

**2017**  
**Gauhati University**  
**M. Phil/ Ph. D. Course Work Syllabus**

**BOTANY**  
**Duration: 6 months**

**There are four papers, each with 6 credits (30 lectures)**  
**Total credit: 6x4=24**

**Marks Distribution:**

<b>PAPERS</b>	<b>Type</b>	<b>Internal assessment</b>	<b>End Semester marks</b>	<b>Credits</b>
<b>Compulsory Papers:</b>				
CP-I: Research methodology, Instrumentation and Research Techniques	Theory	20	80	6
CP-II: Environmental Studies	Theory	20	80	6
<b>Optional papers (Any TWO):</b>				
OPT: Plant Taxonomy	Theory	20+20	80+80	6 + 6
OPM: Microbiology & Plant Pathology				
OPG: Genetics and Molecular Biology				
OPE: Plant Ecology				
OPP: Plant Physiology and Biochemistry				
<b>TOTAL = 400</b>		80	320	24

**Programme specific outcome:**

**M. Phil. in Botany**

- Train up skill human resources in different fields of plant sciences.
- Standardize protocol for analyzing and assessment of biodiversity of the NER India and their application

**Ph. D. in Botany**

- Train up skill human resources in different areas of plant sciences.
- Document the plant and microbial resources of N E Region of India and their application
- Analyses the issues of environmental contexts and sustainable development.
- Characterize the novel plant and microbes based bioactive components.
- Analyse the application of plant and microbial resources in agriculture, health care, industry and other environmental issues.

**Compulsory Paper – I**  
**Research methodology, Instrumentation and Research Techniques**  
**Code: Bot-CP-I**

**Unit I:** Research methodology: Research concept, Identification of research gap, Understanding the scientific question(s), Novelty of research in support of existing literatures, setting hypothesis and objectives, writing research proposal/synopsis.

**Unit II:** Experimental designs: Formulation of research problem, sampling technique, methods selection, experimental set up, data generation/acquiring, Coding/decoding and reproducibility of data.

**Unit III:** Statistical analysis and data representation: SD, SE, Correlation and Regression, Test of significance, ANOVA, DMRT, data validation, biological significance of data, impact of small sampling size in data analysis, utility of computer/software (MS office, excel, power point, graphics, sigma plot, SPSS etc.) in data analysis and presentation

**Unit IV:** Scientific writings: Forms of scientific writing i.e. research articles, notes, reports, review, monograph, dissertation/thesis, popular article, etc. Components of research article, Writing strategy for a research article. Research ethics and Plagiarism

**Unit V:** Field Techniques: Collection and preservation techniques of specimens (Algae, Fungi, Higher Plants), Instrumentation and safety measures in laboratory and field, sampling methods/strategy, Principle and application of GIS, GPS, Remote sensing

**Unit VI:** Basic knowledge on analytical (Principle and application of UV-Vis, IR, FTIR and NMR Spectroscopy), Basic knowledge on separation techniques (Principle and application of Chromatography techniques, Gel filtration, Ion exchange, GC, HPLC), Centrifugation, Microscopy (Principle and application of Phase contrast, DIC, Fluorescence, Confocal, SEM, TEM) and molecular techniques.

**Compulsory Paper – II**  
**Environmental studies**  
**Code: Bot-CP-II**

**Unit I:** Definition of biodiversity; levels - microbial, genetic, species, ecosystem, landscape; drivers, magnitude and distribution of biodiversity; evolution of biodiversity; change in biodiversity over time in different regions of the world; concept of diversity hotspots; biodiversity in India: in the past and present; global distribution of biodiversity (latitudinal diversity gradient); biome.

**Unit II:** Assessment and monitoring of biodiversity; Indicators for biodiversity; methodology of assessment and analysis of different species groups, monitoring of different species groups; importance of documentation and use of information technology in biodiversity study.

**Unit III:** sustainable use of biodiversity; biodiversity loss and its consequences;

Estimates of extinction rates worldwide and in India; biodiversity and food security; biodiversity and legal issues; Analysing and discussion of causes and consequences of extinction/changes in biodiversity, North East Scenario.

**Unit IV:** Conservation strategies; conservation genetics; wildlife biology; ex -situ conservation: facilities, establishment of new populations, captive breeding, reintroduction, , discussion on advantages and disadvantages; in-situ conservation: assessment of adequate areas, design and management of protected areas; problems of protected areas in India, connectivity and corridors; population biology of endangered species .

