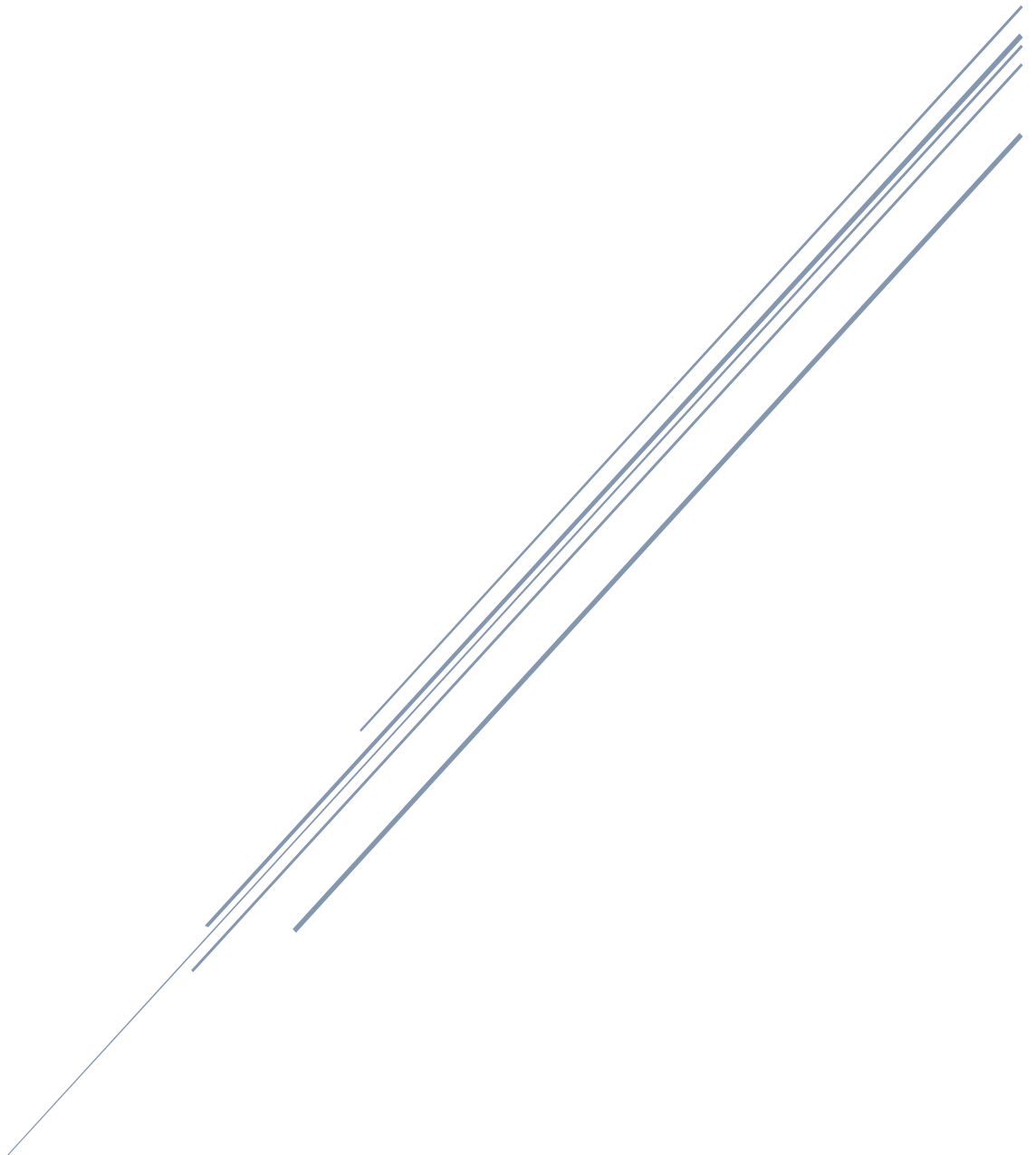


BACHELOR OF SCIENCE (HONS) (BOTANY)-ODL

PROGRAMME PROJECT REPORT (PPR)



School of Sciences

PPR of B.Sc. in Botany approved by 39th Academic Council (vide memo no.: Reg/0322 dated 14.03.2023) for delivery of programme through Open Distance Learning mode.

i. Programme's mission and objectives:

Mission: Plant Science has contributed colossal knowledge and information as inputs to the national developmental planning based on its fundamental and applied aspects of researches. The learner nurtured with botanical knowledge is the need of the hour to save the natural environment, educate the human resources towards conservation of biodiversity and save our planet thereon.

