



Netaji Subhas Open University

HB T: Honours in Botany [B.Sc. (Honours)]

Syllabus

❖ Programme Objectives:

Three years CBCS B.Sc. Botany Hons. programme is formulated for developing competent botanist for which significant job opportunities exist in this country. The programme is interdisciplinary in nature. The learner graduating with the Degree B.Sc. in Botany (Hons.) should be able to acquire-

✓ **Core competency:**

- Botany being an integral part of studies in Biological sciences, the learners will gain from core knowledge in general on all fundamental processes that encompass life and will acquire competency in the subject Botany and all allied areas of Life Sciences. The student will become familiar with all major plant groups, will be able to compare them and will benefit from critical knowledge on their forms, classification, characterization and exploitation.
- Students will become familiar with the world of microorganisms and the programme will keep themselves abreast with classical as well as modern developments in the microbiology, particularly in relation to the huge role they play in sustaining the living world.
- Learners will be able to use the evidence based comparative botany approach to explain the evolution of organism and understand the genetic diversity on the earth.
- Students will be able to explain various plant physiological processes and functions, metabolism, concepts of gene, genome and how an organism's function is influenced at the levels of cells, tissues and organs respectively.
- Learners will be able to understand adaptation, development and behavior of different forms of life. The understanding of networked life on earth and tracing the energy pyramids through nutrient flow will make the learner better

equipped specialists in sustenance and improvement of environment both in micro and macro level.

- Learners will have plenty of opportunities in gaining hands on training in modern biological techniques through an integrated demonstration and application based core curriculum .

✓ **Analytical ability:**

- Learners will be able to demonstrate the knowledge in understanding research and addressing practical problems.

✓ **Critical Thinking and problem solving ability:**

- At the end of this programme, Learners will become critical thinker and acquire problem solving capabilities.

✓ **Digitally equipped:**

- Learners will acquire digital skills and integrate the fundamental concepts with modern tools. They will familiar with different educational platform viz. SWAYAM, MOOCs, NSOU_LMS, NSOU_e-Resources (digital library), NSOU_Mobile apps etc.

✓ **Ethical and Psychological strengthening:**

- Learners will also strengthen their ethical and moral values and shall be able to deal with different psychological weaknesses. It will be helpful to prepare the students to accept the challenges in upcoming life.

✓ **Social Interaction::**

- Learners will learn team workmanship in order to serve the institutions, industry and society more efficiently. Elicit views of others, mediate disagreements and help reach conclusions in group settings.

✓ **Environment and Sustainability:**

- Learners will be able to understand the issues of environmental contexts and sustainable development.

✓ **Independent Learner:**

- Apart from the subject specific skills, generic skills, especially in botany, the program outcome would lead to gain knowledge and skills for further higher studies, competitive examinations and employment. Learning outcomes based curriculum would ensure equal academic standards across the country and

broader picture of their competencies. The freshers and existing workforce can take the advantage of ODL system to increase their skills and competencies without disturbing their work schedule.

❖ **Expected Learning Outcome:**

The goal of the HBT_syllabus is to make the study of Botany popular, interesting and encouraging to the learners for higher studies including research. The new and updated syllabus for all the three years are based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other Universities and the needs of industries and research. The Core Courses (CC) would strengthen the learners with in-depth subject knowledge. Concurrently, the Discipline Specific Electives (DSE) will add additional knowledge about applied aspects of the program as well as its applicability in both academia and industry. Generic Electives (GE) will introduce integration among various interdisciplinary courses. The Skill Enhancement Courses (SEC) would add additional skills related to the subject as well as those from outside the purview of the subject. After successful completion, the student graduated with this curriculum would be able to disseminate subject knowledge along with necessary skills to suffice their capabilities for academia, entrepreneurship and Industry. The curriculum is aimed at enhancing the employability of B.Sc. Botany graduate, as due importance is given to the development of core competence in the subject matter, both theoretical and practical, in relation to demand and outlook of the society. To expand the employability of graduates, a number of skill development courses have also been introduced in this framework.

❖ Programme Structure:

SEM	CODE	Course Name	Theory/ Prac.	Credit	Study Hours	TE Full Marks	Assig. Full Marks	Total Marks	Pass Marks 30%		
1 st Year	I	CC-BT-01	1. Phycology, Microbiology 2. Mycology and Phytopathology, 3. Archegoniatae	Practical	6	180	70	--	70	21	
		CC-BT-02	Phycology, Microbiology	Theory	6	180	50	20	70	21	
		AE-BG-11	* Bengali	Theory	2	60	50	20	70	21	
		AE-EG-12	* English								
		GE-01: # Refer Table below	Theory	6	180	50	20	70	21		
	II	CC-BT-03	Mycology & Phytopathology	Theory	6	180	50	20	70	21	
		CC-BT-04	Archegoniatae	Theory	6	180	50	20	70	21	
		AE-ES-21	Environmental Studies	Theory	2	60	50	20	70	21	
		GE-02: # Refer Table below	Theory	6	180	50	20	70	21		
	2 nd Year	III	CC-BT-05	1. Anatomy, Economic Botany 2. Morphology, Plant Systematics 3. Plant Ecology and Phytogeography	Practical	6	180	70	--	70	21
CC-BT-06			1. Biomolecules and Plant Metabolism 2. Plant Physiology, Reproductive Biology of Angiosperms	Practical	6	180	70	--	70	21	
CC-BT-07			Anatomy, Economic Botany	Theory	6	180	50	20	70	21	
GE-03: # Refer Table below			Theory	6	180	50	20	70	21		
SE-BT-11			Medicinal Botany	Theory	2	60	50	10	60	18	
IV		CC-BT-08	Morphology, Plant Systematics	Theory	6	180	50	20	70	21	
		CC-BT-09	Plant Physiology, Reproductive Biology of Angiosperms	Theory	6	180	50	20	70	21	
		CC-BT-10	Biomolecules, Plant Metabolism	Theory	6	180	50	20	70	21	
		GE-04: # Refer Table below	Theory	6	180	50	20	70	21		
		SE-BT-21	Plant Diversity and Human Welfare	Theory	2	60	50	10	60	18	
3 rd Year		V	CC-BT-11	1. Cell Biology 2. Plant Biotechnology 3. Genetics and Molecular Biology	Practical	6	180	70	--	70	21
			CC-BT-12	Genetics and Molecular Biology	Theory	6	180	50	20	70	21
			DS-BT-11	Stress Biology	Theory	6	180	50	20	70	21
	DS-BT-21		1. Stress Biology 2. Natural Resource Management 3. Plant Breeding	Practical	6	180	70	--	70	21	
	VI	CC-BT-13	Plant Ecology and Phytogeography	Theory	6	180	50	20	70	21	
		CC-BT-14	Cell Biology, Plant Biotechnology	Theory	6	180	50	20	70	21	
		DS-BT-31	Plant Breeding	Theory	6	180	50	20	70	21	
		DS-BT-41	Natural Resource Management	Theory	6	180	50	20	70	21	
		TOTAL				140				1800	

