

Syllabus
Department of Botany
CBCS Honours

Course code	Course Name	Units	Name of Teachers	Methodology
CBCS (Honours)				
Semester I				
BOT-HC-1016	Phycology and Microbiology	Unit 1: Introduction to microbial world Scope of microbes in industry and environment; Microbial nutrition, growth and metabolism [Only an overview of microbial metabolism- the concept of anabolism (Biosynthesis) and catabolism (ATP-generating Pathways-Respiration and Fermentation)].	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 2: Viruses Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases.		

<p>Unit 3: Bacteria</p> <p>Discovery, general characteristics; Types-archaeobacteria, eubacteria, actinomycetes, mycoplasma, rickettsia, chlamydiae and sphaeroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria with reference to their role in agriculture and industry (Alcohol and Antibiotic production)</p>		
<p>Unit 4: Algae</p> <p>General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; Evolutionary significance of Prochloron; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Role of algae in the environment, agriculture, biotechnology and industry, Economic importance of Diatoms</p>	<p>Dr. Neeta Basumatary</p>	<p>Lecture, notes, powerpoint, practical and laboratory</p>
<p>Unit 5: Cyanophyta and Xanthophyta</p> <p>Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of Nostoc and Vaucheria.</p>		

		<p>Unit 6: Chlorophyta, Charophyta and Bacillariophyta</p> <p>General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Volvox, Oedogonium, Coleochaete, Chara. General Account of Bacillariophyta.</p>		
		<p>Unit 7: Phaeophyta and Rhodophyta</p> <p>Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Ectocarpus, Fucus and Polysiphonia.</p>		
<p>BOT-HC-1026</p>	<p>Biomolecules and Cell Biology</p>	<p>Unit 1: Biomolecules</p> <p>Types and significance of chemical bonds; Structure and properties of water; pH and buffers.</p> <p>Carbohydrates: Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides.</p> <p>Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.</p> <p>Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins.</p> <p>Nucleic acids: Structure of nitrogenous bases;</p>	<p>Dr. Zina Moni Basumatary</p>	<p>Lecture, notes, practical and laboratory, power point,</p>

		<p>Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, C, D, Z types of DNA; Types of RNA.</p>		
		<p>Unit 2: Bioenergetics Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.</p>		
		<p>Unit 3: Enzymes Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity</p>		
		<p>Unit 4: The cell Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory)</p>		
		<p>Unit 5: Cell wall and plasma membrane Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.</p>		
		<p>Unit 6: Cell organelles Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton: Role and structure of microtubules,</p>		

		<p>microfilaments and intermediary filament.</p> <p>Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.</p> <p>Endomembrane system: Endoplasmic Reticulum: Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes</p>		
		<p>Unit 7: Cell division</p> <p>Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle-checkpoints, role of protein kinases.</p>		
Semester II				
BOT-HC-2016	Myxology and Phytopathology	<p>Unit 1: Introduction to Fungi</p> <p>General characteristics; Status of Fungi in living system; Thallus organization, modification of hyphae; Cell and Cell wall composition; Nutrition, flagella, septum, homothallism and heterothallism, cell division.</p> <p>History of Classification (Hidetta et al. 2007); Classification of Fungi (Ainsworth, 1973, Webster 1977) up to sub-division with diagnostic characters and examples.</p> <p>General characteristics of Myxomycota, Oomycota, Zygomycota, Ascomycota, Basidiomycota and</p>	Dr. Rakhi Bhattacharyya	Lecture, practical and laboratory notes, and

