



Darrang College (Autonomous), Tezpur-784001

Syllabus

Two year Post Graduate course

(As per National Education Policy, 2020)

Subject: BOTANY

Approved by:

Board of Studies meeting held on 18/06/2026

&

Academic Council vide Resolution no. DC/AC/3/2026/06 dated 29th June 2026

Effective from the Academic Session 2026-27

POST GRADUATE PROGRAMME OF BOTANY
DARRANG COLLEGE(AUTONOMOUS), TEZPUR

1. INTRODUCTION

The Postgraduate Programme in Botany at Darrang College (Autonomous) has been thoughtfully designed in accordance with the vision and objectives of the National Education Policy (NEP) 2020, to provide students with advanced knowledge and comprehensive understanding of plants, their diversity, structure, function, evolution, interactions with the environment and applications in agriculture, healthcare, biotechnology, industry and conservation. The programme provides an integrated understanding of classical and modern areas of plant sciences through a combination of theoretical knowledge, laboratory training, field-based learning and research-oriented activities.

Keeping in view the academic flexibility promoted by NEP 2020, the programme also includes a lateral entry facility for students who have completed the Four-Year Undergraduate Programme (FYUGP) in Botany from Darrang College (Autonomous). This ensures a smooth academic transition and enables students to continue their higher studies within an integrated educational framework.

The programme offers specialization in four important and emerging areas of Botany — Angiosperm Taxonomy, Plant Ecology, Mycology and Plant Pathology, and Plant Physiology and Biochemistry. These specializations allow students to pursue their individual academic interests while gaining in-depth knowledge and practical expertise in their chosen field. The third semester is dedicated to specialization-specific advanced papers, helping students strengthen their subject expertise and technical understanding. The fourth semester is primarily focused on research work, where students undertake dissertation-based studies, field investigations and laboratory research to develop independent research skills and scientific aptitude. The dissertation component includes internal assessment, dissertation evaluation and viva-voce, thereby promoting independent research, scientific writing, data interpretation and scientific communication.

The curriculum also incorporates regional perspectives, particularly the biodiversity, flora, ecological resources and conservation concerns of North-East India. Students are exposed to field studies, botanical gardens, herbaria, research institutions and locally available biological resources. Students are trained in techniques such as plant identification and herbarium preparation, ecological analysis, microbial isolation and characterization, cytological studies, biochemical estimation, DNA isolation, PCR, electrophoresis, plant tissue culture, sequence analysis and bioinformatics.

2.AIMS OF THE POSTGRADUATE PROGRAMME IN BOTANY

The M.Sc. Botany programme aims to:

1. **Provide advanced and comprehensive knowledge of plant sciences**, encompassing plant diversity, taxonomy, anatomy, physiology, biochemistry, genetics, evolution, ecology, microbiology and molecular biology.
2. **Develop an integrated understanding of plants and their environment**, including biotic and abiotic interactions, population and community dynamics, ecosystem processes, biodiversity and conservation.
3. **Develop expertise in plant diversity and systematics**, including identification, classification, nomenclature, herbarium techniques, phytogeography and phylogenetic relationships of plants.
4. **Develop practical and laboratory skills** required for the study and analysis of biological materials through appropriate botanical, microbiological, cytological, biochemical and molecular techniques.
5. **Provide advanced training in modern plant sciences**, including molecular biology, genetic engineering, plant tissue culture, biotechnology, bioinformatics, molecular taxonomy and contemporary approaches to plant breeding.
6. **Develop research aptitude and scientific thinking** through practical investigations, field studies, data analysis, specialized courses and dissertation work.
7. **Develop competence in biological data analysis and interpretation**, including the application of biostatistics, statistical software, bioinformatics tools and quantitative ecological methods.
8. **Create awareness of biodiversity conservation and sustainable resource management**, with particular emphasis on the flora, biodiversity and conservation concerns of North-East India.
9. **Develop an understanding of applications of plant resources** in agriculture, healthcare, biotechnology, industry, environmental management and other areas of societal importance.
10. **Promote awareness of ethical, legal and societal dimensions of biological sciences**, including biosafety, intellectual property rights, traditional knowledge, plant variety protection and responsible use of biotechnology.
11. **Prepare students for higher education, research and professional careers** in Botany, biotechnology, environmental science, agriculture, microbiology, plant breeding, taxonomy and related biological disciplines.
12. **Encourage lifelong learning and scientific inquiry**, enabling students to critically engage with emerging developments and research in plant sciences.

3.PROGRAMME OUTCOMES (POs)

On successful completion of the M.Sc. Botany programme, students will be able to:

PO1. Advanced Knowledge of Plant Sciences

Demonstrate comprehensive and advanced knowledge of major branches of Botany, including plant diversity, taxonomy, ecology, physiology, biochemistry, genetics, microbiology, molecular biology, biotechnology and developmental biology.

PO2. Understanding of Plant Diversity and Evolution

Explain the diversity, life-cycle patterns, evolutionary relationships, phylogeny and economic significance of major groups of plants, including cryptogams and phanerogams, with appropriate emphasis on the flora of North-East India.

PO3. Taxonomic and Systematic Competence

Identify and classify plants using morphological, anatomical, palynological, cytological, phytochemical and molecular characteristics and apply principles of botanical nomenclature, herbarium techniques and modern taxonomic approaches.

PO4. Ecological and Environmental Understanding

Analyse relationships between plants and their biotic and abiotic environments and apply ecological principles to population, community and ecosystem studies, biodiversity conservation and environmental management.

PO5. Laboratory and Technical Skills

Demonstrate competence in laboratory procedures and scientific techniques including microscopy, staining, microbial culture, cytological preparations, biochemical analysis, chromatography, electrophoresis, DNA isolation, PCR, tissue culture and other relevant techniques.

The practical curriculum explicitly provides training in microbial isolation, chromosome analysis, biochemical estimation, DNA isolation, PCR, electrophoresis and tissue culture.

PO6. Molecular Biology and Biotechnology Skills

Apply concepts of molecular biology, genetic engineering, plant transformation, tissue culture, molecular markers and bioinformatics to biological and agricultural problems.

PO7. Research and Problem-Solving Skills

Formulate scientific questions, design appropriate investigations, collect and analyse data, interpret results and develop scientifically justified solutions to problems in plant sciences.

PO8. Quantitative and Computational Competence

Apply biostatistical methods, statistical software, ecological indices, molecular databases and bioinformatics tools for quantitative analysis and interpretation of biological data. The syllabus specifically includes statistical analysis, ANOVA, correlation, regression and statistical software, as well as BLAST, sequence alignment and protein structure analysis.

PO9. Plant Health and Agricultural Applications

Explain and apply principles of plant pathology, plant breeding, plant-microbe interactions, stress physiology, crop improvement and biological control for addressing agricultural and plant-health-related problems.

PO10. Biodiversity Conservation and Sustainable Development

Evaluate biodiversity threats and conservation strategies and demonstrate awareness of sustainable management of plant resources, forests, ecosystems and environmental resources.

PO11. Application of Plant Resources

Recognize and evaluate the applications of plant resources in agriculture, healthcare, industry, environmental management and other socially relevant areas.

PO12. Research Communication

Prepare scientific reports, dissertations, field-study reports and research presentations and communicate scientific findings effectively using appropriate scientific terminology and formats.

PO13. Ethical and Professional Awareness

Demonstrate awareness of laboratory safety, research ethics, biosafety, intellectual property rights, biodiversity legislation, traditional knowledge and responsible application of biotechnology.

PO14. Independent Learning and Research Readiness

Demonstrate the ability to independently acquire, evaluate and apply new scientific knowledge and pursue higher studies, research and professional opportunities in Botany and allied disciplines.