▪ **GE combination list:**

Subject	SEM-I: GE-01	SEM-II: GE-02	SEM-III: GE-03	SEM-IV: GE-04
Zoology	GE-ZO-11: Animal Diversity	GE-ZO-21: Aquatic Biology	GE-ZO-31: Insect Vector and Disease	GE-ZO-41: Food, Nutrition and Health
Chemistry	GE-CH-11: Basic Physical Chemistry	GE-CH-21: Basic Inorganic Chemistry	GE-CH-31: Basic Organic Chemistry	GE-CH-41: Application Oriented Chemistry
				GE-CH-42: Approved MOOCs ¹

* Learners have to choose any one from **AE-BG-11:** Bengali or **AE-EG-12:** English as Ability Enhancement Compulsory Course 1.

Learners have to choose any one course from each individual GE group of Semester I, II, III and IV.

❖ **Examination System Per Semester:**

	SEM-I	SEM-II	SEM-III	SEM-IV	SEM-V	SEM-VI
Core Course	CC-01, 02	CC-03, 04	CC-05, 06, 07	CC-08, 09, 10	CC-11, 12	CC-13, 14
Generic Elective	GE-01	GE-02	GE-03	GE-04	--	--
Discipline Specific	--	--	--	--	DSE-01, 02	DSE-03, 04
Ability Enhancement Compulsory Course	AECC-01	AECC-02	--	--	--	--
Skill Enhancement Course	--	-	SEC-01	SEC-02	--	--
Total No. of Course	4	4	5	5	4	4
Total Credits	20	20	26	26	24	24

Detailed Syllabus

❖ Core Course: CC-BT-01: (Credit-6 / Marks-70; TEE-70; ASSGN-0)

Practical (Phycology and Microbiology; Mycology and Phytopathology; Archegoniate)

- **Unit-1:** Microscopy and Micrometry.
- **Unit-2:** Bacterial Sample Preparation and Gram Staining (Curd).
- **Unit-3:** Preparation and identification: *Nostoc*, *Oedogonium* and *Ectocarpus*.
- **Unit-4:** Study of *Vaucheria* and *Polysiphonia*.
- **Unit-5:** Preparation and identification: *Rhizopus* and *Ascobolus*.
- **Unit-6:** Study of reproductive stages of *Penicillium*, *Puccinia* and *Agaricus* and study of morphological types of Lichens.
- **Unit-7:** Sterilization and inoculation techniques. Preparation Culture Media (slants and stabs).
- **Unit-8:** Study of some diseased plant specimens: **Late blight of potato, Stem rust of wheat, Brown spot of rice.**
- **Unit-9:** Work out and identification of *Marchantia*.
- **Unit-10:** Study of permanent slides of vegetative and reproductive stages of *Riccia*, *Anthoceros* and *Funaria*.
- **Unit-11:** Work out and identification of *Lycopodium* and *Pteris*.
- **Unit-12:** Identification of *Selaginella*, *Equisetum* and *Calamites*.
- **Unit-13:** External Morphological study, description and identification of *Cycas* and *Pinus*; vertical section of ovule of *Gnetum*.
- **Unit-14:** Description of T.S of stem of *Lyginopteris* and *Vertebraria*. Description of leaf of *Glossopteris*.

❖ Core Course: CC-BT-02: (Credit-6 / Marks-70; TEE-50; ASSGN-20)

Phycology and Microbiology

Block 1: Phycology

- **Unit-1: Introduction:** Definition and status of algae; history of Phycology; habit, habitats and ecology; general characteristics, pigments, chloroplast and flagella ultra structure; range of thallus structures in algae; concept of endosymbiosis (SET theory) and origin of algal chloroplast.
- **Unit-2:** Modern criteria of algal classification; classification systems by Fritsch (1935, 1945), Bold and Wynne (1985) and Lee (2008). Algal biotechnology and its application of algae: in bioremediation, agriculture (bio-fertilizers and other aspects), biotechnology (Microalgal food, Bio-diesel and Bio-ethanol production). Phycocolloids, Diatomaceous earth, Industrial applications.
- **Unit-3:** Modes of reproduction and life cycle patterns in algae.
- **Unit-4: Cyanophyta:** General characteristics, cells ultra-structure; heterocyst-structure and function. Cyanobacterial genetic recombination. Prochloron and its evolutionary status.
- **Unit-5: Chlorophyta:** General characteristics, life cycle of *Chlamydomonas*, *Volvox* and *Oedogonium*.
- **Unit-6: Charophyta:** Characteristic features; life cycle of *Coleochaete* and *Chara*; evolutionary significance of charophytes in origin of land plants.
- **Unit-7: Xanthophyta:** General characteristic; life cycle of *Vaucheria*.
- **Unit-8: Bacillariophyta:** General characteristic; cell structure; auxospore formation; economic importance of Diatoms including Diatomaceous earth.
- **Unit-9: Phaeophyta:** General characteristics; life cycle of *Ectocarpus* and *Fucus*.
- **Unit-10: Rhodophyta:** General characteristics; life cycle patterns, sexual reproduction and post fertilization events; life cycle of *Polysiphonia*.