Deuteromycota.		
Unit 2: Mastigomycotina (Chytridiomycetes and Oomycetes) Characteristic features; Reproduction; Life cycle with reference to Synchytrium, Phytophthora and Albugo.		
Unit 3: Zygomycotina Characteristic features; Reproduction; Life cycle with reference to Rhizopus.		
Unit 4: Ascomycotina General characteristics (asexual and sexual fruiting bodies); Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to Saccharomyces, Aspergillus, Penicillium, Neurospora and Peziza		
Unit 5: Basidiomycotina General characteristics; Life cycle and Classification with reference to black stem rust on wheat Puccinia (Physiological Specialization), loose and covered smut (symptoms only), Agaricus; Bioluminescence, Fairy Rings and Mushroom Cultivation.		
Unit 6: Deuteromycotina (Fungi Imperfecti) General characteristics; Thallus organization; reference to Alternaria and Colletotrichum.		
Unit 7: Allied Fungi- Myxomycota General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies	Dr. Neeta Basumatary	
Unit 8: Symbiotic associations Lichen – Occurrence; General characteristics; Range of thallus organization; Internal structure and nature of associations of algal and fungal partners; Reproduction. Mycorrhiza- Ectomycorrhiza,		Lecture, notes,assignment

		<p>Endomycorrhiza and their significance.</p> <p>Unit 9: Applied Mycology Role of fungi in biotechnology; food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Pharmaceutical (Secondary metabolites); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.</p> <p>Unit 10: Phytopathology Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.</p>		
BOT-HC-2026	Archegoniate	<p>Unit 1: Introduction Unifying features of archegoniates; Transition to land habit; Alternation of generations.</p> <p>Unit 2: Bryophytes General characteristics; Adaptations to land habit; Classification; Range of thallus organization.</p> <p>Unit 3: Type Studies- Bryophytes Classification, morphology, anatomy and reproduction of Riccia, Marchantia, Anthoceros, Sphagnum and Polytrichum; Reproduction and evolutionary trends in Riccia, Marchantia, Anthoceros, Sphagnum and Polytrichum. Ecological</p>	Dr. Zina Moni Shandilya	Lecture, practical and laboratory notes, and

		and economic importance of bryophytes.		
		Unit 4: Pteridophytes General characteristics; Classification; Early land plants (Cooksonia and Rhynia).		
		Unit 5: Type Studies- Pteridophytes Classification, morphology, anatomy and reproduction of Psilotum, Lycopodium, Selaginella, Equisetum, Pteris and Marsilea. Apogamy and apospory, heterospory and seed habit, telome theory, stelar evolution; Ecological and economic importance		
		Unit 6: Gymnosperms General characteristics, classification (up to family), morphology, anatomy and reproduction of Cycas, Pinus, Ginkgo and Gnetum; Ecological and economic importance.	Dr. Neeta Basumatary	Lecture, notes, field work
Semester III				
BOT-HC-3016	Morphology, Anatomy of Angiosperm	Unit 1: Morphology Morphology of inflorescence, stamens and carpel, fruit; Telome theory, phyllode theory; Role of morphology in plant classification	Dr. Neeta Basumatary	Lecture, notes, practical and laboratory
		Unit 2: Introduction and scope of plant Anatomy Application in systematics, forensics and pharmacognosy.		
		Unit 3: Structure and Development of Plant Body Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development.		
		Unit 4: Tissues Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiation of tracheary		

elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers

Unit 5: Apical meristems
Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root

Unit 6: Vascular Cambium and Wood
Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.

Unit 7: Adaptive and Protective Systems
Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni-and multicellular, glandular and non-glandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and

		hydrophytes.		
BOT-HC-3026	Economic Botany	Unit 1: Origin of Cultivated Plants Centres of Origin, their importance with reference to Vavilov's work. Introductions, domestication and loss of crop genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory, exhibition
		Unit 2: Cereals Wheat and Rice (origin, morphology, processing & uses); Brief account of millets		
		Unit 3: Legumes Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.		
		Unit 4: Sources of sugars and starches Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.		
		Unit 5: Spices Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper.		
		Unit 6: Beverages Tea, Coffee (morphology, processing & uses).		
		Unit 7: Sources of oils and fats General description, classification, extraction, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.		
		Unit 8: Natural Rubber Para-rubber: tapping, processing and uses.		

