

M.Sc. Botany Syllabus

DEPARTMENT OF BOTANY

Krishnaguru Adhyatmik Visvavidyalaya,

SYLLABUS FOR M.Sc. PROGRAMME (CBCS)

IN

BOTANY

Effective from Academic Session 2024-2025

Paper Code	Name of the paper	Total Marks	Internal Assessment	Semester Exam	Teaching Hours/Week	Credits
First Semester						
BOT1016	Diversity I : (Algae and Fungi) Theory	80	20	100	5	6
BOT1026	Diversity II : (Bryophytes and Pteridophytes) Theory	80	20	100	5	6
BOT1036	Diversity III: Gymnosperm, Angiosperm and Phytogeography. Theory	80	20	100	5	6
BOT1044	Algae, Fungi, Bryophytes and Pteridophytes Practical	80	20	100	9	3
BOT1054	Gymnosperm, Angiosperm Practical	80	20	100	9	3
Second Semester						
BOT2016	Cytogenetics ,Plant Breeding & Evolution Theory	80	20	100	5	6
BOT2026	Plant pathology and Microbiology Theory	80	20	100	5	6
BOT2036	Plant Physiology and Biochemistry Theory	80	20	100	5	6
BOT2044	Plant pathology, Microbiology and Cytogenetics. Practical	80	20	100	9	3
BOT2054	Plant Physiology Biochemistry and Ecology. Practical	80	20	100	9	3
Third Semester						
BOT 3016	Molecular Biology and Plant Biotechnology Theory	80	20	100	5	4
BOT3026	Reproductive and Developmental Botany, Bioinstrumentation Theory	80	20	100	5	4
BOT3036	Bioinformatics and Biostatistics Theory	80	20	100	5	4
BOT3044	Reproductive and Developmental Botany and Microtome Practical	80	20	100	9	4
BOT3054	Molecular Biology and Plant Biotechnology, Biostatistics Practical	80	20	100	9	4
Fourth Semester						
BOT4016	Special Paper I: Theory	80	20	100	5	4
BOT4026	Special Paper II Theory	80	20	100	5	4
BOT4036	Special Paper III Theory	80	20	100	5	4
BOT 4046	Special Paper Practical	80	20	100	9	4
BOT4056	Dissertation		20	100	9	4

VAC Papers:

1. **First semester:** BOT-VAC-1014-English Communication.
2. **Second semester:** BOT-VAC-2014-Ecosystem, Biodiversity and Pollution
3. **Third semester:** BOT-VAC-3014-Mushroom Cultivation.
4. **Fourth semester:** BOT-VAC-4014-Vermiculture and Vermicomposting.

Programme specific outcome:**M.Sc. in Botany**

Study, understand and explore the life cycle pattern, phylogeny and economic values of Cryptogamic and Phanerogamic plants of the NE Region.

Analyse ecosystem interactions, interdependence and ecological balance and understanding basic concepts and recent trends in Cytology, Genetics and Plant Breeding, Plant Physiology and Biochemistry, Microbiology, Plant Ecology, Mycology and Plant Pathology

Train up skill human resources in the field of Angiosperm Taxonomy, including identification, classification, field survey and documentation.

Performing standard lab procedures in microscopy, staining, culturing techniques. Understand the application of plant resources in agriculture, health care, industry and other environmental issues.

Bottom of Form

FIRST SEMESTER

Allotment of Marks and Credits

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOT1016	80	20	100	6	5
BOT1026	80	20	100	6	5
BOT1036	80	20	100	6	5
BOT1044	80	20	100	3	4
BOT1054	80	20	100	3	4
Total	400	100	500	24	23

Examination Time: Theory.....3(Three Hours); Practical...5(Five Hours)

BOT-1016 Diversity I (Algae & Fungi)

Unit-I

Algae: Diversity and classification, recent trends in the classification, pigmentation, morphology and reproduction, phylogeny and interrelationships among different groups, General characteristics,

Unit-II

classification and brief introduction of Chlorophyta- Chlamydomonas, Volvox, Oedogonium Xanthophyta, Phaeophyta and Rhodophyta, Ecological importance in different habitats, Algal indicators, Algal blooms, Eutrophication, symbiotic association, Algal culture.

Unit-III

Fungi: Introduction to fungi and their significance to humans. Characteristics of fungi and cell structure, recent trends in classification and phylogeny. Different mode of reproduction, heterothallism, parasexuality and degeneration of sex in fungi. General characteristics, classification and brief introduction of – Mastigomycotina- Chytridiomycetes, Oomycetes, Zygomycotina- Mucorales, Glomales and Rhizopus with special reference to evolutionary trends in thallus.

Unit-IV

Fungi: Physiological and ecological specialization (coprophilous, cellulolytic, entomogenous and lignolytic); Mutualism: Mycorrhiza, Lichen; Parasites: common parasites of plants and humans, Saprophytes - decomposition of organic matter, Economic importance.

Unit-V

Lichen: Classification and nomenclature, structure and reproduction, mechanism of phycobiont and mycobiont interaction, lichen as ecological indicator.

Unit-VI

Virus: Types and nomenclature of viruses, replication of RNA and DNA viruses, virus-vector relationships, tumor virus, viroids, prions and interferons. Bacterial cell: Ultra structure, cell wall, different groups of bacteria, recent developments in classification.

BOT 1026

DiversityII (Bryophytes and Pteridophytes)

Unit-I:

Bryophytes: Origin and evolution of Bryophytes, classification, physiology and ecology; diversity and distribution in North East India, Economic importance of Bryophytes.

Unit-II:

Morphological, anatomical and reproductive diversity, Morphogenesis, Evolution of gametophytes and sporophytes; Bryophytes as pollution indicator and monitoring.

Unit-III:

General characteristics, morphology, anatomy and life history of Anthocerotopsida - Anthoceros, Notothylas, Bryopsida – Sphagnum, Andreae, Polytrichum.

Unit-IV: Pteridophyta: Origin and evolution of Pteridophytes; Telome concept; stellar evolution; heterospory and origin of seed habit; Embryogeny in Pteridophytes, classification of vascular cryptogams.

Unit-V

Morphological, anatomical and reproductive diversity, soral evolution in ferns, gametophytic structure in eusporangiate and leptosprongiate forms and evolution of sex.

Unit-VI

Comparative morphology, anatomy, reproductive biology and evolutionary studies of the following groups – Psilopsida, Lycophta, Sphenopsida, Isoetes, Psilotum, Adiantum and Pteris.

BOT 1036
Gymnosperm, Angiosperm and Phytogeography

Unit-I

Gymnosperms: Classification and salient features of major taxa; characteristics, affinities and relationships of Ginkgoales, Coniferales, Taxales and Gnetales. Origin and evolution of gymnosperms. Origin of seed habit.

Unit-II

Comparative morphology, anatomy, reproductive biology and phylogenetic studies of the following groups: Glossopteridales, Cycadopsida, Ginkgopsida, Coniferopsida and Gnetopsida. Endangered gymnosperms, their conservation and present status.

Unit-III

Angiosperms: Historical background of Plant Taxonomy; Pre Darwinian, Post Darwinian and recent system of classifications (Takhtajan, Cronquist, APG); recent trends in Taxonomy; ICN- History, Principles and major rules of nomenclature, type concept, principles of priority and its limitation, effective and valid publication, author citation; plant collection and documentation; importance of botanical gardens and herbaria in taxonomic studies: important botanical gardens in India and abroad; Botanical Survey of India.