4. TEACHING–LEARNING PROCESS

The teaching–learning process for the M.Sc. Botany programme shall follow a **student-centred, outcome-oriented and research-informed approach**, integrating classroom instruction with laboratory, field and computational learning.

4.1 Classroom Teaching

- Interactive lectures for systematic development of advanced botanical concepts.
- Concept-based discussions and explanation of complex biological processes.
- Use of diagrams, flowcharts, models and illustrations for structural and developmental topics.
- Comparative teaching of plant groups, physiological pathways and molecular mechanisms.
- Integration of classical botanical knowledge with contemporary developments.

4.2 Tutorial and Discussion-Based Learning

- Tutorials for clarification and reinforcement of difficult concepts.
- Student-led discussions on current developments in Botany.
- Critical discussion of scientific literature and research findings.
- Problem-solving exercises in genetics, plant breeding, ecology and biostatistics.

4.3 Practical and Laboratory-Based Learning

Practical learning shall constitute an important component of the programme. Students will learn through **demonstration, hands-on experimentation, observation, measurement, data recording and interpretation.**

The syllabus provides practical training in plant morphology and anatomy, ecological sampling, microbial isolation and identification, chromosome behaviour, biochemical estimation, chromatography, DNA isolation, PCR, electrophoresis, tissue culture and bioinformatics.

4.4 Field-Based Learning

Field studies shall be used to provide first-hand exposure to:

- Plant diversity and identification
- Plant communities
- Ecological factors
- Biodiversity assessment

- Conservation sites
- Herbarium techniques
- Local flora
- Environmental problems
- Forest and ecosystem management

The syllabus specifically includes field-study reports and visits to research institutions, universities, botanical gardens and herbaria.

4.5 Research-Based Learning

Students will be encouraged to:

- Identify research problems.
- Review scientific literature.
- Develop hypotheses.
- Design experiments.
- Collect and analyse data.
- Interpret results.
- Prepare scientific reports.
- Present research findings.

The dissertation component provides an important platform for independent research and application of specialized knowledge.

4.6 Case-Based and Problem-Based Learning

Real-world biological problems may be used for teaching, particularly in:

- Plant disease management
- Biodiversity conservation
- Environmental pollution
- Climate change
- Forest management
- Crop improvement
- Plant stress
- Biotechnology
- Bioinformatics
- Sustainable utilization of plant resources

4.7 Seminar and Presentation-Based Learning

Students may be engaged in:

- Seminars
- Journal presentations
- Student presentations
- Group discussions
- Research paper discussions
- Poster presentations
- Viva-voce
- Scientific report writing

4.8 Computational and Bioinformatics Learning

Students shall be trained in computational approaches wherever relevant, including:

- Biological databases
- Sequence retrieval
- BLAST
- Sequence alignment
- Molecular data analysis
- Protein structure analysis
- Statistical software
- Ecological data analysis

The syllabus specifically includes database retrieval, BLAST, FASTA, sequence alignment, annotation, gene prediction and protein modelling.

5.TEACHING–LEARNING TOOLS

The following teaching–learning tools may be employed to support effective delivery of the M.Sc. Botany curriculum.

A. Conventional Teaching Tools

- Chalkboard/whiteboard
- Textbooks and reference books
- Lecture notes
- Printed study materials
- Botanical charts and posters

B. ICT-Based Tools

- LCD/projector-based presentations
- PowerPoint presentations
- Digital images and animations
- Educational videos
- E-books and e-resources
- Online scientific databases
- Learning Management Systems and digital learning platforms

C. Botanical and Laboratory Tools

- Compound and stereo microscopes
- Permanent and temporary slides
- Botanical specimens
- Herbarium specimens
- Museum specimens
- Anatomical models
- Laboratory glassware and instruments
- Microtome
- Spectrophotometer
- Electrophoresis apparatus
- PCR equipment
- Chromatographic facilities
- Tissue-culture facilities

The syllabus explicitly incorporates microscopy, spectroscopy, chromatography, electrophoresis, centrifugation, DNA sequencing and radio-isotope techniques as bioinstrumentation areas.

D. Field-Based Tools

- Quadrats
- Measuring instruments
- GPS
- Field notebooks
- Plant collection equipment
- Soil and water testing equipment
- Ecological sampling equipment
- Herbarium equipment

The ecology specialization includes remote sensing, GIS and GPS applications, while practical work includes vegetation mapping and soil and water-quality analysis.

E. Computational Tools

- Statistical software
- Spreadsheet/data-analysis tools
- Biological databases
- BLAST and sequence-analysis platforms
- Molecular modelling tools
- GIS and remote-sensing software

F. Research and Learning Resources

- Research journals
- Scientific databases
- Review articles
- Research papers
- Herbarium and botanical garden resources
- Research institutions

6.ASSESSMENT METHODS

The assessment system shall evaluate **knowledge, understanding, practical competence, analytical ability, research aptitude, scientific communication and application of botanical concepts.**

The uploaded syllabus provides **80 marks for course work and 20 marks for internal assessment** for the major theory and practical papers. It also specifies three-hour theory examinations and five-hour practical examinations.

6.1 Continuous/Internal Assessment

Internal assessment may be used to assess students progressively through:

- Class tests
- Assignments
- Tutorials
- Seminars
- Presentations
- Practical records
- Field-study reports

- Project work
- Participation in academic activities
- Problem-solving exercises

Note: The syllabus specifies the 20-mark internal assessment component but does not prescribe a detailed internal-assessment breakup. Therefore, the above may be adopted as appropriate institutional mechanisms rather than presented as the prescribed marks distribution.

6.2 End-Semester Theory Examination

Theory examinations shall assess:

- Conceptual understanding
- Knowledge and comprehension
- Application of botanical principles
- Analytical and critical thinking
- Problem-solving ability
- Interpretation of biological information
- Ability to relate theoretical concepts to practical situations

The syllabus prescribes a **three-hour theory examination**.

6.3 Practical Examination

Practical examinations shall evaluate:

- Laboratory skills
- Observation and identification
- Experimental technique
- Accuracy of measurements
- Data recording
- Data analysis
- Interpretation of results
- Scientific drawing/documentation
- Laboratory safety and procedure

The practical curriculum involves activities such as microbial isolation, chromosome analysis, biochemical estimations, DNA isolation, PCR, electrophoresis and tissue culture.

6.4 Field-Based Assessment

Field learning may be assessed through:

- Field notebooks
- Plant identification exercises
- Ecological data collection
- Field-study reports
- Biodiversity documentation
- Herbarium preparation
- Field presentations

The syllabus specifically includes field-study reports and ecological data collection.

6.5 Seminar/Presentation Assessment

Students may be assessed on:

- Content accuracy
- Understanding of the topic
- Use of scientific literature
- Analytical ability
- Presentation skills
- Scientific communication
- Response to questions

6.6 Dissertation Assessment

For specialization dissertations, assessment is explicitly divided into:

- **Dissertation: 50 marks**
- **Viva-Voce: 30 marks**
- **Internal Assessment: 20 marks**
- **Total: 100 marks**

The dissertation assessment should therefore evaluate the student's ability to:

- Identify and formulate a research problem
- Review relevant literature
- Plan and conduct research
- Apply appropriate methodology
- Collect and analyse data
- Interpret findings

- Draw scientific conclusions
- Prepare a scientific dissertation
- Defend the work during viva-voce

6.7 Assessment of Research and Analytical Skills

Research-oriented assessment may include:

- Data interpretation
- Statistical problems
- Analysis of experimental results
- Scientific literature review
- Research proposal preparation
- Bioinformatics exercises
- Ecological data analysis
- Molecular-data interpretation