		<p>Unit 9: Drug-yielding plants Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis; Tobacco (Morphology, processing, uses and health hazards).</p>		
		<p>Unit 10: Timber plants (3 Lectures) General account with special reference to teak and pine.</p>		
		<p>Unit 11: Fibers Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses).</p>		
<p>BOT-HC-3036</p>	<p>Genetics</p>	<p>Unit 1: Mendelian genetics and its extension Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Numericals; Polygenic inheritance.</p> <p>Unit 2: Extrachromosomal Inheritance Chloroplast inheritance: Variegation in Four o'clock plant; Mitochondrial inheritance in yeast; Maternal effects-shell coiling in snail; Kappa particles in Paramecium.</p> <p>Unit 3: Linkage, crossing over and chromosome mapping Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.</p> <p>Unit 4: Variation in chromosome number and structure</p>	<p>Dr. Zina Moni Shandilya</p>	<p>Lecture, practical and laboratory, notes, and</p>

		Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy		
		Unit 5: Gene mutations Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms		
		Unit 6: Fine structure of gene Classical vs molecular concepts of gene; Ciston, Racon, Muton, rII locus		
		Unit 7. Population and Evolutionary Genetics Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.		
BOT-SE-3014	Biofertilizer	Unit 1: General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier-based inoculants, Actinorrhizal symbiosis.	Dr. Rakhi Bhattacharyya	Lecture, notes, assignment
		Unit 2: Azospirillum: isolation and mass multiplication – carrier-based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication. (16 lectures).	Dr. Neeta Basumatary	Lecture, notes, practical and laboratory
		Unit 3: Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla	Dr. Rakhi Bhattacharyya	Lecture, notes,
		Unit 4: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization	Dr. Neeta Basumatary	Lecture, notes, test

		of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.		
		Unit 5: Organic farming – Green manuring and organic fertilizers, Recycling of bio-degradable municipal, agricultural and Industrial wastes – bio-compost making methods, types and method of vermicomposting – field Application.	Dr. Zina Moni Shandilya	Lecture, notes
Semester IV				
BOT-HC-4016	Molecular Biology	Unit 1: Nucleic acids: Carriers of genetic information Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment.	Dr. Zina Moni Shandilya	Lecture, practical and laboratory notes,
		Unit 2: The Structures of DNA and RNA /Genetic Material DNA Structure: Miescher to Watson and Crick-historic perspective, DNA structure, Salient features of double helix, denaturation and renaturation, cot curves; Organization of DNA; Prokaryotes, Viruses, Eukaryotes. Organelle DNA -- mitochondria and chloroplast DNA. The Nucleosome Chromatin structure- Euchromatin, Heterochromatin-Constitutive and Facultative heterochromatin		
		Unit 3: The replication of DNA Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semiconservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA; Enzymes involved in DNA replication.		
		Unit 4: Central dogma and genetic code		

		Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)		Lecture, notes
		Unit 5: Transcription Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E. coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing.		
		Unit 6: Processing and modification of RNA Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' poly A tail); Ribozymes; RNA editing and mRNA transport.		
		Unit 7: Translation Structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.		
BOT-HC-4026	Plant Ecology and Phytogeography	Unit 1: Introduction Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory, field work
		Unit 2 : Soil Importance; Origin; Formation; Composition;		

Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.

Unit 3 : Water

Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

Unit 4: Adoption of plants to various environmental factors Light, temperature, wind and fire

Unit 5: Biotic interactions

Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop.

Unit 6: Population ecology (4 lectures) Population characteristics, Growth curve, population regulation, r and k selection. Ecological speciation: Allopatric/ Sympatric and Parapatric speciation

Unit 7: Plant communities

Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Unit 8: Ecosystems

Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.

Unit 9: Functional aspects of ecosystem

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.