Unit-IV

Phylogeny and affinities of Magnoliales, Ranunculales, Euphorbiales, Scrophuriales, Lamiales, Asterales, Orchidales, Zingiberales, Poales

Unit-V

Morphology: Origin and evolution of Angiosperms; Inflorescence and flowers; Co- evolution of flower and pollinators; Morphology of stamens and carpels; staminodia; nectaries; types of ovaries, morphology of inferior ovary; placenta and placentation.

Unit-VI

Dynamic phytogeography and its basic principles , theories and hypotheses, centre of origin of cultivated plants, plant migration, theory of tolerance, age and area hypothesis, concept of endemism, megacentres of endemism in India, endemic plants of India with special reference to N E India, phytogeographic regions of the world and India and their characteristic vegetations. Characteristic flora of N E India.

BOT 1044

Practical Paper: Algae, Fungi, Bryophytes and Pteridophytes

1. Study of range of thallus organization and reproductive structures of algae with the help of suitable representatives.
2. Gram staining, capsule staining and acid fast staining of bacteria.
3. Collection and study of symptoms of virus infected plants.
4. Study of morphological, anatomical and reproductive features of some fungi growing in Assam
5. Study of morphological and anatomical features of some lichens growing in Assam
6. Study of some important genera of Bryophytes available in NE India with respect to their morphology, anatomy and reproductive structures.
7. Study of some important fossil and living members of major groups of Pteridophytes

BOT 1054

Practical Paper: Gymnosperms, Angiosperms

1. Determination of minimum size and number of quadrats necessary to study herbaceous communities
2. Determination of abundance, density, frequency, basal cover of plant communities by quadrat method.
3. Estimation of aboveground and below ground biomass from unit area.
4. Effect of biotic disturbances on botanical composition.
5. Study of similarity between plant communities using index of similarity and dissimilarity.
6. Estimation of dissolved oxygen concentration trophic and oligo trophic water samples.
7. Study on effects of effluents/contaminants on plant growth.
8. Morpho-anatomical adaptive features of hydrophytes and xerophytes.
9. Preparation of a map of India showing biogeographical zones.
10. To plot Biosphere Reserves/ Ramsar sites/ National Parks/ Wildlife Sanctuaries located in different biogeographical zones of India in general and NE India in particular.
11. Study of morphological, anatomical and reproductive features of gymnosperms available in the region.

12. Study of Angiospermic plants with analytical drawings, botanical description and identification up to the rank of species
13. Study of special types of inflorescence, primitive and advance flowers, ovaries and fruits
14. Collection and preparation of herbarium specimens of common plants for familiarization of herbarium techniques.
15. Morphological and anatomical studies on economically important plants/ Part (s) of cotton, jute, tea, bay leaf, rauwolfia, tulsi.
16. Field study report.

Allotment of Marks and Credits

Paper(s)	Coursework	Internal Assessment	Total	Credit	Class/week
BOT2016	80	20	100	6	5
BOT2026	80	20	100	6	5
BOT2036	80	20	100	6	5
BOT2044	80	20	100	4	9
BOT2054	80	20	100	4	9
Total	400	100	500	26	33
Examination Time:		Theory.....3(Three Hours);		Practical...5(Five Hours)	

BOT 2016

Cytogenetics, Plant-breeding and Evolution

Unit-I: Basic concept and organization: Chromosomes structure, structure of prokaryotic and eukaryotic chromosomes, centromeres and telomeres, euchromatin and heterochromatin special types of chromosomes- Polytene, Lamp-brush and B chromosomes. Concept of genes and alleles

Unit-II: Structural organization and function of intracellular organelles; cell division and cell cycle, regulation and control.

Unit-III: Linkage mapping. sex-linked inheritance, cytoplasmic inheritance, cis and trans arrangement of linked genes, crossing over. Genome organization, genome size and C-value paradox, DNA packaging, unique and repetitive DNA. Transcriptional regulation in prokaryotes, operon system for lactose, and tryptophan metabolism.

Unit-IV: Mutation: concept and types of mutations. Spontaneous, reverse and induced mutation, physical and chemical mutagens, molecular basis of mutations.

Unit-V: DNA damage and repair; in born errors of metabolism, metabolic pathways, overview of the metabolic basis of inherited diseases.

Unit-VI: Principle of plant breeding; distant hybridization, barrier to distance hybridization, techniques for distant hybridization; back Cross methods of plant breeding; breeding for quantitative characters, handling of quantitative data, environmental effect on quantitative characters, estimation of heritability and genetic advance.

BOT 2026
Plant Pathology and Microbiology

Unit-I: Plant Pathology: Principles of plant pathology, mechanism of pathogenesis, symptomatology and epidemiology, host defense mechanism, causal organism and etiology of certain important plant diseases occurred in NE India

Unit-II: Immunology: Innate and acquired immunity, antibodies, cells and tissues of the immune system, immune diseases, serological reactions and serodiagnostics, cancer biology,

Unit-III: Applied microbiology: Application of microbes in the field of agriculture, fermented foods and dairy products, industry and bio-waste management.

Unit-IV: Microbial diversity: 'Species' and 'Strain' concept in microbiology, ICN for virus, bacteria and other microbes, microbiome concept, ecological significance of microbes, microbiology of soil, air, water and milk.

Unit-V: Microbial techniques: sterilization techniques, population estimation (direct spore count, CFU, spectrophotometric method), pure culture and visualization techniques, culture preservation and maintenance, taxonomic and functional characterization of microbes.

Unit-VI: Microbial genetics & Physiology: Mode of reproduction (vegetative, asexual & sexual), genetic recombination, mode of nutrition, growth conditions and nutritional requirements, different metabolic pathways (respiratory and photosynthetic).

Unit-I: Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Biomolecules: their structures and functions: Carbohydrate, lipids, proteins.

Unit-II: Enzymes: Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes; Protein synthesis and processing: Nitrate and ammonium assimilation; amino acid biosynthesis. Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins.

Unit-III: Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C₃, C₄ and CAM pathways. Respiration and photorespiration: Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Unit-IV: Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

Unit-V: Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement.

Unit-VI: Solute transport and photo-assimilate translocation: uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; mechanisms of loading and unloading of photoassimilates.

BOT 2044

Practical Paper : Microbiology, Plant Pathology and Cytogenetics

1. Isolation and pure culture of microbes from soil, air and water
2. Identification and characterization of isolated pure cultures
3. Estimation of water quality
4. Identification and characterization of milk bacteria and nodule bacteria
5. Methylene blue reductase test for bacterial contamination of milk
6. Estimation of bacterial growth by spectrophotometric method and counting of cells
7. Effect of physical and chemical factors on growth of microbes
8. Study of plant pathogenic fungi from diseased specimens (symptoms, causal organism and their morphological & reproductive characters)
9. Spore measurement and camera lucida diagram
10. Chromosome analysis, study of chromosome behavior in mitosis and meiosis, chromosome anomalies in plant cells.
11. Principle, techniques and procedure of emasculation.