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.

ii. Relevance of the program with HEI's Mission and Goals:

The program is entirely consistent with the Netaji Subhas Open University's strategic goals as well as its mission to provide modern education to underprivileged sections of society who are unable to thrive to spend non-elastic timings of formal conventional class room education. Such a higher education in science subject with appropriate laboratory experiences will enrich the human resources for the uplift of the nation to Educational, Social, Technological, Environmental and Economic Magnificence.

iii. Nature of prospective target group of learners:

This programme through ODL mode is developed by keeping in mind to give opportunity to economically and socially excluded people of various socio-economic status viz., unemployed youths, employed with marginalized salary due to lack of sufficient knowledge in the subject Botany. Also, the target group of learners includes various level employees of agro-based companies, secondary-level school teachers, research aspirants, women taking care of family—the important unit of the community etc.

iv. Appropriateness of programme to be conducted in Open and Distance Learning and/or Online mode to acquire specific skills and competence:

This programme through Distance Learning mode is developed in order to give subject-specific skills including

- ✓ Knowledge about various kind of life forms of plant kingdom, their classification,
- ✓ Anatomical, embryological, cellular, genetical, molecular approach and plant metabolisms.
- ✓ Inter-disciplinary knowledge like biostatistics.
- ✓ Modern concepts like plant biotechnology, plant tissue culture.
- ✓ Applied botany viz., biofertilizer, economic botany, medicinal botany.
- ✓ Conservation of biodiversity and sustainable development.

The programme is developed to give detailed exposure theoretically and free-hands experience on practical parts of the study in order to impart skills of Botany to the learners.

v. Instructional Design:

The curriculum design and detailed syllabus for UG-CBCS Botany Learners is as follows.

Introduction: As the state and national level, the higher educational institutions are expected to provide quality education, education for all, strategic plans for an institution that defines targets and measures of the programmes to be achieved by the institution. Apart from physical infrastructure, administrative policy and code of behaviour, school of sciences is actively engaged in its academic development of respective subjects. The School of Sciences has designed its curriculum, several learning resource materials, and Feedback system through the BOS and an expert committee. Learning Material through print-media named Self-Learning Material (SLM) is developed with the approach of self-explanatory, self-contained, self-motivating and self-evacuating followed by the UGC guideline.

The Department takes every care to prepare the Learning Materials in printed form popularly known as the Self-Learning Materials (SLM) with the approach of self-explanatory, self-contained, self-

motivating and self-evacuating following the guidelines offered by the University Grants Commission through its notifications. The details of the Under graduate programme given below:

a. Course Structure: (Please see the detailed table below):

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

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'

* 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.

Course Legend: CC – Core Courses, AECC – Ability Enhancement Compulsory Courses, GEC – Generic Elective Courses, SEC – Skill Enhancement Courses, DSEC – Discipline Specific Elective Courses

b. Detailed Syllabus: (Learners are advised to check the relevant Self Learning Materials (SLM's) for actual distribution of Modules and Units. All courses have been designed in keeping with UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 regarding the minimum number of Units)

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 of 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

Module 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

Module-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.

Module-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)

Module-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 Trachieds.
- **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).

Module-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*.

Module-III: Morphology

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

Module-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.

Module-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)

Module-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.

Module-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.

Module-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

Module- 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.

Module-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**

Module- 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.

Module-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

Module-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 micro-elements 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, turgour 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.