Block-II: Microbiology

- **Unit-11: Virus-I:** Introduction, discovery, general characteristics, structures, symmetry of capsids, replication and multiplication (general account); nutritional types of nucleic acids in viruses (Baltimore classification).
- **Unit-12: Virus-II:** Bacteriophages – structure, life cycle and lysogenic cycle, plant viruses – structure and transmissions of TMV, viroids and prions.
- **Unit-13: Cellular organization of Bacteria-I:** basic differences between prokaryotic and eukaryotic cell, shape and size, cell membrane, cell wall – gram positive and gram negative, flagella, pili and fimbriae, capsule and slime, S-layer.
- **Unit-14: Cellular organization of Bacteria-II:** Bacteria genome, Nucleoid and Plasmid, Ribosome, Endospore, Inclusion bodies.
- **Unit-15: Bacterial Systematics:** Eubacteria and Archaebacteria – brief account of five kingdom and three domain classification, difference between Archaea and Bacteria.
- **Unit-16: Bacterial growth and Reproduction**– binary fission and population growth, phase of bacterial growth, generation time, growth conditions – temperature, oxygen, water activity, pressure and pH .
- **Unit-17: Genetic Recombination in Bacteria-I:** conjugation, F and Hfr donor, role of plasmid.
- **Unit-18: Genetic Recombination in Bacteria-II:** transformation and transduction, historical account of transformation, competence, uptake of DNA and expression, induced transformation, transduction – generalized and specialized.
- **Unit-19: Microbial Ecology:** Importance and scope of microbiology, aquatic habitat, bio-geochemical cycles, plant-microbe Interaction – tumorigenesis and nitrogen fixation, microbial infection of man.
- **Unit-20: Applied Microbiology:** Role of microbes in pharmaceutical industry, food industry and research.

❖ Core Course: CC-BT-03: (Credit-6 / Marks-70; TEE-50; ASSGN-20)

Mycology and Phytopathology

Block-I: Mycology

- **Unit-1: Introduction of true Fungi:** General characteristics. affinities with plants and animals, thallus organization, structure and composition of cell wall, nutrition, reproduction, homothallic and heterothallic nature. **Classification of fungi** (Ainsworth, 1973) up to sub-division with diagnostic characters and examples, economic importance of fungi.
- **Unit-2: Chytridiomycota and Zygomycota:** General characteristics, habitat, economic importance, thallus organization, reproduction, life cycle (based on word diagram).
- **Unit-3: Ascomycota:** general characters, habitat, economic importance, thallus organization, reproduction, types of fruit bodies. Classification and life cycle of Ascomycota.
- **Unit-4: Basidiomycota:** general characters, economic importance, thallus organization, reproduction, types of fruit bodies, classification and life cycle. **Cultivation technique of mushroom** (in brief).
- **Unit-5: Deuteromycota:** general characters, economic importance, thallus organization, reproduction, heterokaryosis and parasexuality, classification.
- **Unit-6: Myxomycota:** present status, habitat, classification, vegetative body, fructification. **Oomycota:** present status, habitat, thallus organization, life cycle with reference to *Phytophthora*.
- **Unit-7:** Life cycle of *Rhizopus* and *Penicillium*.
- **Unit-8:** Life cycle of *Agaricus* and *Helminthosporium*.
- **Unit-9: Lichen:** habitat, types, vegetative and reproductive structures, specialized structures,

economic and ecological importance. **Mycorrhiza:** types and their characteristics, economic importance.

Block-II: Phytopathology

- **Unit-10:** Some relevant terms and their definitions.
- **Unit-11:** General symptoms of plant diseases.
- **Unit-12:** Spread of disease and physiological effects of pathogen.
- **Unit-13:** Chemical and external features of infection.
- **Unit-14:** Defence mechanism of plants.
- **Unit-15:** Control of plant diseases.
- **Unit-16:** Some common plant diseases.
- **Unit-17:** Diagnoses of some diseases affecting Indian crops.

❖ **Core Course: CC-BT-04: (Credit-6 / Marks-70; TEE-50; ASSGN-20)**

Archegoniate (Bryophyte + Pteridophyte + Gymnosperm)

- **Unit-1:** Bryophyta: Introduction, general characteristics. Modern classification of Bryophytes (Crandal-Stotler and Stotler 2009) up to class.
- **Unit-2:** General features, life cycle of *Riccia*, *Marchantia*, *Porella*, *Anthoceros* and *Funaria* (developmental stages not included).
- **Unit-3:** Ecological and economic importance of Bryophytes with special reference to *Sphagnum*.
- **Unit-4:** Pteridophytes: general characteristics of Pteridophytes. Classification of Pteridophytes up to class (Sporne, 1975).
- **Unit-5:** General features, life cycle of *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum* and *Pteris* (developmental stages not included).
- **Unit-6:** General characters of *Cooksonia*, *Rhynia* and *Lepidodendron*.
- **Unit-7:** Apogamy. Apospory, Heterospory and Seed habit. Origin and evolution of Pteridophytes. Telome concept and its significance. Stelar evolution. Economic importance of Pteridophytes.
- **Unit-8:** Characteristics of Gymnosperms and their classification.
- **Unit-9:** General features, life cycle of *Cycas*, *Pinus* and *Gnetum* (developmental stages not included).
- **Unit-10:** General features of *Lyginopteris*, *Williamsonia* and *Cordaites*.
- **Unit-11:** Ecological and Economic importance of Gymnosperms.

❖ **Core Course: CC-BT-05: (Credit-6 / Marks-70; TEE-70; ASSGN-0)**

Practical (Anatomy, Economic Botany; Morphology, Plant Systematics; Plant Ecology and Phytogeography)

Block-I: Anatomy

- **Unit-1:** Identification of anatomical structures with reasons (from permanent slide). Parenchyma and Collenchyma.
- **Unit-2:** Identification of anatomical structures with reasons (from permanent slide): Sclerenchyma.
- **Unit-3:** Identification of anatomical structures with reasons (from permanent slide): Sclereids and Tracheids.
- **Unit-4:** Identification of anatomical structures with reasons (from permanent slide): Trachea and Sieve Tube.
- **Unit-5:** Identification of anatomical structures with reasons (from permanent slide): Different types of vascular bundles.
- **Unit-6:** Identification of anatomical structures with reasons (from permanent slide): Different types of stomata.
- **Unit-7:** Identification of anatomical structures with reasons (from permanent slide): Trichomes and Lenticel.

- **Unit-8:** Study of secondary growth (permanent slides should be prepared by the students): *Boerhavia* and *Bignonia* stem.
- **Unit-9:** Study of secondary growth (permanent slides should be prepared by the students): *Dracaena* stem and *Tinospora* root.
- **Unit-10:** Ecological anatomy- Study of anatomical features of *Hydrilla* stem, *Nymphaea* petiole (hydrophytes), *Nerium* leaf (xeromorph) and *Vanda* root (epiphytes).