BOT 2054

Practical Paper: Plant Physiology and Biochemistry

1. Preparation of normal, molar and molal solutions
2. Extraction of proteins from plant materials and estimation by Lowry's method using BSA standard curve.
3. Extraction of carbohydrates from plant materials and estimation of reducing and non reducing sugars.
4. Extraction of oil/fat from plant materials
5. Extraction of plant phenols and estimation of total phenols.
6. Extraction of chloroplast pigments and quantitative estimation; Determination of chlorophyll a/b ratio and total chlorophyll in C3, C4 and CAM plants.
7. Separation of amino acid mixture by thin layer/paper chromatograph.

THIRD SEMESTER

Allotment of Marks and Credits

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOT3016	80	20	100	4	5
BOT3026	80	20	100	4	5
BOT3036	80	20	100	4	5
BOT3046	80	20	100	4	4
BOT3056	80	20	100	4	4
Total	400	100	500	20	23
Examination Time:		Theory.....3(Three Hours);		Practical...5(Five Hours)	

BOT-3016

MOLECULAR BIOLOGY and PLANT BIOTECHNOLOGY

Unit- 1 : Physical properties of DNA (UV absorption spectra, denaturation and renaturation), DNA topology, DNA - Protein Interactions, DNA replication, RNA synthesis and processing, small RNAs

Unit- 2: Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G protein coupled receptors, signal transduction pathways, regulation of signaling pathways, bacterial chemotaxis and quorum sensing.

Unit-3: Plant tissue culture and in vitro morphogenesis: Plant tissue culture techniques, embryo culture and its applications, embryogenesis and organogenesis, micropropagation, haploids and their applications, somaclonal variations and applications, Endosperm culture and production of triploids.

Unit-4 : Introduction to protoplast isolation, somatic hybridization. Protoplast and tissue culture for genetic manipulation of plants, crop improvement and development of transgenic plants. Single cell protein (SCP), economic implications of SCP.

Unit-5:

Genetic manipulations and practical utility:

Basic concept of recombinant DNA technology, principles of gene cloning. Restriction modification systems, use of restriction enzymes in biotechnology, cloning vectors, methods of gene transfer, DNA libraries, Introduction to PCR, RFLP.

Unit-6:

Development of recombinant vaccines, monoclonal antibody their applications. Introduction to transgenics, gene therapy, Production of secondary metabolites/products: Insulin, growth hormones and interferons.

BOT 3026
REPRODUCTIVE AND DEVELOPMENTAL BOTANY,
MICROTOME

Unit- 1:

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogen gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; genomic imprinting; mutants and transgenics in analysis of development.

Unit- 2:

Sporogenesis and Gametogenesis in plants; pollination, double fertilization, embryogenesis, development of endosperms, types of endosperms; polyembryony, seeds and seed development, seed dispersal; apomixis, apospory, parthenocapry; comparative embryology

Unit- 3:

Morphogenesis and organogenesis in plants: Organization of shoot and root apices; shoot and root development; root-stem transition; leaf development and phyllotaxy; Transition to flowering and development of flower. Periderm: Origin and activity, Rytidome, protective tissue in Monocotyedons, bark and cork; Cambium- Origin, function, behaviour (normal and abnormal).

Unit- 4:

Palynology: Pollen morphology, ultrastructure, pollen chemistry, viability, storage and adaptation; Applications of palynology: aeropalynology and pollen allergy, melissopalynology, forensic palynology, palaeopalynology and hydrocarbon exploration.

Unit– 5:

centrifugation techniques, differential and density gradient centrifugation, DNA sequencing methods.

Unit – 6:

Microscopy: Types, Basics of staining and imaging techniques, Principles and applications of different microscopes (light, dark field, phase contrast, fluorescence, scanning and transmission electron microscopes), Chromosome banding, FISH; Microtomy and herbarium techniques; Macro and micro-morphological studies of plants.

BOT - 3036
BIOINFORMATICS and BIOSTATISTICS

Unit-1:

Introduction to bioinformatics and data generation:

Bioinformatics and its relation with molecular biology, related tools, databases (protein, nucleic acid and structural databases) and data retrieving system

Unit-2:

Data generation: Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray).

Unit-3:

Bioinformatics and application: Applications of Bioinformatics. Genome Annotation, Genome Assembly, Structural and Functional Genomics. Concept of metabolome and metabolomics, drug discovery and designing. Chemoinformatics and cheminformatics tools for drug discovery.

Unit-4:

Biostatistics: Measures of central tendencies; mean, mode, median, standard errors and standard deviations. Probability; normal, binomial and poisson distribution.

Unit-5: Null hypothesis, T-test, Chi Square test, F-test; Analysis of variance (ANOVA): Variance and co-variance analysis, Correlation and methods of studying the correlation, Regression and methods of studying regression

Unit -6: Statistical software packages and their importance in data analysis.

BOT 3044

Practical Paper: Reproductive and developmental Botany

1. Study of anomalous secondary growth of selective families of Angiosperms.
2. Study of developmental stages of leaf, stem and root.
3. Preparation of pollen grain slides by following different techniques.
4. Study of microsporogenesis, megasporogenesis, embryosacs and endosperms with the help of permanent slides.
5. Preparation of permanent slides by the process of microtome technique

BOT 3054

Practical Molecular Biology and Plant Biotechnology, Biostatistics

1. Protein isolation and gel electrophoresis
2. DNA isolation, quantification and electrophoresis
3. Restriction digestion and mapping
4. PCR reaction and gel electrophoresis
5. Regeneration of plantlets through tissue culture
6. Culture of Mushroom
7. Production of Synthetic Seeds
8. To work out mean, mode, median, standard errors and standard deviation
9. Field study and Visit to different Research Institutions/Universities/Centers/Botanical Garden/ Herbaria within India.

FOURTH SEMESTER

SPECIAL PAPERS OFFERED:

1. Angiosperm Taxonomy
2. Cytology, Genetics and Plant Breeding.
3. Plant Ecology.
4. Microbiology.
5. Mycology and Plant pathology.
6. Plant Physiology and Biochemistry

Optional–I: Angiosperm Taxonomy (Special Paper)

Allotment of Marks and Credits

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOT4016	80	20	100	4	5
BOT4026	80	20	100	4	5
BOT4036	80	20	100	4	5
BOT4046	80	20	100	4	9
BOT4056	80	20	100	4	9
Total	400	100	500	20	33

Examination Time: Theory.....3(Three Hours); Practical...5(Five Hours)

BOT 4016 (Special paper: ANGIOSPERM TAXONOMY: I)

Unit-I : Basics of Taxonomy: Concept, Aims and Principles, Alpha and Omega taxonomy; Concept of Phenetic, Phyletic, and Phylogenetic classification; Classificatory Systems: Pre- and Post Darwinian Classifications, Recent development of classificatory system in Angiosperms- APG System

Unit-II : Phenetic Methods: Taxometric: Principles, OTUs, coding of characters, Measuring Resemblances, Cluster analysis, Application of Taxonomy. Phylogenetic Methods: Cladistic taxonomy, Character analysis, Cladogram construction and Analysis.

Unit-III : Taxonomic Structure: Concept of Taxa; Concept of Species, Genus, Family and Infra specific categories

Unit-IV : Material basis of Taxonomy: Concept of Character; Character Correlation, Weighing, Variations; Isolation and Speciation.