Module-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

Module-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:** Triacylglycerols 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: loss 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.

Module-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)

Module-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.

Module-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.

Module-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

Module- I: Genetics

- **Unit-1: Mendelian Genetics and its extensions.** Mendel's Laws and Chromosome Theory of Inheritance; Gene Interactions; Complete Dominance, Incomplete Dominance and Co-dominance.
- **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.

Module- 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 Phytogeography

Module 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.

Module 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

Module-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.

Module-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.

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)

Module-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.

Module-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.

Module-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.**

Generic Elective (GE)

❖ **GE-BT-11: (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-BT-21: (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-BT-31: (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-BT-41: (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 nurseryproduction, 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.

c. Duration of the programme:

The minimum duration of the Programme is 3 (three) years from the date of registration. The registration is valid for a period of maximum 6 (six) years.

d. Faculty & Support Staff requirement:

Sl. No.	Faculty	Name of the Faculty	Work at (HQ/RC)	Number
1	Associate Professor	Dr. Swapan Bhattacharyya	RC - 1	1
2	Assistant Professor	Mr. Sandip Das	RC - 1	1
3	Assistant Professor	Dr. Sanjib Kr. Chattopadhyay	RC - 1	1

e. Support Staff:

Sl. No.	Office Staff (Designation)	Work at (HQ/RC)	Number
1	Junior Assistant	RC - 1	1
2	Junior Assistant Cum Typist	HQ - 1	1

f. Instructional Delivery Mechanisms:

Mode of Delivery/ Types	Delivery Mechanisms	Provided (Yes/No)	Detailed Information (Please Mention the Activity Hour)
Face to Face Mode	PCP	Yes	Provided at LSC. For 6 Credits Theory Courses 9 counselling sessions of 2 hours each (Total 18 hrs); for 2 Credits Ability/Skill Courses 3 counselling sessions of 2 hours each (Total 6 hrs)
	Tutorials/ Special Classes/ Remedial Classes/ PCP	Yes	Provided online by NSOU faculty @ 6 hrs for each 6 Credits Course; Offline remedial classes once every semester at RC's (6 hrs for each 6 Credits Course)
	Seminar/ Research Colloquium	Yes	Learners participates in the seminar/workshops conducted by the University as per prior notice
	Laboratory based Practical	Yes	96 hour Practical session per Core Courses and Discipline Specific Courses
Self-Learning	SLMs	Yes	All Courses are designed within the range of Units specified by relevant regulations. 20 hours of self- study time is envisaged for each SLM

Mode of Delivery/ Types	Delivery Mechanisms	Provided (Yes/No)	Detailed Information (Please Mention the Activity Hour)
	Reference Books	Yes	All Units have suggested reading lists. Additionally, faculty at LSC (during PCP) & NSOU faculty (at online sessions) guide learners regarding Reference Books
ICT/ Digital Wellness of students	Online (Web driven/Mobile App)	Yes	Learners have access to institutional Learning Management System (LMS)
	Offline DVD/SD Card/USB Drive	Yes	USB drive used
	Telecommunications	Yes	Supports are given as per need. Communication Support is provided to the learners through University technical team as per requirement
Blended	Smart Classrooms	Yes	Arrangements are available both at RC's and at LSC's
	Flipped Learning	No	Will come into effect in a phased manner from the upcoming session with the development of NSOU MOOC

vi. Procedure for admissions, curriculum transaction and evaluation:

University frames its policy related to admission entry criteria, method of admission, conduction of admission through the Admission Committee (statutory body) following the guideline of the UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 and Department of Higher Education, Govt. of West Bengal. Admissions are conducted entirely through Online mode centrally by the University.

Information Circulation Policy:

All information related to the programme like admission policy, eligibility, fee structure, course curriculum, medium of instruction, method of instruction, evaluation method, SLMs etc. are transacted through prospectus, brochure, official notification etc.

Learner Support Services:

Learner support services are provided by the University at three level of functioning of the Open University architecture i.e. Learner Support Centre (LSC), Regional Centre and Head Quarter.