Block-II: Economic Botany

- **Unit-11:** Beverages: Tea (plant specimen, tea leaves).
- **Unit-12:** Essential oil-yielding plants: Habit sketch of *Rosa*, *Vetiveria* (specimens/ photographs).
- **Unit-13:** Essential oil-yielding plants: Habit sketch of *Santalum* and *Eucalyptus* (specimen/photographs).
- **Unit-14:** Rubber: specimen, photograph/model of tapping, samples of rubber products.
- **Unit-15:** Drug-yielding plants: Specimens of *Digitalis*, *Papaver* and *Cannabis*.

Block-III: Morphology

- **Unit-16:** Study of cohesion and adhesion of stamen and carpel.
- **Unit-17:** Types of inflorescence, placentation.

Block-IV: Plant Systematics

- **Unit-18:** Taxonomic study of angiospermic plants : *Brassica sp*, *Sida sp*, *Cassia sp*, *Coccinia cordifolia*.
- **Unit-19:** Taxonomic study of angiospermic plants: *Solanum sp*, *Leonurus sibiricus*, *Leucus sp*, *Oldenlandia sp*, *Ixora sp*.

Block-V: Plant Ecology and Phytogeography

- **Unit-20:** Study of Community structure by quadrat method.
- **Unit-21:** Preparation and submission of ten herbarium specimens of different taxa.
- **Unit-22:** Determination of pH of various soil and water samples (pH meter, Universal indicator/Lovibond comparator and pH paper).

❖ Core Course: CC-BT-06: (Credit-6 / Marks-70; TEE-70; ASSGN-0)

Practical (Biomolecules and Plant Metabolism; Plant Physiology; Reproductive Biology of Angiosperms)

Block-I: Biomolecules and Plant Metabolism

- **Unit-1:** Detection of organic acids: Citric and Tartaric.
- **Unit-2:** Detection of organic acids: Oxalic and Malic.
- **Unit-3:** Detection of titrable acidity from plant sample.
- **Unit-4:** Detection of Carbohydrate from plant samples.
- **Unit-5:** Detection of protein from plant samples.
- **Unit-6:** Detection of Ca, Mg from plant sample.
- **Unit-7:** Detection of Fe, and S from plant sample.
- **Unit-8:** Estimation of dissolved oxygen content from water samples.
- **Unit-9:** Estimation of catalase activity from plant materials by colorimetric method and amino nitrogen by titrimetric method.
- **Unit-10:** To compare the rate of respiration in different parts of a plant.

Block-II: Plant Physiology

- **Unit-11:** Preparation of solutions (% and Molar).

- **Unit-12:** Demonstration of osmotic pressure by plasmolytic method using *Rhoeo* leaf.
- **Unit-13:** Determination of osmotic pressure by gravimetric method using *Rhoeo*/potato tuber.
- **Unit-14:** Determination of rate of transpiration per unit area by weighing method.
- **Unit-15:** Imbibition of water by dry seeds (starchy, proteinaceous and fatty seeds).
- **Unit-16:** Determination of (%) seed viability by TTC (Triphenyl Tetrazolium Chloride) test.
- **Unit-17:** Effect of CO₂ on photosynthesis using bicarbonate solutions.
- **Unit-18:** Determination of rate of aerobic respiration using germinating seeds.
- **Unit-19:** Comparison of the rate of transpiration (in upper and lower surface of leaf).
- **Unit-20:** Determination of Q₁₀ for imbibition of water using dry gram seeds.

Block-III: Reproductive Biology

- **Unit-21:** Pollen grains: Fresh preparation and permanent slides showing ornamentation and apertures.
- **Unit-22:** Study of pollinia from permanent slides.

❖ Core Course: CC-BT-07: (Credit-6 / Marks-70; TEE-50; ASSGN-20)

Anatomy; Economic Botany

Block- I: Plant Anatomy

- **Unit-1:** Plant cell wall.
- **Unit-2:** Tissues types and functions.
- **Unit-3:** Structures of root apex and shoot apex.
- **Unit-4:** Mechanical tissues and their principles of distribution.
- **Unit-5:** Types of stomata.
- **Unit-6:** Stelar types and evolution.
- **Unit-7:** Nodal anatomy.
- **Unit-8:** Cambium-primary and secondary structures, nature and functions.
- **Unit-9:** Secondary growth of stem.
- **Unit-10:** Secondary growth of root.
- **Unit-11:** Anomalous secondary growth (stem of *Bignonia*, *Boerhaavia*)
- **Unit-12:** Anomalous secondary growth (stem of *Dracaena* and root of *Tinospora*).
- **Unit-13:** Anatomical adaptation of Xerophytes and Hydrophytes.

Block-II: Economic Botany

- **Unit-14:** Concept of Centres of Origin, their importance with reference to Vavilov's work.
- **Unit-15:** Economic plants – classification and uses.
- **Unit-16:** Scientific name, family, parts used and uses of Maize, Mung, Ginger, Sugar cane, Mustard.
- **Unit-17:** Scientific name, family, parts used and uses of Lemon grass, Coconut, Sal, Teak, Cotton.
- **Unit-18:** Cultivation of Paddy, Wheat and Jute.
- **Unit-19:** Cultivation of Tea and Coffee and their processing.
- **Unit-20:** Pharmacognosy- definition, objectives and importance.
- **Unit-21:** Scientific name, family, active principles and uses of the following medicinal plants: Ipecac, Kalmegh, Neem and Vasaka.

❖ Core Course: CC-BT-08: (Credit-6/Marks-70; TEE-50, ASSGN-20)

Morphology; Plant Systematics

Block- I: Morphology

- **Unit-1:** Inflorescence – different types with examples.
- **Unit-2:** Flowers – types, aestivation, cohesion and adhesion of stamens.
- **Unit-3:** Placentation, different types of ovules.
- **Unit-4:** Fruits – types with examples.
- **Unit-5:** Seed – types with examples.