Unit-V : Botanical Nomenclature: History, Principles and Major rules, Typification, Effective and Valid Publication, Authors' citation, Principles of Priority and Limitations, synonym, basionym, nominal conserve and rejection of names, illegitimate names, nomennudum, tautonym, later homonym.

BOT:4026 (Special Paper: ANGIOSPRM TAXONOMY:II)

UNIT:1 Sources of Taxonomic Characters: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Serology., major areas.

Unit-II :

Modern Approach to Taxonomy: Molecular Approach in taxonomy, Diagnostic tools, Polymerase Chain Reaction (PCR) analysis, applications of molecular markers in plant taxonomy; Biosystematics: Definition, importance and categories; Role of computers in taxonomic studies, commonly available softwares

Unit-III :

Taxonomic Literature: Classical and recent literature of World in general and India in particular (World flora, Indian flora); Taxonomic journals, Icones, Checklist, Illustrations

Unit-IV :

Process of Identifications: Herbarium techniques: Methods of Collection, Identification and Documentation; Roles and importance of herbaria, Botanical Gardens and Museums in taxonomic studies, major Herbaria and Botanic Gardens in World and India.

Unit-V :

Botanical exploration: Contributions made in earlier and recent periods. Presentation of Data, Flora, Manuals, Monograph, Revision; Preparation of a flora; Botanical keys, their construction and uses.

BOT 4036 (Special paper: ANGIOSPEREM TAXONOMY: III)

Unit-I: Phytogeography:

Concept, Static and Dynamic Phytogeography, Phytochoria and botanical provinces of India; Major theories, Ranges, Migration and Barriers; Centres of Origin; Vicariance biogeography; Endemism; IUCN categories; Hotspots, India as a mega diversity country; plant introduction and acclimatization.

Unit-II: Flora of North East India: Characteristics of flora of North East India; Endemic, Exotics and RETP lands of North East India, their multiplication and conservation.

Unit-III: Botanical Survey of India: History, Activities, Publications.

Unit-IV: Origin and Evolution:

Characteristic features of early Angiosperms; Origin of Angiosperms, Primitive and advanced angiosperms; Evolutionary trends in Angiosperms.

Unit-V: Phylogeny and Evolution of Angiospermic Taxa:

Magnoliales, Ranunculales, Euphorbiales, Scrophulariales, Lamiales, Asterales, Alismatales, Orchidales, Poales, Zingiberales.

BOT 4044: Dissertation

Dissertation=	50
Viva-Voce=	30
Internal Assessment =	20
Total=	100

BOT 4054

1. Floristic studies of locally available angiospermic plants in and around Greater Guwahati, their collections, describing with analytical drawing, botanical keys and identification up to the rank of species.
2. Practices on Nomenclatural problems
3. Plotting of various centers of BSI, Botanical Gardens and Herbaria in different regions of India.
4. Practices on identification of taxa/herbarium specimens.

Optional–II: Cytology, Genetics and Plant Breeding (Special Paper)

Allotment of Marks and Credits

Paper(s)	Coursework	Internal Assessment	Total	Credit	Class/week
BOT4016	80	20	100	4	5
BOT4026	80	20	100	4	5
BOT4036	80	20	100	4	5
BOT4046	80	20	100	4	9
BOT4056	80	20	100	4	9
Total	400	100	500	20	33

Examination Time: Theory.....3(Three Hours); Practical...5(Five Hours)

BOT 4016 (Cytology, Genetics and Plant Breeding –I)

Unit-I :

Cell architecture and function; membrane structure; cytoskeleton: intermediate filaments; microtubules; cell division cycle; cell-division control in multicellular animals.

Unit-II :

Chromosome structure and organization; chromatin structure, nucleosome, chromosome banding and painting. gene interaction - epistasis, complementation, pleiotropy, penetrance and expressivity

Unit-III :

Genome organization in viruses, prokaryotes and eukaryotes; organization of nuclear and organellar genomes; c-value paradox; repetitive DNA, satellite DNAs and interspersed repeated DNAs; fine structure of gene, split genes, pseudogenes, overlapping genes and multigene families.

Unit-IV :

Overview and concept of epigenetics; chromatin modifications and their mechanism of action, role of chromatin in gene expression and gene silencing, types of histones, histone modifications-methylation, acetylation, phosphorylation and its effect on structure and function of chromatin, heterochromatin formation and gene silencing.

Unit-V :

Molecular basis of gene mutations. Molecular nature and use of transposable elements in prokaryotes and eukaryotes; controlling elements in maize, yeast and Drosophila P element.

Unit-VI :

Genetic distance and phylogenetic analysis; molecular divergence and molecular clock; origin of new genes and proteins; gene duplication and divergence.

BOT 4026 (Cytology, Genetics and Plant Breeding-II)

Unit-I :

Structure and processing of messenger RNA, transfer RNA, ribosomal RNA, small interfering RNAs and micro RNAs, regulation through RNA processing and decay, alternative splicing, mRNA stability.

Unit-II :

Transcription, RNA polymerases, initiation, elongation and termination; anti termination, attenuation; eukaryotic promoters, enhancers, transcription factors, processing of mRNA for translation. Operon concept in prokaryotes.

Unit-III :

Techniques in molecular genetics; electrophoresis, restriction digestion, ligation, DNA probes and hybridization, DNA cloning, vectors, genomic and cDNA library, PCR amplification, nested PCR, forensics and PCR, DNA sequencing.

Unit-IV :

Comparative genome analysis, protein analysis, SDS-PAGE, protein purification, monoclonal antibody and hybridoma technology, blotting techniques, model organisms in molecular biology.

Unit-V :

Metagenomic approaches, gene and protein sequence data banks, sequence analysis, multiple sequence alignment, homology and analogy, in silico computational techniques for gene functions, high-throughput analysis of gene functions, single nucleotide polymorphisms.

Unit-VI :

Genetic engineering and public concerns, genetically engineered foods; molecular farming and plant bodies, antisense RNA technology; ethical and environmental concerns on genetic engineering of plants; biosafety issues related to genetically modified organisms.

BOT 4036 (Cytology, Genetics and Plant Breeding)

Unit-I :

Principles of plant breeding, hybridization and selection; concepts in improvement of major Crop species; polyploidy inheritance, self-incompatibility.

Unit-II :

Quantitative and evolutionary genetics; polygenic inheritance; QTL mapping using molecular marker, population statistics; heritability; measurement of heritability; population genetics and Hardy-Weinberg law of equilibrium.

Unit III :

Chromosome variation in higher plants; haploid production system, breeding application of haploids; aneuploidy, trisomic, tetrasomic, nullisomic and their significance in genetic studies; parthenogenesis and apogamy, action of physical and chemical mutagens; mutation in crop improvement.

Unit-IV :

Plant transformation; cloning of plant cells and manipulation of plant genomes; Agrobacterium mediated gene transfer - biology and molecular basis of Agrobacterium mediated plant transformation and its application, development of plant vectors for transformation and features.

Unit-V :

Plant genetic engineering: Crop improvement, herbicide resistance, insect resistance, virus resistance, tolerance of environmental extremes in crops - drought, cold, salinity, flooding, heavy metal; plant as bioreactors (molecular farming).

Unit-VI :

Plant cell, tissue and organ cultures; micropropagation and clonal propagation, protoplast culture and somatic hybridization; nuclear and cytoplasmic hybrids; somaclonal variation, DNA-microchip in plant tissue culture industry.