Following the UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 LSCs are provide various learner support services in order to facilitate the acquisition of teaching-learning experience for its enrolled learners throughout at various phases of learners' study life cycle. LSC also main contact points for access by the learners, responsive and facilitating information centres, arranging contact sessions and other operations like processing of assignments etc.

University has constituted Learner's Facilitation Centre (LFC) at each Regional Centres to provide various support services. Beside that University has also provided learners support services through web based platform/ telephone/ email/ instant messaging services.

Transaction of Curriculum and Academic Planner:

The whole curriculum of the programme is well structured and well designed with the updated syllabus structure. The curriculum transaction involves the face to face PCP sessions through chalk and talk method, use of Power Point presentations, web-based lessons, animated videos, etc. The PCP sessions would be such that the learner should participate actively in the discussion. Apart from this ICT enables online supports are provided for better understanding of the subject.

For practical courses exclusive study materials containing the requirements, procedure for the experiments are issued to the learners. In the laboratory, instruction would be given for the experiments followed by demonstration and finally the learners have to do the experiments individually.

Curriculum transaction is through Online and or Offline modes as detailed above and all academic activities are conducted following the programme is following the below mentioned activity planner during the academic session:

Name of the Activity	Tentative months schedule (specify months) during Year			
	From (Month)	To (Month)	From (Month)	To (Month)
Admission	Jun	Jul	NA	NA
Distribution of SLM	Jul	Aug	NA	NA
Contact Programmes (counselling, Practical, etc.)	Aug	Oct	Jan	Mar
Assignment Submission	Oct	Nov	Mar	Apr
Evaluation of Assignment	Nov	Nov	Apr	Apr
Examination	Nov	Dec	May	Jun
Declaration of Result	Dec	Dec	Jun	Jun
Renewal/ Re-registration	NA	NA	Jun	Jul

Evaluation:

Evaluation is on a 2-tier basis, divided into Assignment submission (online mode) and Term End Examinations (Offline mode). The weightage is as follows:

Assignment – 20 marks

Term End Examination – 50 marks

Total marks for each course – 70

Assignment / Internal Assessment/ Continuous Assessment / Formative Assessment: Assignment submission is the first interaction between the learner and the teacher. It has a very important role to play in the teaching-learning process in distance education. So, submission of Assignment is mandatory for all learners. The assignment responses reflect what the learners have understood and learnt. The assignment answer scripts are returned to the learners so that the assignment answers serve the purpose of providing feedback to the learners and inform them their strengths and weaknesses. Learners will be required to submit assignment for each course and the marks obtained on evaluation of those assignment courses will be entered into his/her individual record of performance. This will constitute 30% (maximum) of the Full marks in the course as per University Grants Commission (Open and Distance Learning Programmes and Online Programmes) regulations, 2020. All the Marks secured by the learners will be progressively entered into the result card. Every learner is required to submit the assignment courses before each Term-End Examination. In practical course of Science stream, there is no assignment.

Term-End Examinations: Minimum 70% of the total credit points of the course (except practical course where it is 100%) would be reserved for Term-End Examination as per University Grants Commission (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020. Minimum qualifying marks in each course is 30% (Term End Examination Marks + Assignment Marks).

Practical Examination / Laboratory Counselling-cum-Evaluation Sessions (LCES) for Lab based subjects: Practical Sessions or Laboratory Counselling-cum-Evaluation Session (LCES), for Core and Discipline Specific Elective courses of Science stream, are arranged by the University for the learners who have enrolled for the particular programme. Centre for practical work (LCES) will be allotted by the University. For UG, a length of 12 days' practical session is held during Puja vacation at different study centres. First 11 days during the total session, the learners gain hands on experiences with the help of counsellors. Marks have been allotted on each day's work and awarded on the basis of the

actual performance of the Learners. The sum of normalized marks awarded by Counsellors in continuous assessment contribute 70% to the final marks. On 12th day of the programme a Practical Examination which is unguided have been conducted and evaluated jointly by an external and internal examiner and 30% marks from this examination is reflected to the final marks. Examination is held in the examination centres in presence of both the internal and external examiners appointed by the Controller of Examination of the University. Attendance in the Lab Counselling Evaluation Session (LCES) is mandatory.