Block-II: Plant Systematics

- **Unit-6:** Taxonomy, Systematics, Classification, Identification and Nomenclature – terms and definitions only. Types of Classifications– Artificial, Natural and Phylogenetic, definitions and examples.
- **Unit-7:** Nomenclature – elementary knowledge of ICN (ICBN) including important rules. Effective and Valid Publications. Rules of priority Author citation, Ranks and Names.
- **Unit-8:** Broad features of the systems of classifications of Linnaeus (artificial). Bentham and Hooker (natural). Cronquist (phylogenetic). APG Classifications.
- **Unit-9:** Herbaria and Botanical gardens – importance and functions, five each important herbaria in India and World. Collection of specimens, preparation of herbarium sheets, their preservation and maintenance of Herbarium; Virtual Herbarium; E-Flora.
- **Unit-10:** Diagnostic features and systematic position (according to Bentham and Hooker, and Cronquist's systems) of the following families: Magnoliaceae, Nymphaeaceae, Malvaceae, Cucurbitaceae, Brassicaceae (Cruciferae).
- **Unit-11:** Diagnostic features and systematic position (according to Bentham and Hooker, and Cronquist's systems) of the following families: Fabaceae (Leguminosae), Euphorbiaceae, Apiaceae (Umbelliferae).
- **Unit-12:** Diagnostic features and systematic position (according to Bentham and Hooker, and Cronquist's systems) of the following families: Solanaceae, Lamiaceae (Labiatae), Scrophulariaceae, Rubiaceae and Asteraceae (Compositae).
- **Unit-13:** Diagnostic features and systematic position (according to Bentham and Hooker, and Cronquist's systems) of the following families: Alismataceae, Arecaceae (Palmae), Poaceae (Gramineae).
- **Unit-14:** Alpha taxonomy and Omega taxonomy. Taxonomic evidences from palynology, cytology, phytochemistry and molecular data..
- **Unit-15:** Character and character states, OTU, Phenograms, Numerical Taxonomy, Cladistics and Cladogram.

❖ Core Course: CC-BT-09: (Credit-6/Marks-70; TEE-50, ASSGN-20)

Plant Physiology; Reproductive Biology of Angiosperms

Block-I: Plant physiology

- **Unit-1:** Cell Physiology: Introduction, cell membrane, water potential and its component imbibition, diffusion, osmosis, plasmolysis, osmotic relation of a plant cell.
- **Unit-2:** Water relation in plants: Introduction, molecular structure and physical properties of water, types of water in the soil, availability and usefulness of water to the plants, absorption of water by the land plants, factors affecting absorption of water.
- **Unit-3:** Ascent of sap: introduction, different theories, experiments on conduction of water.
- **Unit-4:** Transpiration: definition, types and sites of transpiration, mechanism of stomatal transpiration, factors affecting transpiration, anti-transpirations, guttation.
- **Unit-5:** Mineral nutrition of plants: Introduction, essential and non-essential elements, criteria of essentiality of elements, general and specific rolls of macro- and microelements in plants, deficiency symptoms.
- **Unit-6:** Translocation of solutes: definition, translocation of organic materials, direction and mechanism of phloem transport, translocation of inorganic materials.
- **Unit-7:** Growth Physiology: definition of growth and development, sites of plant growth, phases of growth, factors affecting growth, measurement of growth.
- **Unit-8:** Plant growth: Concept of plant growth regulators and phytohormones. Natural, synthetic and postulated hormones, physiological roles of Auxins, Gibberelins, Cytokinins, Ethylene and Abscisic acid. Biosynthesis and bioassay of Auxins and Gibberelins.
- **Unit-9:** Photosynthesis: Light reaction, concept of photosystem I and II, reaction centre, antenna molecule; electron transport and mechanism of ATP synthesis, Calvin cycle, photosynthetic efficiency, HSK and CAM pathway, bacterial photosynthesis, law of limiting factors.

- **Unit-10:** Respiration: types of Respiration, Glycolysis, Krebs cycle, ETS and Oxidative Phosphorylation, Pentose Phosphate Pathway, R.Q.
- **Unit-11:** Photorespiration: definition, mechanism, differences between Respiration and Photorespiration, significance.
- **Unit-12:** Nitrogen fixation: sources of nitrogen, biological nitrogen fixation, mechanism, nodulins, basic concept of *nif* and *nod* genes.
- **Unit-13:** Plant movements: different types of movements, movements of curvature, tropic movements, nastic movements, nutation, turgor movements.
- **Unit-14:** Physiology of flowering: Photoperiodism, critical day length, SDP, LDP, DNP, SLDP, and LSDP, site of perception of photoperiodic stimulus, vernalization and devernialization, role of phytochrome in flowering.
- **Unit-15:** Seed physiology: definition of propagules, germination and dormancy of seeds, morphological and biochemical changes during seed germination, types, causes of methods of breaking seed dormancy.

Block-II: Reproductive Biology of Angiosperms

- **Unit-16:** Introduction: History (contributions of J. Heslop-Harrison, P. Maheshwari, B.M. Johri) and scope.
- **Unit-17:** Pollination— definition, types, contrivances, agents, advantages and disadvantages.
- **Unit-18:** Development of male and female gametophytes.
- **Unit-19:** Fertilization, types with examples.
- **Unit-20:** Development of endosperms (three types); apomixis, apospory and apogamic, polyembryony.
- **Unit-21: Self Incompatibility:** Basic concept (interspecific; intraspecific, heteromorphic); Cybrids; In-vitro fertilization.

❖ **Core Course: CC-BT-10: (Credit-6/Marks-70; TEE-50, ASSGN-20)**

Biomolecules and Plant Metabolism

Block-I: Biomolecules

- **Unit-1: Carbohydrates:** Nomenclature and classification; Monosaccharides, Disaccharides; Oligosaccharides and Polysaccharides.
- **Unit-2:** Lipids: Definition and major classes of storage and structural lipids; fatty acid structure and function; essential fatty acids.
- **Unit-3:** Triglycerols structure, function and properties; phosphoglycerides.
- **Unit-4:** Proteins: structure of amino acids; levels of protein structure—primary, secondary, tertiary and quaternary.
- **Unit-5:** Protein denaturation and biological roles of proteins.
- **Unit-6:** Nucleic acids: structure of nitrogenous bases; structure and functions of nucleotides; types of nucleic acids.
- **Unit-7:** Structure of A, B and Z-types of DNA; Types of RNA, structure of t-RNA.
- **Unit-8:** Bioenergetics: laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reaction, redox reaction.
- **Unit-9:** ATP; structure and its role as an energy currency molecule.

Block-II: Plant Metabolism

- **Unit-10:** Concept of metabolism.
- **Unit-11:** Water, pH, buffer solutions.
- **Unit-12:** Amino acids and primary structure of proteins.
- **Unit-13:** General structure of amino acids, structure of twenty common amino acids.
- **Unit-14:** Proteins – different structure levels of proteins, denaturation and biological roles of proteins.
- **Unit-15:** Enzymes – properties, enzyme inhibition, allosteric enzyme.