BOT 4044
Dissertation

Dissertation=	50
Viva-Voce=	30
InternalAssessment =	20
Total=	100

BOT 4054

1. Preparation of smears and squashes from pollen mother cells and root tips using suitable staining techniques.
2. Studies on some special chromosomal staining techniques for chromosome banding.
3. Preparation of karyotypes and idiograms from polar view of mitotic metaphase stage.
4. Studies of chiasma frequencies in meiosis cell division.
5. Studies of natural and induced chromosomal aberrations.
6. Studies of effects of colchicines on polyploidy.
7. Emasculation and artificial hybridization.
8. Isolation of genomic DNA from plant materials, purification, estimation, separation with gel electrophoresis and documentations.
9. Working out of genetical problems.
10. Introduction to NCBI databases, BLAST: BLASTn, BLASTp, sequence manipulation, multiple sequence alignment, primer designing, phylogenetic analysis, protein modelling and protein structure analysis.

Optional–III: Plant Ecology (Special Paper)

Allotment of Marks and Credits

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOT4016	80	20	100	4	5
BOT4026	80	20	100	4	5
BOT4036	80	20	100	4	5
BOT4044	80	20	100	4	9
BOT4054	80	20	100	4	9
Total	400	100	500	20	33
Examination Time:		Theory.....3(Three Hours)		Practical...5(Five Hours)	

BOT 4016 Plant Ecology

Unit-I

Development of ecology in India from ancient to recent times, evolutionary ecology, Interaction of ecological factors in the environment. Principles pertaining to limiting factors. Biogeochemical cycles.

Unit-II

Population concepts- characteristics, dynamics and control. mechanisms of population regulation, habitat specific demography, population viability analysis. Species interactions- types of interactions, interspecific competition, herbivory, carnivory, symbiosis, allelopathy, weed-crop interference. Concept of meta population–demes and dispersal, inter demic extinctions, age structured populations. Ecological amplitude of a species and adaptation - ecads, ecotypes, ecospecies.

Unit-III

Concepts of community and continuum; analysis of communities (analytical and synthetic characters); community coefficients; interspecific associations; ordination; concept of Ecological niche, species diversity (α, β, γ).

Unit-IV

Vegetation development, temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession.

Unit-V

Principles and basic concepts of remote sensing; application of remote sensing in environmental studies: land use mapping, forest survey, habitat analysis, water management, drought monitoring and flood studies, wetland survey, rain fall estimation, pollution studies, soil conservation, waters management and vegetation mapping. Geographical Information System (GIS) - basic principles and techniques. Importance of Geographical Information System in environmental studies. Global Positioning System (GPS): basic principles, Applications in ecological studies.

BOT 4026 Plant Ecology

Unit-I

Ecosystem organization- structure and functions; Terrestrial and aquatic ecosystems, primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, controlling factors); ecosystem nutrient cycles and nutrient budgeting.

Unit-II

Ecosystem stability-Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; Wetlands, its importance & benefits, causes of degradation and its consequences.

Unit-III

Introduction and elements of system ecology; ecosystem modeling, conceptual model, working model, auxiliary variable and foresters diagram. Basic concepts to statistical ecology, fundamental knowledge on pattern analysis, cluster analysis and ordination.

Unit-IV

Introduction to conservation ecology- principles, postulates and ethics, genetic variation and its loss, variation in natural populations, Species and habitat conservation-prioritizing species and habitat, protected area networks; major approaches to their management, Indian case studies on conservation/management strategy

Unit-V

Methods for biodiversity monitoring, mega diversity zones and hot spots; biodiversity and ecosystem services- provisioning, regulating, supporting and cultural; threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red data book; keystone and flagship species. Biodiversity act and biodiversity action plan; IPRs, national and international programs for biodiversity conservation, wildlife values and eco-tourism, wildlife distribution in India, problem in wildlife protection, role of WWF, WCU, CITES, TRAFFIC.

BOT 4036 Plant Ecology

Unit-I

Scope of environmental management, basic concepts of sustainable development, advantages of environmental monitoring, deterioration of environmental quality with reference to anthropogenic impact; methods of assessment of environmental quality; Short term studies/surveys; Rapid assessment; Continuous short and long term monitoring; general guidelines for the preparation of environmental impact statement.

Unit-II

Effect of pollution on water quality, on phytoplankton productivity; bio-indicators of water pollution. biological treatment of wastewater. Biomonitoring of air pollution, active and passive monitoring; air pollution tolerance indices; control of air pollution by plants, green belt design. Plant indicators. Environmental problems of NE India with special reference to shifting cultivation, deforestation, opencast coal mining, oil exploration, encroachment, flood, erosion, landslides etc.;

Unit-III

Environmental Policies and Regulations. Evolution of International Environmental Policies. Environmental Movement in India. International Environmental Treaties and Conventions. Objectives and Provisions of Environmental Acts and Rules of India. IBP, MAB.

Unit-IV

Concepts of ecological restoration, aims and strategies; ecosystem reconstruction, major tools used in restoration, restoration of biological diversity- Acceleration of ecological succession, reintroduction of biota; restoration of degraded ecosystems- Forest, grassland and lake including contaminated soils, mine spoils etc.

Unit-V

Bioremediation, biotransformation, biodegradation and phytoremediation, In situ and Ex situ practices. Use of microbes (algae, bacteria and fungi) and plants to check biodegradation, biotransformation; waste water treatment using aquatic plants; root zone treatment. Ecological techniques for biowaste and e-waste management.

BOT 4044
Dissertation

Dissertation=	50
Viva-Voce=	30
Internal Assessment =	20
Total=	100

BOT 4054

1. Determination of light intensity, relative humidity, wind speed, maximum and minimum temperature at different times of the day.
2. Determination of amount of rainfall.
3. Mapping of vegetation.
4. Analysis of edaphic characters- soil profile, texture, soil moisture, water holding capacity, porosity, pH, organic matter content, quantitative estimation of N, P, K, Na, Ca and C:N.
5. Determination of carbonates, nitrates, chlorides, based efficiency by rapid soil test method.
6. Analysis of water quality- DO, COD, BOD, pH, hardness, alkalinity, conductivity, free CO₂, chloride, phosphate.
7. Estimation of litter contribution in different forest stands; estimation of litter decomposition rate by litter bag technique, soil respiration.
8. Determination of IVI; lifeform and biological spectrum; phenology; diversity indices in various plant communities.
9. Determination of gross and net primary productivity of aquatic ecosystem by light and dark method; estimation of phytoplankton biomass in terms of chlorophyll.
10. To study primary productivity for herbaceous community by Harvest method; Leaf Area Index.
11. To find out seed output and reproductive capacity of herbaceous plants.
12. To find out allelopathic effects of weeds on cultivated plants.
13. Morpho-anatomical variation of plant species as affected by environmental changes.
14. Ecological data collection for computer use.

