crore tons of crude steel. The most important centre of iron and steel industry in Germany is the Rhenish-Westphalia, contributing more than 80 per cent of the steel produced in Germany, and 85 per cent of pig iron. It manufactures a wide variety of specialities. Other regions of importance are the Siegerland Hessen-Nassau, Northern and Central Germany, Saxony, and South Germany. The greatest centre is Essen in the Ruhr valley where the world famous works of Krupp are situated. South Korea : South Korea is the 6th leading country of the world in iron and steel production. It is the third Asian country after China and Japan which produces high-grade steel. Its annual production is 24.8 crore tons of pig iron and 43.4 crore tons of crude steel. Brazil : Brazil is the 7th ranking country in iron and steel production in the world. Its annual production is 27.7 crore tons of pig iron and 27.8 crore tons of steel. The development of the production of steel in Brazil has been spectacular. Since 1973, production of steel has witnessed more than 300 per cent increase. The consumption of steel within the country is very low. 70 NSOU ● CC-GR-10 Therefore, Brazil is able to export bulk of her steel production. Most of the steel industries are located around Sao-Paulo and Curumba. Brazil possesses vast amount of iron ore. The largest of these deposits is located near Minas-Gerraes. Another large steel plant is located at Santa Catarina. Most of the mills obtain energy from hydel-power plants. India : India has a long history of the use of iron and steel. However, it was only after the first decade of the 20th century that manufacture of iron and steel as a modern industry made a beginning in this country. It was in 1911 that India's first iron and steel plant - the Tata Iron and Steel Company Ltd. (TISCO) was set up in Jamshedpur in Bihar in private collaboration with a US firm. Nearly three and a half decades later another plant was launched at Burnpur in neighbouring Bengal - the Indian Iron and Steel Company Ltd. (IISCO) — with British participation. At the commencement of Five-Year Plans (1951) there were three steel plants located at Jamshedpur, Asansol and

Bhadravati. Not only capacity of these plants was increased but six integrated plants in public sector have been established at Durgapur, Rourkela, Bhilai, Bokaro, Vishakhapatnam and Salem, Apart from these more than 140 mini steel plants have also been set

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62/74	SUBMITTED TEXT	105 WORDS	96%	MATCHING TEXT	105 WORDS

SUBMITTED TEXT	MATCHING TEXT
The plant has the following advantages : ? The coastal location facilitates for import of coal and export of iron and steel. ? It is well connected to coal fields of Damodar valley in Jharkhand. Metallurgical coal is imported from Australia which meets about 70 per cent power requirements. ? The plant has a bright future with respect to its energy requirements because there are plans to replace coal imported from Australia by natural gas from the Krishna-Godavari basin. ? High quality rich iron ore deposits are available in the Bailadila area of Chhattisgarh. ? Most of the requirements of limestone, dolomite and manganese are met by supplies from Chhattisgarh; Madhya Pradesh and Orissa. 78	The plant has the following advantages:(i) The coastal location facilitates import of coal and export of iron and steel.(ii) It is well connected to coal fields of Damodar valley in Jharkhand. Metallurgical coal is imported from Australia which meets about 70 per cent power requirements.(iii) The plant has a bright future with respect to its energy requirements because there are plans to replace coal imported from Australia by natural gas from the Krishna-Godavari basin.(iv) High quality rich iron ore deposits are available in the Bailadila area of Chhattisgarh.(v) Most of the requirements of limestone, dolomite and manganese are met by supplies from Chhattisgarh; Madhya Pradesh and Orissa. 11.

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63/74	SUBMITTED TEXT	32 WORDS	82%	MATCHING TEXT	32 WORDS

up to meet the growing internal demand. India contains largest iron ore deposits in the world and also has coal reserves, therefore, having very good prospects of further growth of iron and steel industry.

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64/74	SUBMITTED TEXT	11 WORDS	90%	MATCHING TEXT	11 WORDS

is the second largest producer of iron and steel in the

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65/74	SUBMITTED TEXT	36 WORDS	45%	MATCHING TEXT	36 WORDS

The plant management intends to go in for massive upgradation of technology and skill of its personnel which will be required if the natural gas from the Krishna-Godavari basin is to be utilised to cut down

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66/74	SUBMITTED TEXT	10 WORDS	73%	MATCHING TEXT	10 WORDS

Ambala-Amritsar in Haryana-Punjab o Saharanpur-Muzaffarnagar-Bijnaur in Uttar Pradesh. o Indore-Dewas-Ujjain in

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67/74	SUBMITTED TEXT	17 WORDS	80%	MATCHING TEXT	17 WORDS

of the multiplicity of controls and clearances, the absence of world-class infrastructure and an unstable fiscal regime.

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68/74	SUBMITTED TEXT	22 WORDS	57%	MATCHING TEXT	22 WORDS

SEZ Rules, came into effect on 10th February, 2006, providing simplification of procedures and single window clearance on matters relating to Central

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69/74	SUBMITTED TEXT	12 WORDS	100%	MATCHING TEXT	12 WORDS

industries that produce a finished, usable product or are involved in construction.

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70/74	SUBMITTED TEXT	16 WORDS	100%	MATCHING TEXT	16 WORDS

ground facilities for operation; and (ii) availability of traffic for economic working. Air transport is still

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71/74	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

is best suited for the carriage of commodities which are low in bulk but high in value.

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72/74	SUBMITTED TEXT	18 WORDS	55%	MATCHING TEXT	18 WORDS

India is one of the leading exporters of tea in the world. 18.38 percent of India's tea is

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73/74	SUBMITTED TEXT	9 WORDS	100%	MATCHING TEXT	9 WORDS

pp.1-2. Khullar, D.R.(2006), India- a Comprehensive Geography. Kalyani Publishers,

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74/74	SUBMITTED TEXT	15 WORDS	65%	MATCHING TEXT	15 WORDS

the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development (the World Bank). 11.4

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