- **Unit-16:** Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzyme and prosthetic groups.
- **Unit-17:** Classification of enzymes, according to IUB active site of enzyme, specification, mechanism of action (activation energy, lock and key hypothesis, induced – fit and acid-base theory).
- **Unit-18:** Michaelis – Menton equation, different types of enzyme inhibition and their effect on V_{max} and K_m , factors affecting enzyme activity.
- **Unit-19:** Plant pigments: Introduction, plastidial and non-plastidial pigments.
- **Unit-20:** Absorption of light energy by plant pigments, chemistry of chlorophylls and carotenoids.

❖ **Core Course: CC-BT-11: (Credit-6/Marks-70; TEE-70; ASSGN-0)**
Practical (Cell Biology; Plant Biotechnology; Genetics and Molecular Biology)

Block-I: Cell Biology

- **Unit-1: Study of mitotic chromosome: Metaphase chromosome preparation** (Pre-treatment, Fixation, Staining).
- **Unit-2:** Temporary squash preparation of *Allium cepa* root tips.
- **Unit-3:** Temporary squash preparation of *Aloe* root tips.
- **Unit-4:** Determination of mitotic index and frequency of different mitotic stages in prefixed root tips of *Allium cepa*.
- **Unit-5:** Identification of different mitotic stages from permanent slides.
- **Unit-6:** Temporary smear preparation from *Allium* flower buds for study of meiotic chromosome.
- **Unit-7:** Temporary smear preparation from *Rhoeo* flower buds for study of meiotic chromosome.
- **Unit-8:** Identification of different meiotic stages from permanent slides.

Block-II: Plant Biotechnology

- **Unit-9:** Study of anther, embryo and endosperm culture.
- **Unit-10:** Micropropagation, somatic embryogenesis and artificial seeds through photographs.
- **Unit-11:** Study of steps of genetic engineering for production of Bt cotton through photographs.
- **Unit-12:** Study of steps of genetic engineering for production of Golden rice through photographs.
- **Unit-13:** Study of steps of genetic engineering for production of Flavr Savr tomato through photographs.

Block-III: Genetics and Molecular Biology

- **Unit-14:** Determination of mean, standard deviation and standard error from samples. (leaflet size etc.)
- **Unit-15:** Determination of Goodness of fit in normal and modified monohybrid ratios.
- **Unit-16:** Determination of Goodness of fit in normal and modified dihybrid ratios.
- **Unit-17:** Study of structures of prokaryotic RNA polymerase through photographs.
- **Unit-18:** Study of structures of eukaryotic RNA polymerase II through photographs.
- **Unit-19:** Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey and Chase's, Fraenkel and Conrat's experiments).
- **Unit-20:** Preparation of MS medium.

❖ **Core Course: CC-BT-12: (Credit-6/Marks-70; TEE-50, ASSGN-20)**
Genetics and Molecular Biology

Block- I: Genetics

- **Unit-1: Mendelian Genetics and its extensions.** Mendel's Laws and Chromosome Theory of Inheritance; Gene Interactions; Complete Dominance, Incomplete Dominance and Codominance.
- **Unit-2:** Multiple Alleles; Lethal Alleles; Allelic Complementation Test and Complementary Gene Action.
- **Unit-3:** Epistasis – different types; Modifier and Suppressor Genes; Pleiotropy; Penetrance and Expressivity.

- **Unit-4:** Environment and Gene Expression; Polygenic Inheritance.
- **Unit-5: Linkage, Crossing-over and Chromosome mapping:** Linkage types; Synteny; Linkage Groups and Linkage Maps; Crossing-over and its cytological proof (in Maize); Recombination Frequency; Three-point test cross; Interference and Coincidence; numerical based on Gene-mapping; Sex-chromosomes and Sex-linkage.
- **Unit-6: Extra-Nuclear Inheritance:** Maternal, Paternal and Bi-parental inheritance; Chloroplast mutation – variegation in *Mirabilis jalapa*; Mitochondrial mutation in yeast; Maternal Effects – shell-coiling in snail; Infective heredity – kappa particles in *Paramecium*.
- **Unit-7: Eukaryotic Chromosome – structure and organization:** Chromosome Number, Morphology, Nomenclature and Organization; Chromosome Banding, Chromosome Painting. **In-situ Hybridization**– FISH; Polytene chromosomes; Euchromatin, Heterochromatin – Constitutive and Facultative.
- **Unit-8: Variation in Chromosome Number and Structure:** Polyploidy and Aneuploidy; Deletion, Duplication, Inversion and Translocation; Position Effect.
- **Unit-9: Gene Mutation:** Types and molecular basis of mutations; Mutagens; Detection of mutations – CIB method; DNA Repair Pathways.
- **Unit-10: Modern Concept of Gene and Genetic Code:** One gene- One Polypeptide hypothesis; Central Dogma; Properties of genetic code and its decipherence.
- **Unit-11: Population and Evolutionary Genetics:** Allele and Genotype frequencies; Hardy–Weinberg Law. Role of Natural Selection, Migration, Mutation and Genetic Drift; Genetic variation and Speciation.

Block- II: Molecular Biology

- **Unit-12: DNA – Genetic Material and Structure:** DNA as genetic material – proof, types of DNA and genetic material; Denaturation, Renaturation and Cot Curves; Nucleosome Model.
- **Unit-13: DNA Replication:** General principles – bi-directional, semi-conservative and semi-discontinuous; RNA priming; models of DNA replication; enzymes involved in DNA replication.
- **Unit-14: Gene Expression and its Regulation:** Transcription and its regulation in Prokaryotes and Eukaryotes; Eukaryotic RNA – split genes and splicing Mechanism; mRNA processing; RNA editing and mRNA transport. Translation – initiation, elongation and termination of polypeptides; inhibitors of protein synthesis; Post-translational modification of proteins.
- **Unit-15: Transposable Elements and Plasmids:** Transposable elements in Prokaryotes and Eukaryotes, their classification and properties. **Plasmids** – structure and properties; plasmid pBR 322 – salient features.
- **Unit-16: Restriction Endonuclease and Recombinant DNA Technology:** Restriction enzymes – nomenclature, types and functions with examples. Gene Cloning – basic steps; Cloning Vectors – properties and types; shuttle vector and expression vector; Reporter Genes; Cloned Genes and Recombinant Proteins; Ethical and legal considerations.
- **Unit-17: Genomic Library and RFLP:** Construction of Genomic, Chromosome and cDNA libraries; screening of DNA library; Genomics, Genome Sequences and their Annotation; Single Nucleotide Polymorphisms and Haplotypes. Future directions in Genomics; RFLPs and their uses.