7. OVERALL TEACHING–LEARNING AND ASSESSMENT FRAMEWORK

Component	Major Approach	Learning Focus	Assessment
Theory	Lectures, tutorials, discussions	Knowledge and conceptual understanding	Internal + semester examination
Practical	Demonstration and hands-on experiments	Technical and laboratory skills	Practical examination + record
Field Work	Field visits, surveys and sampling	Observation, identification and ecological skills	Field report + practical assessment
Seminar	Student presentations and discussions	Scientific communication	Presentation/seminar
Case Study	Problem-based learning	Application and critical thinking	Assignment/presentation
Computational Learning	Statistical and bioinformatics exercises	Data analysis and interpretation	Practical/exercises
Research	Literature review, experimental work	Research aptitude	Dissertation/project
Viva-Voce	Question-answer and defence	Conceptual clarity and communication	Viva assessment

CURRICULUM COMPONENTS

Distribution of Credits in Two years

COURSE STRUCTURE OF Post Graduate Programme in BOTANY

Semester	Course Name	Code	Credit
SEMESTER -1			
1	Paper 1 Plant breeding, Genomics & Bioinformatics	BOT-1-DSC-4014 (Level-400)	3
	Practical		1
	Paper 2 Conservation Ecology, & Biodiversity	BOT-1-DSC-4024 (Level-400)	3
	Practical		1
	Paper 3 Plant diseases, Diagnostics & Management	BOT-1-DSC-4034 (Level-400)	3
	Practical		1
	Paper 4/ DSE-1 Environmental Microbiology BOT-1-DSE-4044 (A)	BOT-1-DSE-4044 (Level-400)	3
	Practical		
	Paper 4/ DSE-2 Plant growth & Morphogenesis BOT-1-DSE-4044 (B)		
	Practical		1
	Paper 5 **Research Methodology	BOT-1-FSC-4054 (Level-400)	3
	Practical		1
SEMESTER -2			
2	Paper 1 Molecular Biochemistry	BOT-2-DSC-5014 (Level-500)	3
	Practical		1
	Paper 2 Fungal Diversity, Genetics & Application	BOT-2-DSC-5024 (Level-500)	3
	Practical		1
	Paper 3 Advanced Taxonomy Morphology	BOT-2-DSC-5034 (Level-500)	3
	Practical		1
	Paper 4/ DSE-1 Plant Taxonomy Resources, Ecology Biostatics BOT-2-DSE-5044 (A)	BOT-2-DSE-5044 (Level-500)	3
	Practical		
	Paper 4/DSE-2 Plant Physiology & Plant Pathology BOT-2-DSE-5044 (B)		
	Practical		1

	Paper 5 Laboratory Techniques. Theory & practice	BOT-2-FSC-5054 (Level-500)	3
	Practical		1

SEMESTER -3

SPECIALIZATION OPTIONAL 1: ANGIOSPERM TAXONOMY

Paper 1	BOT-AT-3-DSC-5064 (Level-500)	4
Paper 2	BOT-AT-3-DSC-5074 (Level-500)	4
Paper 3	BOT-AT-3-DSC-5084 (Level-500)	4
Practical 1	BOT-AT-3 -5094 (Level-500)	4
Practical 2	BOT-AT-3-DSE-5104 (Level-500)	4

SPECIALIZATION OPTIONAL 2 : ECOLOGY & WILDLIFE BIOLOGY

Paper 1	BOT-EW-3-DSC-5064 (Level-500)	4
Paper 2	BOT-EW-3-DSC-5074 (Level-500)	4
Paper 3	BOT-EW-3-DSC-5084 (Level-500)	4
Practical 1	BOT-EW-3-DSC-5094 (Level-500)	4
Practical 2	BOT-EW-3-DSC-5104 (Level-500)	4

SPECIALIZATION OPTIONAL 3 : MYCOLOGY AND PLANT PATHOLOGY

Paper 1	BOT-MPP-3-DSC-5064 (Level-500)	4
Paper 2	BOT-MPP -3-DSC-5074 (Level-500)	4
Paper 3	BOT-MPP -3-DSC-5084 (Level-500)	4
Practical 1	BOT-MPP-3-DSC-5094 (Level-500)	4
Practical 2	BOT-MPP-3-DSE-5104 (Level-500)	4

SPECIALIZATION OPTIONAL 4 : PLANT PHYSIOLOGY AND BIOCHEMISTRY		
Paper 1	BOT-PPB-3-DSC-5064 (Level-500)	4
Paper 2	BOT-PPB-3-DSC-5074 (Level-500)	4
Paper 3	BOT-PPB-3-DSC-5084 (Level-500)	4
Practical 1	BOT-PPB-3-DSC-5094 (Level-500)	4
Practical 2	BOT-PPB-3-DSC-5104 (Level-500)	4
SEMESTER -4		
Paper 1: DISSERTATION (with 3 components)		
(i) Component 1: Dissertation/Thesis	BOT-4-DSC 511-12	6
(ii) Component 2: Viva Voce	BOT-4- DSC 512-2	4
(iii) Component 3: Internship/ Field work	BOT-DSC INT-513-2	6
Paper 2- Advanced Elective – SCIENTIFIC WRITING, PUBLICATION ETHICS & IPR	BOT- DSC 514-4	4

**** To be adopted from SWAYAM-based online credit course (Research Methodology and IPR by Dr. G. Janardhanan, Professor, NITTTR Chennai)**

Detailed Syllabus of 1st Semester

Semester	Course Name	Code	Credit
I	Paper 1 Plant Breeding, Genomics and Bioinformatics	BOT-1-DSC-4014	3
	Practical		1
	Paper 2 Conservation Ecology and Biodiversity Assessment Course	BOT-1-DSC-4024	3
	Practical		1
	Paper 3 Plant diseases, diagnostic and management	BOT-1-DSC-4034	3
	Practical		1
	Paper 4/ DSE-1 Environmental Microbiology	BOT-1-DSE-4044	3
	Practical		
	Paper 4/ DSE-2 Plant Growth and Morphogenesis		
	Practical		1
	**Paper 5 Research Methodology	BOT-1-FSC-4054	3
	Practical		1

Title of the Course	Paper -1 Plant Breeding, Genomics and Bioinformatics
Paper Code	BOT-1-DSC-4014
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Explain the principles of plant breeding, hybridization, and selection, as well as the concepts in the improvement of major crop species, polyploidy inheritance, self-incompatibility, and the Hardy-Weinberg law of equilibrium. • Apply novel plant breeding tools such as TALEN's, CRISPR-Cas9, and base editing in practical scenarios to improve crop species. • Analyze chromosome variations in higher plants, including haploid production systems and the breeding application of haploids, as well as the significance of aneuploidy, trisomic, tetrasomic, and nullisomic conditions in genetic studies. • Evaluate the significance of intellectual property rights in plant breeding and assess the use of bioinformatics tools in genomics and functional genomics. • Design and conduct practical experiments in plant breeding and bioinformatics, including emasculation techniques, sequence analysis, gene prediction, protein modeling, chromosome analysis, and comparative genomics of bacteria.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME
Subject: Botany
BOT-1-DSC-4014

Course Name: *Plant Breeding, Genomics and Bioinformatics*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no	Unit content	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit 1	Principles of plant breeding, hybridization and selection; concepts in improvement of major crop species; polyploidy inheritance, self-incompatibility.	6	-	8	6
Unit 2	QTL mapping using molecular marker, population statistics; heritability, Hardy-Weinberg law of equilibrium, Novel plant breeding tools (TALEN's, CRISPR-Cas9, Base editing).	6	1	10	7
Unit 3	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.	7	1	10	8
Unit 4	Intellectual Property Rights -- Intellectual property rights (IPR); Patents, trade secrets, copyright, trademarks; Geographical Indicators (GI); Registration, subject matter and ownership of IPRs. Plant genetic resources; GATT & TRIPPS; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights.	7	1	10	8
Unit 5	Genomics: Organization of nuclear and organellar genomes, Sequencing Genomes, Comparative genomics, Functional genomics	6		10	6
Unit 6	Bioinformatics: Introduction to bioinformatics, biological databases, data mining and retrieval, scope and application of bioinformatics, nucleic acid and protein sequence analysis, sequence alignment, local and global alignment, database search for homologous sequences-BLAST and FASTA, protein structure analysis,	8	2	12	10