Unit 10: Phytogeography

		Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Vegetation types of NE India with special reference to Assam.		
BOT-HC-4036	Plant Systematics	<p>Unit 1: Significance of Plant systematics</p> <p>Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Functions and importance of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Concept of taxa (family, genus, species); Categories and taxonomic hierarchy.</p> <p>Unit 2: Botanical nomenclature Principles and rules (ICN); Ranks and names; Typification, author citation, Effective and valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.</p> <p>Unit 3: Systems of classification Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG) classification.</p> <p>Unit 4: Numerical taxonomy and cladistics</p>	Dr. Neeta Basumatary	Lecture, notes, practical and laboratory, exhibition

		<p>Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).</p> <p>Unit 5: Phylogeny of Angiosperms</p> <p>Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).</p> <p>Unit 6: Angiospermic Families Detail study of the following families: Magnoliaceae, Fabaceae, Asteraceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Musaceae, Zingiberaceae, Poaceae</p>		
BOT-SE-4014	Nursery and Gardening	<p>Unit 1: Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.</p>	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory
		<p>Unit 2: Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion – Seed production technology - seed testing and certification.</p>	Dr. Zina Moni Shandilya	Lecture, notes, assignment
		<p>Unit 3: Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house - mist chamber,</p>	Dr. Neeta Basumatary	Lecture, notes

		shed root, shade house and glass house.		
		Unit 4: Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	Dr. Zina Moni Shandilya	Lecture, notes
		Unit 5: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.	Dr. Rakhi Bhattacharyya	Lecture, notes
Semester V				
BOT-HC-5016	Reproductive Biology of Angiosperms	<p>Unit 1: Introduction</p> <p>History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope.</p> <p>Unit 2: Reproductive development Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspects.</p> <p>Unit 3: Anther and pollen biology</p> <p>Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC</p>	Dr. Neeta Basumatary	Lecture, notes, practical and laboratory

system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.

Unit 4: Ovule

Structure; Types; Special structures—endothelium, obturator, aril, caruncle and hypostase; Female gametophyte— megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac.

Unit 4: Pollination and fertilization

Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.

Unit 5: Self incompatibility

Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization; Cybrids, in vitro fertilization.

Unit 6: Embryo, Endosperm and Seed

Structure and types; General pattern of development of dicot and monocot embryo and endosperm; Suspensor: structure and functions; Embryo-

		<p>endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in Paeonia. Seed structure, importance and dispersal mechanisms</p> <p>Units 7: Polyembryony and apomixis Introduction; Classification; Causes and applications.</p>		
BOT-HC-5026	Plant Physiology	<p>Unit 1: Plant-water relations Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement. Plant response to water stress.</p> <p>Unit 2: Mineral nutrition Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents, Ion antagonism and toxicity.</p> <p>Unit 3: Nutrient Uptake Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.</p> <p>Unit 4: Translocation in the phloem Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading; Source–sink</p>	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory,

relationship.

		<p>Unit 5: Plant growth regulators Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.</p> <p>Unit 6: Physiology of flowering Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.</p> <p>Unit 7: Phytochrome, cryptochromes and phototropins Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.</p>	Dr. Zina Moni Shandilya	Lecture, notes, field work
BOT-HE-5016	Natural Resource Management	<p>Unit 1: Natural resources Definition and types.</p> <p>Unit 2: Sustainable utilization Concept, approaches (economic, ecological and socio-cultural).</p> <p>Unit 3: Land Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management.</p> <p>Unit 4: Water Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies.</p> <p>Unit 5: Biological Resources Biodiversity-definition and types; Significance; Threats; Management strategies; Bioprospecting; IPR; CBD; National Biodiversity Action Plan).</p>	Dr. Zina Moni Shandilya	Lecture, notes and practical laboratory