❖ Core Course: CC-BT-13: (Credit-6/Marks-70; TEE-50, ASSGN-20)

Plant Ecology and Phytoecography

Block I: Plant Ecology

- **Unit-1:** Plant Ecology- definition, branches, relevance to human civilization.
- **Unit-2:** Ecosystem- concept and types of ecosystem, components – biotic and abiotic, energy flow.

- **Unit-3:** Nutrients cycling (carbon, nitrogen, phosphorous), biotic interrelationship.
- **Unit-4:** Plant communities- definition, habitat and niche, ecotone and edge effects.
- **Unit-5:** Community dynamics and plant succession types: primary and secondary successions.
- **Unit-6:** Ecological factors: soil-origin, formation, composition, soil profile; water-state of water in the environment, precipitation types.
- **Unit-7:** Light and temperature variation, optimal limiting factors.
- **Unit-8:** Atmosphere and plant responses-I: Hydrophytes – Fresh water environments, Classification of hydrophytes and xerophytes.
- **Unit-9:** Morphological, anatomical and physiological adaptations of Hydrophytes.
- **Unit-10:** Atmosphere and plant responses-II: Psammophytes, Lithophytes, Psychrophytes, Succulents and their morphological adaptations.
- **Unit-11:** Atmosphere and plant responses-III: Halophytes and their distributions, mangrove vegetation, ecological adaptations.
- **Unit-12:** Environmental pollution: air pollution, water pollution and their impact on plants.
- **Unit-13:** Global environmental issues: greenhouse gases, global warming, ozone depletion, acid rain and EL-Nino.

Block II: Phytogeography

- **Unit-14:** Phytogeographical zones of India,
- **Unit-15:** Endemism: definition, types, causes of endemism, endemic flora of India.
- **Unit-16:** Flora of Eastern Himalaya.
- **Unit-17:** Flora of western Himalaya.
- **Unit-18:** Flora of Sundarbans.
- **Unit-19:** Definition of Biodiversity, Biodiversity hotspots; rare and threatened plants of India; red data book.
- **Unit-20:** Plant conservation: Significance of conservation, ex-situ and in-situ conservation; biosphere reserve; sanctuary; national park.

❖ Core Course: CC-BT-14: (Credit-6/Marks-70; TEE-50, ASSGN-20)

Cell Biology; Plant Biotechnology

Block-I: Cell Biology

- **Unit-1:** Microscopy: Light, Phase contrast, Fluorescence and Electron microscopy; Confocal microscopy.
- **Unit-2:** Eukaryotic Cell: Organization and functional structures and chemical components.
- **Unit-3:** Nuclear organization: ultrastructure of nuclear envelope, structure and functions of Nucleus.
- **Unit-4:** Structure and functions of Ribosome and Lysosomes.
- **Unit-5:** Structures and functions of Mitochondria.
- **Unit-6:** Structures and functions of chloroplasts.
- **Unit-7:** Endomembrane system, general idea; endoplasmic reticulum: structure and function.
- **Unit-8:** Golgi apparatus: organization and function.
- **Unit-9:** Mitosis and Meiosis: Detail accounts of phases and events; Their significance.
- **Unit-10:** Cell cycle and its control.

Block-II: Plant Biotechnology

- **Unit-11:** Historical perspectives; composition of nutrients.
- **Unit-12:** Inorganic, organic elements and plant growth regulators (role).
- **Unit-13:** Sterilization; cellular totipotency.
- **Unit-14:** Organogenesis, embryogenesis (somatic and zygotic), micropropagation.
- **Unit-15:** Embryo culture and its application

- **Unit-16:** Protoplast culture and its application.
- **Unit-17:** Cryopreservation and germplasm conservation.
- **Unit-18:** Tissue culture in conservation of endangered plants.
- **Unit-19:** Genetic Engineering and transgenic plants.
- **Unit-20:** Electroporation, particle gun technologies, microinjection.
- **Unit-21:** Application of biotechnology in agriculture, horticulture and forestry.

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Discipline Specific Elective (DSE)

❖ **DS-BT-11: (Credit-6/Marks-70; TEE-50, ASSGN-20)**

Stress Biology

- **Unit-1: Defining plant stress:** Acclimation and adaptation.
- **Unit-2: Environmental factors:** Water stress; Salinity stress, High light stress; Temperature stress; Hypersensitive reaction; Pathogenesis– related (PR) proteins; Systemic acquired resistance; Mediation of insect and disease resistance by jasmonates.
- **Unit-3: Stress sensing mechanisms in plants:** Calcium modulation, Phospholipid signaling.
- **Unit-4: Developmental and physiological mechanisms that protect plants against environmental stress:** Adaptation in plants; Changes in root: shoot ratio; Aerenchyma development; Osmotic adjustment; Compatible solute production.

❖ **DS-BT-21: (Credit-6/Marks-70; TEE-70; ASSGN-0)**

Practical (Stress Biology; Natural Resource Management; Plant Breeding)

Block-I: Stress Biology

- **Unit-1:** Quantitative estimation of peroxidase activity in the seedlings in the absence and presence of salt stress.
- **Unit-2:** Superoxide activity in seedlings in the absence and presence of salt stress.
- **Unit-3:** Quantitative estimation and zymographic analysis of catalase.
- **Unit-4:** Quantitative estimation and zymographic analysis of glutathione reductase.

Block-II: Natural Resource Management

- **Unit-5:** Estimation of solid waste generated by a domestic system (biodegradable and non biodegradable) and its impact on land degradation.
- **Unit-6:** Collection of data on forest cover of specific area.
- **Unit-7:** Measurement of dominance of woody species by DBH (diameter at breast height) method.

Block-III: Plant Breeding

- **Unit-8:** Calculation of mean, standard deviation and standard error
- **Unit-9:** Calculation of correlation coefficient values and finding out the probability
- **Unit-10:** Calculation of 'F' value and finding out the probability value for the F value.