	Ramachandran plot, computer-aided drug discovery.		
PRACTICAL [Credit: 01]			
1. Principle, techniques and procedure of emasculation. 2. Sequence (protein/DNA) downloading from databases, alignment and homologous sequence search 3. Sequence BLAST, annotation and gene prediction with the help of bioinformatical tools. 4. Protein modelling, structure prediction and Ramachandran plot analysis 5. Chromosome analysis, study of chromosome behaviour in mitosis and meiosis, chromosome anomalies in plant cells. 6. Comparative genomics of bacteria	30	40	

Reading list:

1. Acquaah, G. (2012). Principles of Plant Genetics & Breeding. 2nd edition. Hoboken, NJ, Wiley.
2. Allard, R.W. (1999). Principles of Plant Breeding. John Wiley, New York.
3. Singh, B.D. (2022). Plant Breeding: Principles and Methods, 12th edition. New Delhi, Delhi: Kalyani Publishers.
4. Frey, K. J. (1982). Plant Breeding II. Kalyani Publishers, New Delhi.
5. Chopra, V.L. (2023). Plant Breeding: Theory and Practice 2nd Restructured Edition, New India Publishing Agency, New Delhi.
6. Poehlman J. M. and Sleper D. A. (1995). Breeding Field Crops, 4th Ed. Panima Publishing Corporation, New Delhi.
7. Welsh, J. R. (1981). Fundamentals of Plant Genetics and Breeding. John Wiley and Sons, New York.
8. Ahuja, V.K. (2007) Laws related to IPR. LexisNexis, India.
9. Snustad DP, Simmons MJ (2010) Principles of Genetics, John Wiley & Sons Inc., India. 5th edition
10. Pierce BA (2016) Genetics-A conceptual approach, W.H. Freeman and Co. USA, Sixth edition.
11. Primerose SB and Twyman RM (2014), Principles of Gene manipulation and genomics. Wiley Blackwell. Seventh Edition.

Title of the Course	Paper -2 Conservation Ecology and Biodiversity Assessment Course
Paper Code	BOT-1-DSC-4024
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Understand the principles of conservation ecology, including conservation ethics, genetic variation, wildlife habitats, population dynamics, carrying capacity, and factors regulating populations. • Compare and evaluate different conservation strategies such as in-situ, ex-situ, and hybrid approaches, and assess their significance in species recovery and biodiversity conservation. • Demonstrate an understanding of biodiversity concepts, levels, hotspots, ecosystem services, and methods used for biodiversity monitoring and conservation planning. Analyze major threats to biodiversity, extinction risks, conservation policies, legal frameworks, and the role of national and international organizations in biodiversity protection. • Apply biodiversity assessment methodologies to document, monitor, analyze, and interpret biodiversity data for sustainable management of biological resources. • Evaluate the significance of protected area networks, wildlife corridors, forest and wetland conservation, and conservation challenges with special reference to India and Northeast India. • Use statistical and computational tools such as Microsoft Excel and SPSS for ecological data management, analysis, interpretation, and presentation. Conduct field-based biodiversity assessments and vegetation analyses, and develop practical skills in observing conservation strategies and ecosystem management practices.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME

Subject: Botany

Semester: 1st

BOT-1-DSC-4024

Course Name: Conservation Ecology and Biodiversity Assessment Course

Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit No	Unit Content	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit 1	Conservation Ecology- objectives of conservation of biotic resources, ethics and values, genetic variation and its loss, variation in natural populations, wildlife habitat – components and related concepts, Species and habitat conservation- prioritizing species and habitat, protected area networks; major approaches to their management, Indian case studies on conservation/management strategy. Biotic potential and environmental resistance, carrying capacity, population dynamics, density dependent and density independent limiting factors.	7	1	10	8
Unit 2	Conservation strategies- In-situ, Ex-situ and hybrid approaches, conservation: facilities, the establishment of new populations, captive breeding, reintroduction, advantages and disadvantages, Metapopulation- concept, types, and conservation importance	6	1	8	7
Unit 3	Biodiversity: Concept, levels, types and Importance, efforts to conserve biodiversity, Methods for biodiversity monitoring, Indicators for biodiversity, megadiversity zones and hot spots; hottest hot spots, mega diversity countries, centres of plant diversity and endemism biodiversity and ecosystem services	6	-	8	6
Unit 4	Threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red data book; 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. Provisions in the constitutions of india-environmental protection act, wildlife protection act 1972, forest conservation act 1980, Indian forest act 1980(revise); the environment protection act 1986, public interest litigation(PIL) and right to information act – there relevance in conservation, role of Pas in conservation of wildlife in india; overview of wildlife trade-global and regional scenerio.	8	2	12	10

Unit 5	Biodiversity Assessment: Concept and Importance, methodology of assessment and analysis of different species groups, plant functional groups, monitoring of different species groups; importance of documentation and use of information technology in biodiversity study, sustainable use of biodiversity; biodiversity loss and its consequences.	6	1	10	7
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Unit 6	Protected Area Network: Concept, History, Indian Scenario: Biospheres, National Parks and Wildlife Sanctuaries, need of forest and wetland conservation and management, recovery of forest and wetland ecosystems, problems of protected areas in India, connectivity and corridors; population biology of endangered species. Population viability analysis, Wildlife conservation in NE India- Case Studies. Environmental law/act. Role of PAs in conservation of wildlife in India; overview of wildlife trade-global scenario.	6	1	10	7
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PRACTICAL [Credit: 01]

1. Ecological data analysis in Microsoft Excel: Data entering in Excel worksheet; Statistical interpretation in Excel; Data analysis tool, Pak: Basic graphical tools; T-test; Chi-Square test for independence of attributes; Spearman's rank correlation test. 2. Introduction to SPSS : Creation of databases, entry of data, saving and formatting of data, queries of data, sorting and classification of data and others. 3. Demonstration of biodiversity assessment methods in the University campus; 4. Qualitative and Quantitative analysis of vegetation. 5. Field visit to the forest nearby or protected area to study the biodiversity and understand the conservation strategies employing the protected area.	30	40
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Reading list:

1. Anna A. Sher, Richard B. Primack · (2019) an Introduction to Conservation Biology. Oxford University Press
2. Anne E. Magurran, Brian J. McGill (2011) Biological Diversity: Frontiers in Measurement and Assessment. Oxford University Press.
3. Fred Van Dyke, Rachel L. Lamb (2020). Conservation Biology: Foundations, Concepts, Applications. Springer International Publishing 6
4. Jase Fitzgerald (2017). Biodiversity: An Introduction. Larsen and Keller Education.
5. Kelsey Malone (2020) Ecology: Evolution, Biodiversity and Conservation CALLISTO REFERENCE.
6. Krishnamurthy KV (2018) an Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.