Optional–IV: Microbiology (Special Paper)

Allotment of Marks and Credits

Paper(s)	Coursework	Internal Assessment	Total	Credit	Class/week
BOT4016	80	20	100	4	5
BOT4026	80	20	100	4	5
BOT4036	80	20	100	4	5
BOT4044	80	20	100	4	9
BOT4054	80	20	100	4	9
Total	400	100	500	20	33
Examination Time:	Theory.....3(Three Hours);			Practical...5(Five Hours)	

BOT 4016 Microbiology

Unit-I

Microbial ecology: Interaction of microbes with microbes, plants and animals, quantitative ecology, microbes of extreme environments, bioremediation of contaminated sites with pesticides, xenobiotics, etc., waste-water treatment with microbes, microorganisms in mining and energy production, role of microbes in hydrocarbon recovery and degradation.

Unit-II

Soil microbiology: Soil environment, microbial diversity in soil, soil microbial communities and decomposition of organic matter, methods to detect and quantify soil microbes, soil metagenomics, biosensors to monitor soil health and toxicity.

Unit-III

Agricultural microbiology: Agriculturally important microbes, biological N₂-fixation, phosphate solubilization, PGPRs, rhizosphere, phyllosphere, Mycorrhiza, Biofertilizers, Crop diseases caused by different pathogens, Biocontrol of plant diseases.

Unit-IV

Industrial microbiology: Industrial importance of microorganisms, Fermentation process, bioreactors, isolation, preservation and maintenance of industrial microbes, kinetics of microbial growth in STR, microbial products, downstream processing, application and immobilization of enzymes, Industrial production of organic acids, antibiotics, ethanol, vitamins and amino acids.

Unit-V

Food microbiology: Fermented foods (milk, meat, vegetables, beer, wine and vinegar, SCP), food spoilage, food sterilization and preservation, food borne diseases.

Unit-VI

IPR: Concept of IPR, types of IPR, Patent and Patent filing, Design, Trade Mark, Trade Secret, Copyright, Role of IPR in economic growth of a nation, Organization and functioning of IP-India, Biotechnology and IPR, Plant Variety Protection and Farmer's Right, GI, Traditional knowledge and benefit sharing.

BOT 4026 Microbiology

Unit-I

Microbial Genetics (genetic materials, nuclear DNA, chloroplast DNA, mitochondrial DNA, plasmids, inheritance of traits, vertical and horizontal gene transfer, genes and chromosomes, DNA replication, RNA and protein synthesis, genome evolution)

Unit-II

Genetic recombination, conjugation, transduction and transformation in bacteria, host cell restriction, mobile genetic elements, fine structure of a gene, Operon concept, promoter, enhancer, repressor, negative feedback, RNA processing (RNA capping, Poly (A) tail formation, RNA splicing).

Unit-III

Gene regulation and gene interactions in prokaryote and eukaryotes, epistasis, complementation, pleiotropy; Concept of genomics, metagenomics, transcriptomics, proteomics and metabolomics; Quorum and anti-quorum sensing

Unit-IV

Microbial growth conditions and growth curves, bioenergetics and different glucose catabolic pathways found in microbes (Glycolytic, EMP, PP, ED, Sikkimic, etc.); biosynthesis of lipids, amino acids, proteins and nucleotides)

Unit-V

Genetic engineering – tools and techniques, manipulation of natural genetical processes in biotechnology, restriction enzymes and ligases, cloning and expression vectors (plasmid, Ti plasmid, cosmid, fosmid, BAC, YAC and PAC)

Unit-VI

Microbial biotechnology for human welfare, cDNA and genomic DNA library, gene isolation, gene cloning, expression of cloned genes, gene therapy, DNA fingerprinting, whole genome sequencing projects, GMOs, application of RNAi technology (miRNA and siRNA) in agriculture and medical sciences.

BOT 4036 Microbiology

Unit-I

Laboratory diagnoses and control of human diseases caused by virus (AIDS, hepatitis, H1N1), bacteria (Streptococcus pyogenes, Mycobacterium tuberculosis), fungi (Aspergillosis, Candidiasis) and protozoa (malaria).

Unit-II

Control of Microorganisms: Physical, chemical and biological; Antibiotics, mode of action of antibiotics, multidrug resistance in bacteria, principles of microbial assay.

Unit-III

Immunology: Humoral and cell mediated immunity; Specific and non-specific immunity; Immune responses, Primary and secondary lymphoid organs; Antigens; B and T cells and Macrophages; Major histocompatibility complex (MHC); Antigen processing and presentation; Antibodies, synthesis of antibody and secretion;

Unit-IV

Molecular basis of antibody diversity; Polyclonal and monoclonal antibody; Antigen-antibody reaction; Hyper sensitivity; Autoimmunity; Hybridoma technique, advantages and application of monoclonal antibodies, Immunodiagnostics

Unit-V

Cancer biology: Mutagens and carcinogens, tumor cells and genetic abnormalities, genetic rearrangements in progenitor cells, mechanism of oncogene activation, tumor suppressor genes, cancer and cell cycle, virus induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth, cancer treatments.

BOT 4044

Dissertation

Dissertation=	50
Viva-Voce=	30
InternalAssessment =	20
Total=	100

BOT 4054

1. Isolation of specific microorganisms using specific media
2. Staining of bacterial spore, capsule and flagella
3. Bacteriological water analysis
4. Isolation of anaerobic bacteria
5. Methylene blue reductase/Phosphatase test for milk
6. Detection of organic acids produced by fungi by paper chromatography method
7. Assessment of antimicrobial activity of microbes against plant pathogens
8. Biochemical tests (phosphatase, urease, nitrate reductase, cellulase) for the activity of microbes
9. Fermentation of carbohydrates
10. Study of microflora from the rhizosphere of agriculturally important crops
11. Mycorrhiza– spore population and root colonization
12. Biochemical tests for identification of bacteria (catalase, IMViC, peroxidase, nitrate reductase, oxidase, etc)
13. Isolation and quantification of plasmid/DNA/protein
14. Estimation of total proteins, phenol coefficient, λ -max of DNA/Protein
15. Study of symptoms and causal organisms of some important plant diseases prevalent in the state.

Optional–V: Mycology and Plant Pathology (Special Paper)

Allotment of Marks and Credits

Paper(s)	Coursework	Internal Assessment	Total	Credit	Class/week
BOT4016	80	20	100	4	5
BOT4026	80	20	100	4	5
BOT4036	80	20	100	4	5
BOT4044	80	20	100	4	9
BOT4054	80	20	100	4	9
Total	400	100	500	20	33

Examination Time: Theory.....3(Three Hours); Practical...5(Five Hours)

BOT 4016 Mycology and Plant Pathology

Unit-I

History and development of mycology, ultra structure of fungal cell, Different groups of fungi, systematics and phylogenetic relationship among different groups of fungi; modern trends in identification and classification of fungi.

Unit-II

Fungal reproduction: different mode of reproduction in fungi, different reproductive structures, parasexuality, degeneration of sex, heterothallism. Spore dispersal mechanism in fungi.

Unit-III

Fungal physiology, growth, nutrition, development and metabolism in fungi, nutritional specialization in parasitic fungi.

Unit-IV

Ecology of fungi, distribution of fungi, role of fungi in biogeochemical cycling, fungi of terrestrial and aquatic environments, fungi of extreme environments.

Unit-V

Fungal biotechnology: Genetically modified fungi, fungi as biocontrol agent, Edible and poisonous mushrooms, cultivation of mushrooms, industrially important fungi as a source of antibiotics, organic acids, enzymes and proteins, IPR.