❖ **DS-BT-31: (Credit-6/Marks-70; TEE-50, ASSGN-20)**

Plant Breeding

- **Unit 1: Plant Breeding:** Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.
- **Unit 2: Methods of crop improvement:** Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.
- **Unit 3: Quantitative inheritance:** Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings. Monogenic vs polygenic Inheritance.
- **Unit 4: Inbreeding depression and heterosis:** History, genetic basis of inbreeding depression and heterosis; Applications.
- **Unit 5: Crop improvement and breeding:** Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

❖ **DS-BT-41: (Credit-6/Marks-70; TEE-50, ASSGN-20)**

Natural Resource Management

- **Unit-1: Natural resources:** Definition and types.
- **Unit-2: Sustainable utilization:** Concept, approaches (economic, ecological and socio-cultural).
- **Unit-3: Land:** Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management.
- **Unit-4: Water:** Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies.
- **Unit-5: Biological Resources:** Biodiversity-definition and types; Significance; Threats; Management strategies; Bioprospecting; IPR; CBD; National Biodiversity Action Plan.
- **Unit-6: Forests:** Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management.
- **Unit-7: National and international efforts in resource management and conservation.**

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Generic Elective (GE)

❖ **GE-01: (Credit-6/Marks-70; TEE-50, ASSGN-20)**

Biodiversity (Microbes, Algae, Fungi and Archegoniate)

- **Unit-1: Microbes:** Viruses – Discovery, general structure, Economic importance; Bacteria – Discovery, General characteristics and cell structure; Economic importance.
- **Unit-2: Algae:** General characteristics; Range of thallus organization; Morphology and life-cycles of the following: *Nostoc*, *Oedogonium*, *Polysiphonia*. Economic importance of algae.
- **Unit-3: Fungi:** Introduction-General characteristics, range of thallus organization, life cycle of *Penicillium*, *Agaricus* (Basidiomycota); Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.
- **Unit-4: Introduction to Archegoniate:** Unifying features of archegoniates.
- **Unit-5: Bryophytes:** General characteristics, Range of thallus organization. Ecology and economic importance of bryophytes with special mention of *Sphagnum*.
- **Unit-6: Pteridophytes:** General characteristics, Early land plants (*Cooksonia* and *Rhynia*). Ecological and economical importance of Pteridophytes.
- **Unit-7: Gymnosperms:** General characteristics; morphology of *Cycas* and *Pinus* (Developmental details not to be included). Ecological and economical importance.

❖ **GE-02: (Credit-6/Marks-70; TEE-50, ASSGN-20)**

Plant Ecology and Taxonomy

- **Unit-1:** Introduction to ecology.
- **Unit-2: Ecological factors:** Brief knowledge about soil, water, light and temperature. Adaptations of hydrophytes and xerophytes.
- **Unit-3: Plant communities:** Characters; Ecotone and edge effect; Succession; Processes and types
- **Unit 4: Ecosystem:** Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous.

- **Unit-5: Phytogeography:** Principle biogeographical zones; Endemism.
- **Unit-6: Introduction to plant taxonomy:** Identification, Classification, Nomenclature.
- **Unit-7: Identification:** Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access.
- **Unit-8: Taxonomic evidences** from palynology and cytology.
- **Unit-9: Taxonomic hierarchy:** Ranks, categories and taxonomic groups
- **Unit-10: Botanical nomenclature:** Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.
- **Unit-11: Types of classification-** artificial, natural and phylogenetic. Bentham and Hooker (up to series)

❖ **GE-03: (Credit-6/Marks-70; TEE-50, ASSGN-20)**

Plant Anatomy and Embryology

- **Unit 1: Meristematic and permanent tissues:** Root and shoot apical meristems; Simple and complex tissues.
- **Unit 2: Organs:** Structure of dicot and monocot root stem and leaf.
- **Unit 3: Secondary Growth:** Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).
- **Unit 4: Adaptive and protective systems:** Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.
- **Unit 5: Structural organization of flower:** Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.
- **Unit 6: Pollination and fertilization:** Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.
- **Unit 7: Embryo and endosperm :**Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship.
- **Unit 8: Apomixis and Polyembryony:** Definition, types and Practical applications.

❖ **GE-04: (Credit-6/Marks-70; TEE-50, ASSGN-20)**

Economic Botany and Plant Biotechnology

- **Unit-1: Origin of Cultivated Plants:** Concept of centres of origin, their importance with reference to Vavilov's work.
- **Unit-2: Cereals:** Wheat- Origin, morphology, uses.
- **Unit 3: Legumes:** General account with special reference to Gram and soybean.
- **Unit-4: Spices:** General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses).
- **Unit-5: Beverages:** Tea (morphology, processing, uses).
- **Unit-6: Oils and Fats:** General description with special reference to groundnut.
- **Unit-7: Fibre Yielding Plants:** General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)
- **Unit-8: Introduction to biotechnology**
- **Unit-9: Plant tissue culture:** Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications
- **Unit-10: Recombinant DNA Techniques:** Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR.

Skill Enhancement Course (SEC)

❖ SE-BT-11: (Credit-2/Marks-60; TEE-50; ASSGN-10)

Medicinal Botany

- **Unit 1: History, Scope and Importance of Medicinal Plants.** Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept:Umoor-e-tabiya, tumors treatments/therapy, polyherbal formulations.
- **Unit 2: Conservation of endangered and endemic medicinal plants.** Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.
- **Unit 3: Ethnobotany and Folk medicines.** Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

❖ SE-BT-21: (Credit-2/Marks-60; TEE-50; ASSGN-10)

Plant Diversity and Human Welfare

- **Unit 1: Plant diversity and its scope-** Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro-biodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.
- **Unit 2: Loss of Biodiversity:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agro-biodiversity, Projected scenario for biodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.
- **Unit 3: Conservation of Biodiversity:** Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.
- **Unit 4: Role of plants in relation to Human Welfare;** a) Importance of forestry, their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

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Suggested Readings:

- College Botany (Vol. I) : Gangulee H. C., Das K. S, Datta C. T. (New Central Book Agency).
- College Botany (Vol. II) : Gangulee H. C. & Kar A. K. (New Central Book Agency).
- College Botany (Vol. III) : Mukherjee S (New Central Book Agency).
- Studies in Botany (Vol. I) : Mitra J. N., Mitra D & Chaudhuri S. K. (Moulik Library).
- Studies in Botany (Vol. II) : Mitra D, Guha J., Chaudhuri S. K. (Moulik Library).
- A Text Book of Biotechnology : Dubey R. C. (S. Chand & Co.).
- Molecular Biology and Biotechnology : Kumar H. D. (Vikash Publication).
- Text Book of Algae : Sharma O. P. (Tata Mc Graw Hill).
- Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
- Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
- A Text Book of Fungi : Chopra G. L. and Verma V. (Pradeep Publication).
- An introduction of Fungi : Dubey H. C. (Vikas Publishing House).
- Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
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- Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.S.A.
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- Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
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- Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
- Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

- Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers IndiaLtd., New Delhi. 4th edition.
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- Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
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- Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
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