7. Lisa Idzikowski (2019). Biodiversity and Conservation. Greenhaven Publishing LLC
8. Malcolm L. Hunter, Jr., James P. Gibbs, Viorel D. Popescu. (2021). Fundamentals of Conservation biology (4th edition). Wiley
9. Michael O'Neal Campbell. 2021. Critical Research Techniques in Animal and Habitat Ecology. Nova Science Publishers.
10. Peter Stiling (2015). Ecology: Global Insights & Investigations 2nd Edition. McGraw-Hill international edition Reference books
11. Petros Ganatsas (2021). Forest Biodiversity, Conservation and Sustainability. Mdp AG
12. Singh JS, Singh SP and Gupta SR (2014) Ecology, Environmental Science and Conservation. 4th Edition. S. Chand & Company Pvt. Ltd

Title of the Course	Pape- 3 Plant diseases, diagnostic and management
Paper Code	BOT-1-DSC-4034
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Comprehend the fundamental concepts of plant diseases, including Koch's postulates, the germ theory of diseases, and the distinction between biotic and abiotic causes of plant diseases. • Analyze the dissemination of plant pathogens, understand the disease cycle, and evaluate the physiological changes induced by diseases in plants, with a focus on the genetic aspects of plant pathogens. • Apply various diagnostic techniques for plant diseases, including visual identification, laboratory methods such as microscopy and culturing, and advanced molecular methods like PCR, DNA sequencing, and ELISA. • Evaluate the epidemiology of plant diseases, including disease mapping, forecasting, and surveillance techniques, to understand the spread and control of plant pathogens in different environments. • Propose and assess various methods for plant disease control, including cultural, chemical, and biological approaches, as well as integrated pest management strategies tailored to manage soil-borne and seed-borne plant pathogens, while also considering the identification and development of disease-resistant plants, including biotechnological approaches such as GMOs.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME

Subject: Botany

Semester:1st

BOT-1-DSC-4034

Course Name: *Plant diseases, diagnostic and management*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
Unit 1	Introduction to Plant Diseases: Koch's postulate and germ theory of diseases, biotic and abiotic causes of plant diseases, symptoms and signs of plant diseases caused by fungi, bacteria, virus, and nematode.	6	6
Unit 2	Dissemination of plant pathogens; disease cycle; physiological changes due to disease in plants; Genetics of plant diseases	8	10
Unit 3	Diagnosis of Plant Diseases: Visual identification of common plant diseases, Laboratory techniques (microscopy, culturing, and serological tests); molecular methods (PCR, DNA sequencing, and ELISA)	8	12
Unit 4	Epidemiology of plant diseases; Disease mapping, forecasting and surveillance techniques	8	8
Unit 5	Concept of plant disease control; Cultural, Chemical, and biological control of plant diseases; Integrated pest management (IPM); Management of soil borne plant pathogens; Management of seed borne pathogens	8	12
Unit 6	Resistant gene identification and development of disease resistant plant (Traditional and biotechnological approach), GMO (bt-cotton, bt-brinjal, bt-chickpea)	7	12
PRACTICAL [Credit: 01]			
8. Study of plant disease symptoms and their causal organisms 9. Isolation and identification of pathogen from diseased plant materials 10. Isolation of soil borne fungal pathogens and their control 11. Proving of Koch's postulate at least one disease		30	40

Reading list:

1. Agrios, G. N. (2005). Plant pathology (5th ed.). Academic Press.
2. Lucas, J. A. (2015). Plant pathology and plant pathogens (4th ed.). Wiley-Blackwell.

- 3.Schumann, G. L., & D'Arcy, C. J. (2010). Essential plant pathology. American Phytopathological Society Press.
- 4.Maloy, O. C., & Murray, T. D. (Eds.). (1993). Encyclopedia of plant pathology (Vol. 1-2). Wiley-Interscience.
- 5.Madden, L. V., Hughes, G., & van den Bosch, F. (2007). The study of plant disease epidemics. American Phytopathological Society Press.
- 6.Hammond, B. G., & Lemaux, P. G. (2008). Genetically modified crops: Promises, perceptions, and realities. *Advances in Agronomy*, 98, 1-41.
- 7.Staskawicz, B. J., & Jones, J. D. (2000). Molecular plant pathology since 2000. *Molecular Plant Pathology*, 1(1), 9-20.

Title of the Course	Paper- 4(A) Environmental Microbiology
Paper Code	BOT-1-DSE-4044(A)
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • List common soil microbes and explain their role in the nitrogen cycle. • Understand the concept of symbiosis and provide examples of how this interaction benefits soil health. • Perform CFU counting and use meta-genomics data to analyze microbial diversity in a soil sample. • Analyze results from the methylene blue reductase test to determine milk quality and identify the presence of specific microbial contaminants. • Evaluate different microbial bioremediation strategies for purifying polluted water and recommend the most effective method based on scientific evidence
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME

Subject: botany

Semester: 1st

BOT-1-DSE-4044(A)

Course Name: *Environmental Microbiology*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no.	Unit content	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit 1	Microbiology of soil, water and air (common soil microflora, microbes in soil health improvement, common water microflora, microbial water quality analysis, common air microflora)	6	-	6	6
Unit 2	Culture-dependent microbial study (Growth media, culture techniques, CFU count and enumeration, characterization of isolates and species identification)	7	1	10	8
Unit 3	Culture-independent microbial study (direct microscopic methods, meta-genomics, transcriptomics, proteomics and metabolomics)	7	1	12	8
Unit 4	Microbial interactions (symbiosis, antagonism, parasitism, commensalism, amensalism, cooperation, quorum and anti-quorum sensing)	7	1	8	8
Unit 5	Biogeochemical cycling (Role of microbes in biogeochemical cycling, carbon cycle, nitrogen cycle, sulfur cycle, phosphorus cycle)	7	1	12	8
Unit 6	Scope of microbiology in environmental engineering (reclamation of degraded soil, purification of polluted water, biodegradable waste management)	7	-	12	7
PRACTICAL [Credit: 01]					
1. Enumeration and identification of common soil microbes 2. Enumeration and identification of common water microbes 3. Use of differential media/specific media to identify a particular group of microbes 4. Catalase/Phosphatase test for bacteria 5. MPN test for water quality 6. Methylene blue reductase test for milk quality		30		40	

Reading list:

1. Sylvia DM, Fuhrmann JJ, Hartel PG, Zuberer DA (2005) Principles and Applications of Soil Microbiology, Pearson, USA.

2. Pepper IL, Gerba CP, Gentry TJ (2014) Environmental Microbiology, Academic Press, USA.
3. Atlas RM (2010) Handbook of Microbiological Media, CRC Press, USA.
4. Madigan MT, Martinko JM, Bender K, Buckley D, Stahl D (2018) Brock Biology of Microorganisms, Pearson, USA.
5. Riesenfeld CS, Schloss PD, Handelsman J (2004) Metagenomics: Genomic Analysis of Microbial Communities, Kluwer Academic Publishers, USA.
6. Hugenholtz P, Tyson GW (2008) Metagenomics, Springer, USA.
7. Falkowski PG, Fenchel T, Delong EF (2008) The Microbial Engines That Drive Earth's Biogeochemical Cycles, Science, USA.
8. Fuqua C, Greenberg EP (2002) Signaling in Bacteria: New Insights into Microbial Ecology and Evolution, ASM Press, USA.
9. Schlesinger WH, Bernhardt ES (2013) Biogeochemistry: An Analysis of Global Change, Academic Press, USA.
10. Paul EA (2014) Soil Microbiology, Ecology, and Biochemistry, Academic Press, USA.
11. Bitton G (2011) Wastewater Microbiology, Wiley-Blackwell, USA.
12. Thakur IS (2006) Environmental Biotechnology: Basic Concepts and Applications, I.K. International Publishing House, India.
13. Cappuccino JG, Welsh CT (2016) Microbiology: A Laboratory Manual, Pearson, USA.
14. Benson HJ (2012) Microbiological Applications: Laboratory Manual in General Microbiology, McGraw-Hill, USA.