BOT 4026 Mycology and Plant Pathology

Unit-I

The concept of diseases in plants, history of plant pathology, role of fungi and other organisms as causes of plant diseases, losses caused by plant diseases, Symptoms of plant diseases caused by fungi, bacteria and viruses.

Unit-II

Diagnosis of plant diseases, Koch's postulate and germ theory of diseases, pathogenesis and host range, stages of development and disease cycle, dissemination of plant pathogens.

UNIT-III

Epidemiology and disease forecasting, Effects of environmental factors on epidemiology; Control of plant diseases, chemical and biological disease control, integrated disease management (IDM), physiological changes due to disease in plants (photosynthesis, movement of water, respiration, permeability of cell membrane, growth and transcription and translation).

Unit-IV

Genetics of plant diseases, genes and disease, mechanism of variability, types of plant resistance to pathogens, Genetics of Virulence in pathogens and resistance in host, Enzymes, toxins and growth regulators in plant disease development.

Unit-V

Symptomatology, disease cycle, control measures and management of some important plant diseases of Assam caused by fungi, bacteria, virus and nematode.

BOT 4036 Mycology and Plant Pathology

Unit I

Defense mechanisms in plants, structural and chemical defenses, defense through lack of essential factors, induced structural and biochemical defenses, plant immunization- systemic acquired resistance, Induced resistance, plantibodies.

Unit II

Biotechnology and plant diseases – resistant gene identification and insertion in suitable host for crop improvement, strategies for development of disease resistance in plants; GMO (bt-cotton, bt-brinjal, bt-chickpea); Use of immunological techniques in plant pathology.

Unit-III

Aerobiology and Plant diseases: Air microflora, air sampling techniques, factors affecting the distribution of air microflora, air-borne plant diseases, aero-allergens

Unit-IV

Soil borne diseases: Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, root exudates, and soil and root borne pathogens, Associative and antagonistic effects; Suppressive soils, biological control- concepts and potentialities for managing soil borne pathogens.

Unit-V

Morphology and anatomy of infected seeds; transmission of pathogens from seed to plants, Seed-borne diseases and pathogens, Toxins affecting seed quality and its impact on human and animal health, management of seed-borne diseases, seed health testing and methods for detecting seed microorganisms, Quarantine and seed certification.

BOT 4044

Dissertation

Dissertation=	50
Viva-Voce=	30
Internal Assessment =	20
Total=	100

BOT 4054

1. Study of vegetative and reproductive structure of different fungal specimens
2. Study of disease symptoms and causal organisms
3. Isolation and identification of pathogen from diseased plant materials
4. Invitro inhibition of plant pathogens by different plant extracts
5. Estimation of spore population and root colonization of mycorrhiza
6. Extraction of cellulase/pectinase/xylem as from diseased plants
7. Proving of Koch's postulate atleast one disease
8. Study of the effect of fungicides and plant extracts on the germination and growth of plant pathogenic fungi
9. Isolation and enumeration of microbes from soil samples
10. Study of effect of physical and chemical factors on the growth of plant pathogens.

Optional–VI: Plant Physiology and Biochemistry (Special Paper)

Allotment of Marks and Credits

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOT4016	80	20	100	4	5
BOT4026	80	20	100	4	5
BOT4036	80	20	100	4	5
BOT4044	80	20	100	4	9
BOT4054	80	20	100	4	9
Total	400	100	500	20	33

Examination Time: Theory.....3(Three Hours); Practical...5(Five Hours)

BOT 4016 Plant Physiology and Biochemistry

Unit-1

Membrane transport and translocation of water and solutes: Membrane transport of proteins. Root microbe interactions in facilitating nutrient uptake.

Unit-II

Nitrogen and sulphur metabolism: Regulation of nitrogen fixation, products of nitrogen fixation and their transport, mechanism of nitrate uptake and reduction, transamination, nitrogen metabolism in relation to photosynthesis and respiration, Sulphate uptake, transport, reduction and assimilation.

Unit-III

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development- genetic and molecular analysis, role of vernalization.

Unit-IV

Post-harvest physiology: Ripening of fruit and its regulation, post-harvest management. Metabolism of leafy vegetables during storage.

Unit-V

Stress physiology: Plant responses to water deficit, salinity, metal ion stress, freezing and heat stress, effect of elevated CO₂ concentration on plant metabolism, Oxidative stress- Generation of reactive oxygen species, Effect of ROS on metabolism, ROX detoxification mechanisms in plants. Biotic stress - effect of fungal infection on plant metabolism; transgenic approach to overcome the abiotic stress in plants.

Unit-VI

Signal transduction: Overviews, receptors and G- proteins, phospholipids signaling, role of cyclic nucleotides, Calcium-Calmodulin cascade, protein kinases and phosphatases, specific signaling mechanisms. e.g., two component sensor – regulator system in bacteria and plants.

BOT 4026 Plant Physiology and Biochemistry

Unit-I

Respiration and lipid metabolism: Overview of plant respiration, anaerobic respiration, modern concept of electron transport and ATP synthesis; glycolysis in plants and its regulation; regulation of pentose phosphate pathway and TCA Cycle; inhibitor of respiration, glyoxylate cycle, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism, gluconeogenesis.

Unit-II

Photochemistry and photosynthesis: Evolution of photosynthetic apparatus, photo-oxidation of water, mechanism of electron and proton transport, Regulation of PCR Cycle and C4 Pathway, RUBISCO and PEP Case, C3–C4 intermediates, ecological significance and modification of CAM.

Unit-III

Carbohydrate metabolism: Regulation of starch and sucrose biosynthesis, Synthesis and degradation of cellulose; A brief idea of pectin biosynthesis and enzymes involved in pectin degradation.

Unit-IV

Organic acid metabolism: Metabolism and roles of oxalic acid, ascorbic acid and malic acid.

Unit-V

Secondary metabolites: Shikimate Pathway and its role in biosynthesis of Secondary Metabolites. Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Unit-VI

Phosphorus nutrition – Forms of phosphorus in soil. Phosphorus uptake, factors controlling 'P' uptake, 'P' fractions in plants. Role of Pyrophosphate in plant metabolism.

BOT 4036 Plant Physiology and Biochemistry

Unit-I

Growth and morphogenesis: photomorphogenesis: phytochromes and cryptochromes and their photochemical and biochemical properties; phytochrome biosynthesis, cellular localization, roles, mechanism of action of photomorphogenetic receptors.

Unit-II

Plant developments: Biochemical changes during development of seeds; phototropism, geotropism and nastic movements.

Unit-III

Senescence and PCD- Biochemical changes during senescence of leaves and petals and regulation of senescence. Programmed Cell Death.

Unit-IV

Enzyme kinetics: Km value, enzyme inhibition, factors responsible for enzyme interaction, abzyme and ribozyme. A brief idea about role of tissue culture, and mutants in physiological studies.

Unit-V:

Environmental Physiology : Principles of plant response to environment, kinds of plant response to environment, Homeostasis. Ecotypes: The role of Genetics. Plant adaptation to radiation to environment, plant responses to radiant energy. Allelochemicals and Allelopathy

Unit-VI

Plant Growth Regulators – A brief idea about discovery, role and possible mechanism of action of Triacanthanol, Brassins, Salicylic acid, Jasmonates and Polyamines. A brief idea about role of plant growth retardants- CCC, Maleic hydrazide, Trizoles and TIBA.