		<p>Unit 6: Forests Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management.</p> <p>Unit 7: Energy Renewable and non-renewable sources of energy.</p> <p>Unit 8: Contemporary practices in resource management EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management.</p> <p>Unit 9: National and international efforts in resource management and conservation</p>	Dr. Rakhi Bhattacharyya	Lecture, notes
BOT-HE-5026	Horticulture Practices and Post-Harvest Technology	<p>Unit 1: Introduction Scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; Urban horticulture and ecotourism.</p>	Dr. Zina Moni Shandilya	Lecture, notes, quiz
		<p>Unit 2: Ornamental plants Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants [rose, marigold, gladiolus, carnations, orchids, poppies, gerberas, tuberose, sages, cacti and succulents (opuntia, agave and spurges)] Ornamental flowering trees (Indian laburnum, gulmohar, Jacaranda, Lagerstroemia, fishtail and areca palms, semul, coral tree).</p>	Dr. Neeta Basumatary	Lecture, notes, practical and laboratory

<p>Unit 3: Fruit and vegetable crops</p> <p>Production, origin and distribution; Description of plants and their economic products; Management and marketing of vegetable and fruit crops; Identification of some fruits and vegetable varieties (citrus, banana, mango, chillies and cucurbits).</p>	Dr. Rakhi Bhattacharyya	Lecture, notes
<p>Unit 4: Horticultural techniques</p> <p>Application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Scope and limitations.</p>	Dr. Neeta Basumatary	Lecture, notes
<p>Unit 5: Landscaping and garden design</p> <p>Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices.</p>	Dr. Zina Moni Shandilya	Lecture, notes
<p>Unit 6: Floriculture</p> <p>Cut flowers, bonsai, commerce (market demand and supply); Importance of flower shows and exhibitions</p>	Dr. Neeta Basumatary	Lecture, notes, assignment
<p>Unit 7: Post-harvest technology</p> <p>Importance of post-harvest technology in horticultural crops; Evaluation of quality traits; Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing losses during storage and transportation; Food irradiation - advantages and disadvantages; food safety.</p>	Dr. Rakhi Bhattacharyya	Lecture, notes

		<p>Unit 8: Disease control and management</p> <p>Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures and nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices; Identification of common diseases and pests of ornamentals, fruits and vegetable crops</p>	Dr. Rakhi Bhattacharyya	Lecture, notes
		<p>Unit 9: Horticultural crops - conservation and management</p> <p>Documentation and conservation of germplasm; Role of micropropagation and tissue culture techniques; Varieties and cultivars of various horticultural crops; IPR issues; National, international and professional societies and sources of information on horticulture.</p>	Dr. Zina Moni Shandilya	Lecture, notes
		<p>Unit 10: Field trip Field visits to gardens, standing crop sites, nurseries, vegetable gardens and horticultural fields at suitable locations.</p>	Dr. Rakhi Bhattacharyya, Dr. Zina Moni Shandilya and Dr. Neeta Basumatary	Lecture, notes
Semester VI				
BOT-HC-6016	Plant Metabolism	<p>Unit 1: Concept of metabolism</p> <p>Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes; classification, nomenclature and importance of enzyme; concept of coenzyme, apoenzyme and prosthetic group; enzyme inhibition (allosteric, covalent modulation and Isozymes)</p>	Dr. Zina Moni Shandilya	Lecture, notes, practical and laboratory
		<p>Unit 2: Carbon assimilation</p> <p>Historical background, photosynthetic pigments, role</p>	Dr. Rakhi Bhattacharyya	Lecture, notes, field work

of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO ₂ reduction, photorespiration, C ₄ - pathways; Crassulacean acid metabolism; Factors affecting CO ₂ reduction.		
Unit 3: Carbohydrate metabolism Synthesis and catabolism of sucrose and starch.	Dr. Rakhi Bhattacharyya	Lecture, notes
Unit 4: Carbon Oxidation Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory
Unit 5: ATP-Synthesis Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers	Dr. Neeta Basumatary	Lecture, notes
Unit 6: Lipid metabolism Synthesis and breakdown of triglycerides, β -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation.	Dr. Neeta Basumatary	Lecture, notes
Unit 7: Nitrogen metabolism Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia	Dr. Rakhi Bhattacharyya	Lecture, notes