Title of the Course	Paper- 4(B) Plant Growth and Morphogenesis
Paper Code	BOT-1-DSC-4044(B)
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Apply knowledge of the mechanism of action of photomorphogenesis receptors in plant responses to light. • Apply knowledge of tropic and nastic movements in plants and their adaptive roles. • Evaluate the advantages and disadvantages of chemical and non-chemical preservation techniques on nutritional changes in fruits and vegetables. • Evaluate the advantages and disadvantages of chemical and non-chemical preservation techniques on nutritional changes in fruits and vegetables.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME

Subject: Botany

Semester: 1st

BOT-1-DSE-4044(B)

Course Name: *Plant Growth and Morphogenesis*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no.	Unit content	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit 1	Photomorphogenesis: Photochemical and biochemical properties of phytochromes, cryptochromes and phototropins; phytochrome biosynthesis, cellular localization, roles; Mechanism of action of photomorphogenetic receptors.	7	1	12	8
Unit 2	Plant developments: Plant developments: Biochemical changes during development of seeds; Plant movement: tropic and nastic movements.	6	-	8	6
Unit 3	Post-harvest physiology: Ripening of fruit and its regulation, post-harvest management; Fruit and vegetable preservation: chemical and non-chemical preservation techniques, nutritional changes during preservation.	7	-	8	7
Unit 4	Plant Growth Regulators: A brief idea about discovery, role and possible mechanism of action of Triacntanol, Salicylic acid, and Polyamines. A brief idea about role of plant growth retardants- CCC, Maleic hydrazide, Trizoles and TIBA.	7	1	10	8
Unit 5	Senescence and Programmed Cell Death (PCD): Biochemical changes during senescence of leaves and petals and regulation of senescence. PCD: Biochemical changes in cellular level, regulation of PCD, caspases and metacaspases.	7	1	10	8
Unit 6	Applied Plant physiology: Foliar nutrition: Conditions, factors affecting efficiency of Foliar nutrition; Advantages, and disadvantages. Chelators and soil conditioners. Phytoremediation: History, Mechanisms and types, Advantages, and disadvantages. Role of tissue culture, and mutants in plant physiological studies.	7	1	12	8
PRACTICAL [Credit: 01]					
1. Study of changes in starch / protein content during seed development. 2. Study of lipid accumulation during development of oil seeds. 3. Demonstration of hormonal regulation of leaf and petal senescence. 4. To study the effect of different PGRs on seedling growth.		30		40	

Suggested Readings:

1. Bajracharya D (1999) Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Bhatla SC, Lal MA (2018) Plant Physiology, Development and Metabolism. Springer Nature Singapore Pte Ltd.
3. Devlin RM (2017) Outline of Plant Physiology. Medtech: Scientific International Pvt. Ltd.
4. Devlin RM, Witham FH, Blaydes DF (2017) Devlin's Exercises in Plant Physiology. Medtech: Scientific international Pvt. Ltd.
5. Hopkins WG, Huner A (2008) Introduction to Plant Physiology (4th edition). John Wiley and Sons. U.S.A.
6. Kochhar SL, Gujral SK (2021) Plant Physiology: Theory and Applications (2nd edition). Cambridge University Press.
7. Malik CP, Srivastava (2015) Text Book of Plant Physiology. Kalyani Publishers, New Delhi.
8. Salisbury FB, Ross CW (2004) Plant Physiology (4th edition). Cengage Learning India Pvt. Ltd., New Delhi, India.
9. Taiz L, Zeiger E, Møller IM, Murphy A (2015) Plant Physiology and Development (6th edition). Sinauer Associates Inc. USA.

Title of the Course	Paper- 5 RESEARCH METHODOLOGY
Paper Code	BOT-1-FSC-4054
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Comprehend fundamental research concepts, critically analyze literature to identify gaps, and articulate scientific questions, setting clear hypotheses and objectives within the context of existing studies. • Apply experimental design principles to formulate research problems, select sampling techniques, design experimental setups, and ensure reproducibility through proper data coding and decoding. • Apply statistical methods and use software tools for data analysis and presentation, understanding the impact of sample size on data validity. • Create diverse forms of scientific writing, understand research article components, develop writing strategies, and evaluate ethical considerations and plagiarism. • Understand and implement collection and preservation techniques for various specimens (Algae, Fungi, Higher Plants), apply GIS, GPS, and remote sensing, and become proficient in various analytical techniques and microscopy methods while adhering to safety measures.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME

Subject: Botany

Semester: 1st sem

Research component-(RC-1)

BOT-1-FSC-4054

Course Name: *Research Methodology*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no.	Unit content	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit 1	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.	6	-	6	6
Unit 2	Experimental designs: Formulation of research problem, sampling technique, methods selection, experimental set up, data generation/acquiring, Coding/decoding and reproducibility of data.	7	1	10	8
Unit 3	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	7	1	12	8
Unit 4	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	7	1	8	8
Unit 5	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	7	1	12	8

Unit 6	Basic knowledge on analytical (Principle and application of UV-Vis, IR, FTIR and NMR Spectroscopy), Basic knowledge on separation techniques (Principal 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.	7	-	12	7
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PRACTICAL [Credit: 01]

1. A local field visits for collection and preservation of specimens like algae, fungi, and higher plants. 2. To perform statistical analysis using the software tool like Excel. 3. To work out standard deviation (SD), standard error (SE), correlation and regression, and test of significance. 4. Demonstrations on HPLC and gel filtration. 5. Detection of plagiarism using any plagiarism detection tool.	30	40
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Suggested Readings:

1. Kumar R (2014) Research Methodology: A Step-by-Step Guide for Beginners. Sage Publications, UK.
2. Booth WC, Colomb GG, Williams JM (2016) The Craft of Research. University of Chicago Press, US.
3. Quinn GP, Keough MJ (2002) Experimental Design and Data Analysis for Biologists. Cambridge University Press, UK.
4. Montgomery DC (2019) Design and Analysis of Experiments. Wiley, United States.
5. Box GEP, Hunter JS, Hunter WG (2005) Statistics for Experimenters: Design, Innovation, and Discovery. Wiley-Interscience, US.
6. Zar JH (2010) Biostatistical Analysis. Pearson, US.
7. Schimel J (2012) Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded. Oxford University Press, US.
8. Hofmann AH (2019) Scientific Writing and Communication: Papers, Proposals, and Presentations. Oxford University Press, US.
9. Brower JE, Zar JH, von Ende CN (1998) Field and Laboratory Methods for General Ecology. McGraw-Hill, US.
10. Wegmann M, Leutner B, Dech S (2016) Remote Sensing and GIS for Ecologists: Using Open Source Software. Pelagic Publishing, UK.
11. Skoog DA, Holler FJ, Crouch SR (2017) Principles of Instrumental Analysis. Cengage Learning, US.
12. Upadhyay A, Upadhyay K, Nath N (2014) Biophysical Chemistry: Principles and Techniques. Himalaya Publishing House, India.
13. Kirkup L (2002) Data Analysis with Excel®: An Introduction for Physical Scientists. Cambridge University Press, UK.

14. Leech NL, Barrett KC, Morgan GA (2011) SPSS for Intermediate Statistics: Use and Interpretation. Routledge, US.

OR

**** To be adopted from SWAYAM-based online credit course (Research Methodology and IPR by Dr. G. Janardhanan, Professor, NITTTR Chennai)**

Detailed Syllabus of 2nd Semester

Semester	Course Name	Code	Credit
II	Paper 1 Molecular Biochemistry	BOT-2-DSC-5014	3
	Practical		1
	Paper 2 Fungal Diversity, Genetics, and Applications	BOT-2-DSC-5024	3
	Practical		1
	Paper 3 Advanced Plant Taxonomy and Diversity of Angiosperms	BOT-2-DSC-5034	3
	Practical		1
	Paper – 4/DSE-1 Plant Taxonomy, Resources, Ecology and Biostatics	BOT-2-DSE-5044	3
	Practical		
	Paper 4/ DSE-2 Plant Physiology and Plant Pathology		1
	Practical		
	**Paper 5 Laboratory Techniques-Theory & Practice	BOT-2-FSC-5054	3
	Practical		1