BOT 4044
Dissertation

Dissertation=	50
Viva-Voce=	30
Internal Assessment =	20
Total=	100

BOT 4054

1. Estimation of starch, Ascorbic acid, Polyphenols, Cellulose.
2. Study of Oxalic acid accumulation in leaf tissue.
3. Hormonal regulation of leaf and petal senescence.
4. Study of changes in starch /protein content during seed development.
5. To study the effect of different PGRs on seedling growth
6. Sugar and amino acids analysis of phloem sap with paper chromatography.
7. Estimation of nitrate in different plant parts.
8. Study of lipid accumulation during development of oilseeds.
9. Study of effect of PEG induced water stress on seed germination
10. Measurement of RWC and Osmotic potential
11. Study of protein/ amino acid profile in plants under stress.
12. Study of effect of fungal infection on peroxidase activity.
13. Study of free radicals scavenging enzymes, Catalase and super oxide dismutase.
14. Study of free proline accumulation in plants under stress.
15. Study of seed germination under stress condition.

Common Value Added Courses (VAC)

BOT-VAC-2014 : Ecosystem, Biodiversity and Pollution

BOT-VAC-3014 :Mushroom cultivation

BOT-VAC-4014 :

SEMESTER-II (PG Botany) Common Value Added Courses (VAC)

BOT-VAC-2014

Paper Title: Ecosystem, Biodiversity and Pollution

Total Marks= 100

Total Credits= 4

UNIT 1: Introduction to Environmental Studies

Definition, scope and importance of environmental studies. Concept of ecosystem; Producers, consumers and decomposers; Energy flow in an ecosystem; Food chain and food webs; Ecological pyramids; Ecological succession. Nutrient cycles (Carbon cycle and nitrogen cycle). Major ecosystems: Terrestrial (Forest) and Aquatic (Pond)

UNIT 2: Natural Resources and management:

Concepts and types of natural resources (Renewable and non-renewable).Importance, threats and management of land resources, forest resources, water resources and energy resources.

UNIT3: Biodiversity and conservation

Definition, levels of biodiversity (genetic, species and ecosystem diversity); Endemism; global biodiversity hot spots. Biodiversity of India with special reference to North East India. Threats to Biodiversity: Habitats loss, poaching of wildlife, man-wildlife conflicts in Indian context. In-situ and ex-situ conservation of biodiversity.

UNIT 4: Environmental pollution and climate change

Environmental pollution: Types (Air, water, soil and noise pollution), causes, effects and controls, Solid waste Management. Climate change, global warming, ozone layer depletion, acid rain and its impact on environment. Environment Laws: Environment Protection Act;Air (Prevention and control of pollution) Act; Water (Prevention and control of pollution); Wildlife Protection Act.

UNIT 5: Environmental ethics and disaster management

Principle and concept of environmental ethics; Animal Welfare and Animal Rights, Deep ecology, Eco feminism, putting environmental ethics into practice. Environmental movement and awareness: Chipko, Silent valley, Bishnois of Rajasthan. Causes, impacts and management of floods, earthquake, cyclones and landslides.

SEMESTER-III (PG Botany) Common Value Added Courses (VAC)

BOT-VAC-3014

Paper Title: Mushroom Cultivation

Total Marks= 100

Total Credits= 4

Unit 1: Introduction to Mushroom

History and Scope of Mushroom Cultivation; Taxonomical rank of Mushroom; Vegetative characters of edible and poisonous mushrooms.

Unit 2: Common edible Mushrooms

Button Mushroom (*Agaricus bisporous*), Oyster mushroom (*Pleurotus sajorcaju*), paddy straw mushroom (*Volvariella volvacea*), Milky Mushroom (*Calocybe indica*); Other economically important and medicinal mushroom- Shiitake Mushroom (*Lentinula edodes*), Kabul Dhingri (King Oyster) Mushroom.

Unit 3: Principle of Mushroom Cultivation

Structure and construction of mushroom house. Sterilization of substrates. Spawn production culture media preparation, Preparation of mother spawn, production of planting spawn, storage/transportation of spawn, Criteria for selection of good quality spawn. Cultivation of Button mushroom and paddy straw mushroom; Introduction to microbiology laboratory Laminar Air flow, Autoclave.

Unit 4: Nutritional and health benefits of Mushroom.

Nutritional and health benefits of mushrooms. Therapeutic aspects- antitumour effects.

Unit 5: Disease and Pest Management in cultivated mushrooms

Dry Bubble and wet bubble- Major diseases of cultivated mushroom; Major insect pests Mushroom flies / nematodes / mites.

Unit 6: Value addition of Mushroom

Value added products / recipes, Quality assurance, Packing and packaging, Market opportunities.

Unit 7: Training / Workshop

Sterilizations and sanitation of mushroom house, instruments and substrate; Preparation of mother culture, media preparation, inoculation, incubation and spawn production; Cultivation of *Volvariella volvacea* (paddy straw mushroom) and *Pleurotus sajorcaju* (oyster mushroom) using paddy straw/agricultural waste.

SEMESTER-IV (PG Botany) Common Value Added Courses (VAC)

BOT-VAC-4014

Paper Title: Vermiculture and Vermicomposting

Total Marks= 100

Total Credits= 4

Unit - I (Vermiculture)

1. About Earthworm: Basic body structure of earthworm (General body plan, Prostomium, Peristomium, Metamerism, Cuticle, Setae, Different body pores, Clitellum, Digestive system).
2. Earthworm Ecology: Distribution; Food habit and habitat; Ecological requirements: moisture, temperature, pH, organic matter etc.; Ecological categories: Epigeic, Endogeic and Anecic earthworms; Ecosystem services i.e. role played by earthworms in soil ecosystem.
3. Reproduction: Hermaphroditism, Copulation and cocoon formation, Cocoon structure, Incubation period of cocoon in vermicomposting earthworm, Fecundity in surface dwelling (epigeic) and soil dwelling (endogeic and anecic) earthworm.
4. Vermiculture: Definition, Difference between vermiculture and vermicomposting, Selective features of earthworms for vermiculture and vermicomposting, Method of vermiculture of phytophagous and geophagous earthworm, Utility of vermiculture (protein source for pisciculture, poultry farming, piggy etc., application in vermicomposting).

Unit - II (Vermicomposting)

1. Vermicomposting: Definition, Habitat of vermicomposting earthworms, Scientific names of native and exotic vermicomposting earthworms (Native Indian earthworms. *Perionyx excavatus*, *Perionyx ceylanensis*, European earthworms'. *Eisenia fetida*, *Eisenia andrei*, South African earthworms. *Eudrilus eugeniae*), Selective features of earthworm species for vermicomposting.
2. Principle of vermicomposting, Components of the vermicomposting System (Appropriate species of earthworms with suitable population characteristics, proper substrate, optimum environmental factors under Indian condition, Design and operations to be implemented).
3. Methods of vermicomposting (a) Low cost floor beds, (b) Tank system; Management during vermicomposting; Products of vermicomposting: earthworm biomass (vermiprotein) and vermicompost.
4. Definition of vermicompost; Physicochemical features of vermicompost; Role of earthworm and vermicompost in growth of plants; Vermiwash and its utility in agriculture.