		assimilation and transamination.		
		Unit 8: Mechanisms of signal transduction Receptor-ligand interactions; Second messenger concept, Calcium calmodulin, MAP kinase cascade.	Dr. Zina Moni Shandilya	Lecture, notes
BOT-HC-6026	Plant Biotechnology	Unit 1: Plant Tissue Culture Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).	Dr. Zina Moni Shandilya	Lecture, notes
		Unit 2: Recombinant DNA technology Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).	Dr. Neeta Basumatary	Lecture, notes
		Unit 3: Gene Cloning Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR	Dr. Zian Moni Shandilya	Lecture, notes
		Unit 4: Methods of gene transfer Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable	Dr. Zina Moni Shandilya	Lecture, notes, practical and laboratory

		marker and reporter genes (Luciferase, GUS, GFP).		
		Unit 5: Applications of Biotechnology Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products– Human Growth Hormone; Humulin; Biosafety concerns.	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 1: Scope of microbes in industry and environment	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory
		Unit 2: Bioreactors/Fermenters and fermentation processes Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations. Components of a typical bioreactor, Types of bioreactors-laboratory, pilot scale and production fermenters; Constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter. A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations.	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 3: Microbial production of industrial products Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory,
BOT-HE-6016	Industrial and Environmental Ecology			

		extraction, precipitation and ultrafiltration, lyophilization, spray drying; Hands on microbial fermentations for the production and estimation (qualitative and quantitative) of Enzyme: amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin)		
		Unit 4: Microbial enzymes of industrial interest and enzyme immobilization Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 5: Microbes and quality of environment. Distribution of microbes in air; Isolation of microorganisms from soil, air and water.	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 6: Microbial flora of water. Water pollution, role of microbes in sewage and domestic waste water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality, check coliform and faecal coliform in water samples.	Dr. Rakhi Bhattacharyya	Lecture, notes, assignment
		Unit 7: Microbes in agriculture and remediation of contaminated soils. Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots.	Dr. Rakhi Bhattacharyya	Lecture, notes
BOT-HE-6026	Analytical Techniques in Plant Sciences	Unit 1: Imaging and related techniques Principles of microscopy; Light microscopy;	Dr. Zina Moni Shandilya	Lecture, notes, practical and

	Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.		laboratory
	Unit 2: Cell fractionation Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl ₂ gradient, analytical centrifugation, ultracentrifugation, marker enzymes.	Dr. Zina Moni Shandilya	Lecture, notes
	Unit 3: Radioisotopes Use in biological research, auto-radiography, pulse chase experiment	Dr. Zina Moni Shandilya	Lecture, notes
	Unit 4: Spectrophotometry Principle and its application in biological research.	Dr. Neeta Basumatary	Lecture, notes
	Unit 5: Chromatography Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.	Dr. Neeta Basumatary	Lecture, notes, test
	Unit 6: Characterization of proteins and nucleic acids Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE	Dr. Zina Moni Shandilya	Lecture, notes
	Unit 7: Biostatistics Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean,	Dr. Zina Moni Shandilya	Lecture, notes, practical and laboratory

		mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.		
BOT-HE-6036	Project Work / Dissertation	Project Work/Dissertation	Dr. Rakhi Bhattacharyya, Dr. Zina Moni Shandilya and Dr. Neeta Basumatary	practical and laboratory, project work
CBCS (Honours Generic)				
Semester I				
BOT-HG-1016	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	Unit 1: Microbes Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 2: Algae General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia. Economic importance of algae.	Dr. Neeta Basumatary	Lecture, notes
		Unit 3: Fungi Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of Rhizopus (Zygomycota) Penicillium, Alternaria (Ascomycota),	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory

		Puccinia, Agaricus (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.		
		Unit 4: Introduction to Archegoniate Unifying features of archegoniates, Transition to land habit, Alternation of generations.	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 5: Bryophytes General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of Sphagnum.	Dr. Neeta Basumatary	Lecture, notes
		Unit 6: Pteridophytes General characteristics, classification, Early land plants (Cooksonia and Rhynia). Classification (up to family), morphology, anatomy and reproduction of Selaginella, Equisetum and Pteris. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.	Dr. Neeta Basumatary	Lecture, notes
		Unit 7: Gymnosperms General characteristics; Classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus (Developmental details not to be included). Ecological and economical importance.	Dr. Neeta Basumatary	Lecture, notes
Semester II				
BOT-HG-2016	Plant Ecology and Taxonomy	Unit 1: Introduction	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 2: Ecological factors Soil: Origin, formation, composition, soil profile.		

		<p>Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes</p>		
		<p>Unit 3: Plant communities Characters; Ecotone and edge effect; Succession; Processes and types</p>		
		<p>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</p>		
		<p>Unit 5: Phytogeography Principle biogeographical zones; Endemism.</p>	<p>Dr. Zina Moni Shandilya</p>	<p>Lecture, notes</p>
		<p>Unit 6: Introduction to plant taxonomy Identification, Classification, Nomenclature.</p>		
		<p>Unit: 7 Identification Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access</p>		
		<p>Unit: 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.</p>		
		<p>Unit 9: Taxonomic hierarchy Ranks, categories and taxonomic groups</p> <p>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.</p>	<p>Dr. Neeta Basumatary</p>	<p>Lecture, notes, practical and laboratory</p>

		<p>Unit 11: Classification Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).</p> <p>Unit 12: Biometrics, numerical taxonomy and cladistics Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).</p>		
Semester III				
BOT-HG-3016	Plant Physiology and Metabolism	<p>Unit 1: Plant-water relations Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.</p>	Dr. Neeta Basumatary	Lecture, notes
		<p>Unit 2: Mineral nutrition Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.</p>	Dr. Neeta Basumatary	Lecture, notes
		<p>Unit 3: Translocation in phloem Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading</p>	Dr. Neeta Basumatary	Lecture, notes
		<p>Unit 4: Photosynthesis Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.</p>	Dr. Rakhi Bhattacharyya	Lecture, notes, practical and laboratory
		<p>Unit 5: Respiration</p>	Dr. Rakhi Bhattacharyya	Lecture, notes

		Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.		
		Unit 6: Enzymes Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 7: Nitrogen metabolism Biological nitrogen fixation; Nitrate and ammonia assimilation.	Dr. Zina Moni Shandilya	Lecture, notes
		Unit 8: Plant growth regulators Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.	Dr. Zina Moni Shandilya	Lecture, notes
		Unit 9: Plant response to light and temperature Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far-red light responses on photomorphogenesis; Vernalization.	Dr. Zina Moni Shandilya	Lecture, notes
Semester IV				
		Unit 1: Meristematic and permanent tissues Root and shoot apical meristems; Simple and complex tissues	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 2: Organs Structure of dicot and monocot root stem and leaf.	Dr. Rakhi Bhattacharyya	Lecture, notes
		Unit 3: Secondary Growth Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood)	Dr. Zina Moni Shandilya	Lecture, notes
		Unit 4: Adaptive and protective systems Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.	Dr. Zina Moni Shandilya	Lecture, notes, practical and laboratory
		Unit 5: Structural organization of flower Structure of anther and pollen; Structure and types of	Dr. Neeta Basumatary	Lecture, notes
BOT-HG-4016	Plant Anatomy and Embryology			

	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.	Dr. Neeta Basumatary	Lecture, notes
	Unit 7: Embryo and endosperm Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship	Dr. Rakhi Bhattacharyya	Lecture, notes