Title of the Course	Paper- 1 Molecular Biochemistry
Paper Code	BOT-2-DSC-5014
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Comprehend fundamental research concepts, critically analyze literature to identify gaps, and articulate scientific questions, setting clear hypotheses and objectives within the context of existing studies. • Apply experimental design principles to formulate research problems, select sampling techniques, design experimental setups, and ensure reproducibility through proper data coding and decoding. • Apply statistical methods and use software tools for data analysis and presentation, understanding the impact of sample size on data validity. • Create diverse forms of scientific writing, understand research article components, develop writing strategies, and evaluate ethical considerations and plagiarism. • Understand and implement collection and preservation techniques for various specimens (Algae, Fungi, Higher Plants), apply GIS, GPS, and remote sensing, and become proficient in various analytical techniques and microscopy methods while adhering to safety measures.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME

Subject: Botany

Semester: 2

BOT-2-DSC-5014

Course Name: Molecular Biochemistry

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no	Unit content	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit 1	Proteins and Mass Spectrometry- Classification of amino acids. Protein Structure: a) Peptide bond, determination of primary structure, end group analysis, sequencing, Solid phase synthesis b) Secondary: alpha-helix, beta-structure, beta-helix, super secondary structure. c) Tertiary Structure: Forces stabilizing, unfolding/ refolding experimentst. d) Quaternary structure – haemoglobin. e) Ramachandran plot. f) Helix coil transitions, Vander Walls, electrostatic, Hydrogen bonding, and hydrophobic interactions. g) Energy terms in Biopolymer conformational calculation. Application of Mass spectrometer in protein biochemistry, Basics of Mass Spectrometry: Mass analyzers-TOF, Ion trap, Quadrupole, Ionization Methods-Electron Impact (EI), Electron Spray Ionization (ESI), Matrix Assisted Laser Desorption Ionization (MALDI), Protein Identification using MS.	8	1	10	9
Unit 2	Protein biosynthesis Eukaryotic translation machinery, structure and assembly of the ribosome, initiation, elongation and termination of translation. Unusual Bio-molecules: Prions, Fullerenes, Lectins, Antifreeze proteins, Stress Proteins, Chaperons, Ionophores (Crown ethers, Cryptands) Cyclophanes, Cyclodextrins, Cyclopeptides. Intracellular protein sorting, movement of proteins between cellular compartments: gated, transmembrane and vesicular transport. Protein transport and translocation to nucleus, mitochondria, chloroplast, peroxisomes, endoplasmic reticular system. Protein degradation.	8	-	10	8
Unit 3	Protein Engineering Theories of Protein designing: Designing by Rational Approach, Site directed mutagenesis, designing by de- novo synthesis. Methods used in de Novo synthesis- Phage display and error prone PCR. Examples of designer proteins – Dihydrofolate reductase and Subtilisin. Effect of amino acids on structure of proteins, Energy status of a protein molecule, Structure function relations of enzymes, Physical methods	8	-	10	8

	such as x- ray crystallography for determination of protein structure, for specific protein function				
Unit 4	Kinetics and Regulation of enzyme activity- Review of uni-substrate enzyme kinetics, multi-substrate enzyme kinetics, Co-operativity phenomenon, Hill and Scatchard plots, protein-ligand binding and its measurement, detailed mechanism of catalysis of serine protease and carbonic anhydrase. Metalloenzymes and Metalloenzymes; Allosteric enzymes and multienzyme systems Allosteric enzymes, sigmoidal kinetics and its physiological significance, symmetric and sequential modes of action and their significance, immobilized enzymes and their industrial applications, study of multienzyme complexes with respect to occurrence, isolation and their properties and polygenic nature eg. pyruvate dehydrogenase and fatty acid synthase.	7	-	10	7
Unit 5	Enzyme regulation General mechanisms of enzyme regulation: Feed-back inhibition and feed forward stimulation, repression and induction of enzymes, reversible and irreversible covalent modifications of enzymes, flexibility and conformational mobility of enzymes, convergent and divergent evolution of enzymes.	6	-	10	6
Unit 6	Industrial enzymes History, sources, uses, screening for novel enzymes, applications, safety and regulatory aspects of industrial enzyme use, Enzyme Nanotechnology in agriculture, cosmetics and industrial processes. Strategies to increase/modify enzyme activity and synthesis. Media, routine and nanotechnological approaches for isolation and purification of extracellular and intra-cellular enzymes, purification- centrifugation, filtration, chromatography, polishing and packaging of enzymes.	7	-	10	7

	Ramachandran plot, computer-aided drug discovery.		
PRACTICAL [Credit: 01]			
1. Estimation of protein by UV Spectrophotometer by E280/E260 method	30	40	
2. Estimation of Riboflavin by Spectrophotometric method.			
3. Estimation of Thiamine by thiochrome method			
4. Separation of proteins by PAGE			
5. Separation of proteins by SDS gel electrophoresis			
6. Western Blotting			
7. Purification of proteins by isoelectric precipitation			
8. Molecular weight determination			
9. Changes in carbohydrate, protein content during germination.			
10. Isolation and characterization of trypsin inhibitor.			
11. Induction of proteinases, amylases, and lipase during germination.			

Title of the Course	Paper- 2 Fungal Diversity, Genetics, and Applications
Paper Code	BOT-2-DSC-5024
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Demonstrate an understanding of the diversity of fungi, their global distribution, and the methods used for estimating and conserving fungal diversity. • Analyze the roles of different types of fungi in various ecosystems, including soil, plants, and their applications in agriculture and medicine. • Apply molecular genetic techniques to analyze fungal genomes, understand the mechanisms of genetic inheritance, and explore the molecular basis of fungal traits and behaviors. • Evaluate the significance of genetic elements, such as mating-type switching and retrotransposons, in fungal evolution and adaptation to different environments. • Design and propose biotechnological applications of fungi in food production, industrial processes, medicine, and environmental remediation, considering the principles of mycology and practical feasibility.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME

Subject: Botany

Semester: 2

BOT-2-DSC-5024

Course Name: *Fungal Diversity, Genetics, and Applications*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no.	Unit content	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit 1	Introduction to fungal diversity; Global fungal diversity and Biogeography; Understanding Cryptic fungi; Methods for estimation of fungal diversity and conservation	6	-	10	6
Unit 2	Diversity of Soil Fungi; Diversity of Phytopathogenic fungi; Mushroom diversity; Diversity of endophytic fungi and their functional roles	6	-	6	6
Unit 3	Molecular genetic analysis of fungi; Extra chromosomal and transposable genetic elements in fungi; Cell cycle control points in yeast	8	1	10	9
Unit 4	Mating-Type switching in Yeasts; Extra-chromosomal inheritance in fungi; Sex hormones in fungi; Retroposon and retrotransposon in fungi	8	1	14	9
Unit 5	Fungal secondary metabolites (Polyketides, Terpenes, and Indole alkaloids); Heat shock protein in filamentous fungi	5	-	8	5

Unit 6	Biotechnological application of fungi in food, industries, medicines, and agriculture; Myconanotechnology; Mycoremediation and mycofumigation; Mycoses (Types, diagnosis, and treatments)	8	2	12	10
PRACTICAL [Credit: 01]					
1.Isolation and enumeration of soil fungi 2.Study of phytopathogenic fungi from diseased samples 3.Molecular identification of fungal specimen 4.Isolation and determination of secondary metabolites from fungi		30		40	

Reading list:

- 5.Introduction to Fungi. John Webster and Roland W. S. Weber
- 6.Introduction to Mycology. C. J. Alexopoulos, C. W. Mims and M. Blackwell.
- 7.Fungi Nutrition & Physiology. Michael O. Garraway and Robert C. Evans.
- 8.Physiology of Fungi. Lilian E. Hawker

9. The Mycota; Vol: III: Biochemistry and Molecular Biology. K. Esser and P. A. Lemke.
10. The Mycota; Vol: VII: Systematics and Evolution (Part A). K. Esser and P. A. Lemke.