Waive of Programme Fee:

University waive of full course fee for transgender learners.

vii. Requirement of the laboratory support and Library Resources:

To educate the students in more scientific way, a rhythmic practical class programme has been introduced. NSOU provides the necessary laboratory facilities to the students in their respective study centres. For BDP level, a period of 12 days (eight hours per day) has been allotted for the students during the Puja vacation. The College and University teachers have been appointed to take classes which show a good sharing of resource persons among the conventional and distance institutions. The students of different study centres have been clubbed into a nearby study centres for practical classes. Due to the increased number of enrolments, the number of study centres for practical classes have been enhanced accordingly.

Library facility is one of important services in any higher educational institution. In addition to the Self Learning Materials (SLMs) and other learning resources the University provides library facility to all of its registered learners. The Library Department, Netaji Subhas Open University is located at Kalyani Campus.

Further, to cater to the needs of huge number of registered students, the University needs unlimited libraries to provide educational support to everyone. To cope with the situation, the University has initiated the process of setting up a strategic partnership with the existing network of Public Libraries that are available in the State of West Bengal to offer educational support to our learners all over the State. This initiative taken by NSOU is the first of its kind in the country.

viii. Cost estimate of the programme and the provisions:

Total course fee is Rs. 15,000/- (Excluding Examination and Studentship Renewal Fees). An approximate distribution of expenditure is given below to get prior view:

Assigned Head	Sub Head	% of Expenditure
Development	SLM Preparation and Development Cost	7
	SLM Printing	44
Maintenance & Programme Delivery	Maintenances Grant	15
	Counselling/ PCP/ Lab Counselling	15
	Delivery Charges	4
	Other Overhead Expenses	8
ICT Support	Admission Processing	1
	ICT Support Services	5
	Computer Training	1

ix. Quality assurance mechanism and expected programme outcomes:

Centre for Internal Quality Assurance (CIQA) as per UGC (Open and Distance Learning and online programme) Regulations, 2020 to ensure the delivery of high quality programmes to its learners and CIQA has the following functions:

- ✓ Facilitating the creation of a learner-centric environment conducive for quality education and faculty maturation to adopt the required knowledge and technology for participatory teaching and learning process.
- ✓ Arrangement for feedback responses from stakeholders, such as Learners, alumni, employers, and community members, is gathered through surveys, focus groups, and other methods to ensure that the program is meeting the needs of the community and to identify areas for improvement.
- ✓ Dissemination of information on the various quality parameters of the University.
- ✓ Development of quality culture in the University, and encourage creativity and innovation among the faculty and staff.
- ✓ Organization of inter and intra Schools/ Institutional workshops, seminars on quality related themes and promotion of quality circles.
- ✓ Documentation of the various programmes / activities of the School leading to quality improvement
- ✓ Acting as a nodal agency of the institution for quality-related activities, including adoption and dissemination of good practices.

Moreover, CIQA records activities undertaken on quality assurance along with the preparation of the PPRs and Annual Reports. The program aims to make learners knowledgeable, proficient and competent enough to secure good job opportunities as well as take up further research work.

Board of Studies (BOS): Board of Studies ensure quality of the Curriculum of Bachelor's Degree Programme in Botany as per University norms. BOS plays a vital role as the following

- ✓ Curriculum review and development of quality Self Learning Materials (SLMs) in print under Choice Based Credit System (CBCS) system. The curriculum is reviewed regularly to ensure that it is up-to-date and relevant to the needs of learners.
- ✓ Learner's assessment and evaluation process through a variety of methods, including exams, assignments. This helps to ensure that Learners are meeting the learning outcomes of the Programme.

Expected Programme outcomes:

The outcome 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. 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. 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.