**Unit V:** impacts of climate change on natural and managed ecosystems, natural: forest, freshwater and marine aquatic systems, managed systems: agriculture, urban infrastructure, society; future climate projections; sea level rises and its impacts on natural systems (physical and biological) and society; Sectoral and regional climate impacts : case studies on infrastructure, agriculture and food system, water intensive industries, health, urban heat island

**Unit VI:** Recent developmental projects & environmental degradation with special reference to N.E. India. Need and necessity of EIA. Intellectual Property Rights issues in respect of: Conservation/ indigenous and traditional knowledge/ biotechnology/ technology transfer/ environmental sustainability

## **Optional Paper Plant Taxonomy Code: Bot-OPT**

**UNIT-I:** Taxonomy and Systematics- Basic components of taxonomy, advancement levels of taxonomy; Digital databases of Plant Taxonomy; Post –Darwinian and APG systems of Classification.

**UNIT-II:** Phenetic Taxonomy- Principles, OTUs, taxonomic characters and their coding, Measuring resemblance (Simple matching coefficient, coefficient of association, Yule coefficient, taxonomic distance), Cluster analysis (Agglomerative methods, divisive methods, hierarchical classifications), ordinations, application of phonetic approaches in angiosperms.

**UNIT-III:** Cladistic Taxonomy- Cladistic Concepts (Plesiomorphic and apomorphic characters; homology and analogy; parallelism and convergence; monophyly, paraphyly and polyphyly, diagrammatic representation of phylogenetic relationships), OETs (Operational Evolutionary Units), Character and their coding, Measurement of similarity, Construction of cladograms, evaluating consensus tree.

**UNIT-IV:** Character concepts; Variation and Speciation- Phenotypic plasticity, types of variation, variance analysis, isolating mechanism, speciation, vicariance biogeography and endemism; exotic elements in India.

**UNIT-V:** Process of Identification- Field work, Herbarium methods, Identification (taxonomic literature, taxonomic keys, computers in identification).

**UNIT-VI:** Botanical Nomenclature- Principles of Nomenclature and codes; Names of taxa (genus, species, infraspecific categories); Rules of Priority and its limitation; Type concepts; Effective and Valid publication; author citation; names of hybrids, names of cultivated plants.

**Optional Paper**  
**Microbiology & Plant Pathology**  
**Code: Bot-OPM**

**Unit I:** Microbial diversity in different ecological niche, driving factors in microbial diversity and succession, energy sources, biogeochemical cycling, microbial interaction and succession; isolation, detection and enumeration of microorganisms from environmental samples.

**Unit II:** Microbial growth physiology and enzymology: Isolation, identification and characterization of microbial enzymes; Recent trends in enzymology research and application of enzymes in industries , different types of culture media, selection of culture media, pure culture and culture preservation techniques, handling of pathogenic and non-pathogenic microorganisms, safety measures and disposal of microbial cultures

**Unit III:** Polyphasic approach of microbial identification; preparation of microscopic slides and viewing techniques under microscopes, different types of stains, cell wall composition and dye specificity, scaling and measurement of microbial cell and colony morphology; biochemical characterization, molecular diagnosis, commonly used DNA markers, Microarray Technology (DArT)

**Unit IV:** Omics in microbiology: Current uses of metagenomics, transcriptomics, proteomics and metabolomics in microbiology. Role of bioinformatics and databases in omics studies

**Unit V:** Applied microbiology: Application of microorganisms in agriculture as biofertilizers and biocontrol agents; bioremediation and waste management; in oil and ore mining; Microorganisms in non-conventional energy production (biogas, hydrogen, ethanol etc.); Biosensors; Role of microorganisms in fermented foods, strain isolation and improvement, quality control in fermented foods, scope of microbial research in translating traditionally fermented foods to commerce; water analysis, MPN count, Coliform test,

**Unit VI:** Plant Pathology: Mechanism of plant pathogenesis, Plant defense mechanisms (hypersensitive response, production of reactive Oxygen species, effector proteins, PR proteins, systemic acquired resistance, induced systemic resistance), current trends in plant pathology and disease management, new tools in epidemiology, disease warning systems, disease control through transgenic plants, cross protection, plantibodies, post harvest diseases with special reference to N.E. India

**Optional Paper**  
**Genetics and Molecular Biology**  
**Code: Bot-OPG**

**Unit I:** Cell Cycle and its regulation, Molecular mechanisms of controlling gene expression and regulation; Concept of Developmental Genetics; Behavioural Genetics; Epigenetics, Ecological and Evolutionary Genetics

**Unit II:** Polyploidy in higher plants; Mutation in crop improvement; Backcross in Plant Breeding; Heterosis and inbreeding depression.

**Unit III:** Recombinant DNA technology and its application in Agriculture, Healthcare, Process industries and Environmental Issues. Gene expression analysis: cDNA library, qRT-PCR analysis.

**Unit IV:** Micropropagation, somatic cell hybridization, protoplast fusion, cybrids, artificial seeds, Agrobacterium mediated gene transfer and use of Ti plasmid. Genetic Engineering of plants for biotic & abiotic stresses. IPM, INM, IPR and Biosafety issues in GMO.

**Unit V:** Biological databases, Nucleotide sequence databases, Protein databases; primary databases and secondary databases, database formats. Structural databases; Protein Data bank (PDB), Molecular modeling Data Bank (MMDB). Global and Local Sequence alignments Phylogenetic analysis tools; Gene sequencing, gene annotation, gene prediction and gene ontology.

**Unit VI:** Molecular markers; Molecular marker systems (RAPD, RFLP, AFLP, ISSR, SSR, CAPS, ScoT, SCAR, DArT), Categories of Molecular markers, Marker assisted breeding (MAS); Linkage mapping, Quantitative trait loci (QTL) analysis.

**Optional Paper**  
**Ecology**  
**Code: Bot-OPE**

**Unit I:** Field Survey, Field Sampling (Soil, Plant and Water Samples) and physicochemical analysis, Overview of phytosociological methods used in ecological study, Vegetation and Community analysis methods, Ethics in ecological research, Finding out research problems and gaps.

**Unit II** Laboratory Maintenance, how to perform experiments and recording of observations, Proper maintenance of data book, Studying principles of research methodologies, Principles of instruments that are used to perform the experiments. Basic biostatistics for ecological research, Data analysis (MS-Excel & SPSS) and interpretation.

**Unit III** Principles of ecology, population ecology-key concept, attributes, population growths and regulations, life history strategies-*r* and *K* selection, Species richness, diversity and its measurement. Population and community ecology research in India-past, current status and future direction. Algal ecology-Indian scenario.

**Unit IV** Ecosystem functioning, definition of ecosystem services (ES); methods of valuation; Ecological niche and its types, habitat analysis, resource partitioning and character displacement- case studies; case studies on ecosystem studies- global, regional and local; Role of algae in ecosystem maintenance.

**Unit V:** Degraded Ecosystem research in NE India-Current status and future direction, Use of algae, microbes and plants for remediation of degraded ecosystem, Ecological Engineering and Eco-toxicology associated with degraded systems, Stress Ecology- biotic and abiotic, Plant-animal and plant microbe interaction-key concept and methods of study. Biological methods for treatment of waste water.

**Unit VI:** Biodegradation-key concept, understanding the pathways of biodegradation of xenobiotics, parent compound, intermediate products and toxicity assay, bioaccumulation, ecological risk analysis

**Optional Paper**  
**Plant Physiology and Biochemistry**  
**Code: Bot- OPP**

**Unit I:** Plant Water relationship: water potential, Movement of water in plant, soil-plant-atmosphere continuum (SPAC), Absorption of water; Transpiration: Stomatal regulation of transpiration, hormonal and energy dependent hypothesis.

**Unit II:** Mineral nutrition and metabolism: Physico-chemical aspects of solute transport, Passive and Active transport, Co-transport and counter transport; Ion channels- role of calmodulin; foliar nutrition, use of chelates and soil conditioner. Nitrogen metabolism- Bio-chemistry of N<sub>2</sub> fixation, Amino acids and protein synthesis; sulfur and phosphorus metabolism.

**Unit III:** Enzymes: Mode of enzyme action, factors influencing enzyme activity, allosteric enzymes, isoenzymes, multienzymes; Enzyme-linked receptors in cell signaling; Industrial application of enzymes; Basic techniques in enzyme research.

**Unit – IV:** Photosynthesis and respiration: Photosynthetic electron transport, Carbon fixation in C<sub>3</sub>, C<sub>4</sub> and CAM pathway, Photorespiration, Energy concept of photosynthetic processes. Aerobic and anaerobic respiration, Oxidative phosphorylation, Gluconeogenesis, Cyanide resistant pathway. Recent trends of research in photosynthesis.

**Unit V:** Growth physiology and physiology of flowering: Plant growth hormones-synthesis, bioassay and mechanism of action, Role in agriculture and horticulture. Photoperiodism, vernalisation, florigen concept, role of phytochrome in flowering. Senescence. Seed physiology- Dormancy, Enzymatic regulation of seed germination.

**Unit VI:** Stress physiology: Types of stresses- draught, temperature, salt, nutritional, irradiation, heavy metal; stress tolerance; Phytoremediation - types, genetic regulation, recent trends of research in stress management.

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