Title of the Course	Paper- 3 Advanced Plant Taxonomy and Diversity of Angiosperms
Paper Code	BOT-2-DSC-5034
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Apply classificatory systems to classify Angiosperms, integrating morphological, anatomical, and molecular data. • Implement rules of botanical nomenclature to accurately name and describe plant taxa, ensuring compliance with priority and legitimacy guidelines. • Expertise in plant collection, herbarium preparation, taxa description, constructing botanical keys and knowledge on taxonomic literatures. • Analyze the correlation between plant taxonomy and disciplines such as morphology, anatomy, palynology, cytology, and phytochemistry, using phenetic and cladistic approaches. • Evaluate the contributions of herbaria, botanical gardens, museums, and organizations like the Botanical Survey of India in cataloging plant diversity and conservation. • Analyze theories of Angiosperm origin, classify primitive and advanced Angiosperms, and interpret evolutionary trends within specific Angiosperm orders.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME
Subject: Botany
Semester: 2
BOT-2-DSC-5034

Course Name: *Advanced Plant Taxonomy and Diversity of Angiosperms*
Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit No.	Unit content	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit 1	Basics of Taxonomy (Concepts, Aims & Principles): Concept of Taxa; Classificatory Systems: Bentham and Hookers system, Takhtajan's system; Recent development of classificatory system in Angiosperms - APG System; Phenetic and Cladistic taxonomy.	7	1	10	8
Unit 2	Sources of Taxonomic Characters (Classical and Experimental): Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Serology	7	1	10	8
Unit 3	Botanical Nomenclature (ICN): History, Principles and Major rules, Typification, Effective and Valid Publication, Authors' citation, Principles of Priority and Limitations, synonym, basionym, nomina conservanda, rejection of names, illegitimate names, nomen nudum, tautonym, later homonym, IBC and Codes, Major changes to the Code of nomenclature.	7	1	12	8
Unit 4	Herbaria and Botanical Gardens: Herbarium techniques, Methods of Collection, processing, mounting and preservation; Roles of Herbaria and Botanical Gardens.	6	-	8	6
Unit 5	Taxonomic Literatures: Flora, Manuals, Monograph, Revision, Periodicals; Construction of Botanical keys; Botanical Survey of India.	6	-	8	6
Unit 6	Diversity of Primitive and Advanced Angiosperms: Primitive and Advanced characters of angiosperms; Phylogeny and Evolution of Angiospermic Taxa: Magnoliales, Ranunculales, Asterales, Alismatales, Poales, Orchidales.	7	2	12	9
PRACTICAL [Credit: 01]					
1. Morphological studies of locally available advanced and primitive angiospermic plants, their taxonomic description with analytical drawing, botanical keys and identification up to the rank of species. 2. Herbarium specimen preparation of locally available Angiospermic plants (15–20 Nos.). 3. Plotting of various centers of BSI, Botanical Gardens and Herbaria in different regions of India.		30		40	

Reading list:

1. Baruah A (2023) Angiosperm Taxonomy for PG Students, Global Net Publication, New Delhi.
2. Heywood VH (2016) Flowering Plant Families of the World, Firefly Books, Canada.
3. McNeill J (2012) International Code of Nomenclature for algae, fungi, and plants (Melbourne Code), Koeltz Scientific Books, Germany.
4. Mitra JN (1988) An Introduction to Systematic Botany and Ecology. The World Press Private Ltd. Calcutta.
5. Mondal AK (2009) Advanced Plant Taxonomy. New Central Book Agency (P) Ltd.
6. Naik VN (1984) Taxonomy of Angiosperms. Tata Mc Graw-Hill.
7. Pandey BP (2018) A Textbook of Botany: Angiosperm. S. Chand Publishing, 7361, Ram Nagar, Qutab Road, New Delhi-110055.
8. Singh G (2012) Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
9. Stace C (2010) Plant Taxonomy and Biosystematics, Cambridge University Press, United Kingdom.

Title of the Course	Paper- 4 Plant Taxonomy, Resources, Ecology and Biostatics
Paper Code	BOT-2-DSE-5044(A) Optional Paper 1
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]

Course Outcomes	By the end of this course/module, students will be able to: - Describe the principles, systems, and rules of plant classification, major taxonomic evidence, economically important plant resources, and basic ecological and statistical concepts. - Explain modern taxonomic tools including molecular systematics, herbarium techniques and nomenclature, types and utilization of plant resources, ecosystem components, energy flow and ecological adaptations. - Apply taxonomic keys and field identification techniques, perform vegetation analysis by quadrat and transect methods, evaluate economic and ethnobotanical uses of plants, and apply biostatistical methods such as measures of central tendency, dispersion, correlation, regression and tests of significance to botanical data. - Analyze phylogenetic relationships, community structure, biodiversity patterns, resource potential and ecological interactions, and interpret statistical results to assess variation and ecological relationships. - Evaluate strategies for plant resource conservation, sustainable use and biodiversity management; design and conduct field studies and research projects integrating taxonomic, ecological and biostatistical approaches for scientific reporting and problem-solving.
Contact hours	45 (Theory) + 30 (Practical)

PG Programme

Subject: Botany

Semester: 2nd

Paper: BOT-2-DSE-5044(A) (Optional Paper 1)

Course Name: *Plant Taxonomy, Resources, Ecology and Biostatistics*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	Introduction to Plant Taxonomy (Concepts, Aims & Principles): Concept of Taxa; Ancient and Modern systems of classifications; A general account on Botanical Nomenclature, Herbaria and Botanical Gardens.	7	1	10	8
Unit-2	Unique characters and economically important taxa of the following families:	7	1	10	8

	Brassicaceae, Malvaceae, Tiliaceae, Rutaceae, Fabaceae, Cucurbitaceae, Lamiaceae, Apocynaceae, Poaceae and Orchidaceae				
Unit-3	Origin, morphology, botany, cultivation and uses of (i) Food & beverage (ii) fiber & oil (iii) medicinal, aromatic and spice plants with their traditional knowledge; NTFPs and important timber-yielding plants, bamboo and wild fruits of Assam.	6	-	10	6
Unit-4	Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection). Community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Methods of studying plant communities. Ecological succession- types; mechanisms; changes involved in succession; concept of climax. Ecosystem- types; structure; function; energy flow	6	-	10	6
Unit-5	Environmental pollution- sources, types of pollutants. Effects of pesticides on soil components, Global climate change: greenhouse effects, ozone layer depletion, acid rain. Dynamic phytogeography and its basic principles, theories and hypotheses, 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.	8	2	10	10
Unit-6	Biostatistics: Measures of central tendencies; mean, mode, median, standard errors and standard deviations. Concept of normal distribution, Skewness and kurtosis. Null hypothesis, T-test, Chi Square test, F-test; Analysis of variance (ANOVA): Variance and co-variance analyses, Correlation and methods of studying the correlation, Statistical software packages and their importance in data analysis.	6	1	10	7

PRACTICAL [Credit: 01]

4. Morphological studies of locally available angiospermic plants, their taxonomic description with analytical drawing, and identification up to the rank of species. 5. Herbarium specimen preparation of locally available Angiospermic plants (15–20 Nos.). 6. Morphological and anatomical studies on economically important plants/ Part (s) of Tea, Cotton, Jute, Ginger, Indian bay leaf, Neem and Tulsi. 7. Determination of minimum size and number of quadrates necessary to study herbaceous communities 8. Determination of abundance, density, frequency, basal cover of plant communities by quadrat method. 9. Estimation of dissolved oxygen content in eutrophic and oligotrophic water samples.	30	40
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10. Morpho-anatomical adaptive features of hydrophytes and xerophytes.		
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Title of the Course Paper- 4 Plant Physiology and Plant Pathology	
Paper Code	BOT-2-DSE-5044(B) (Optional Paper 2)
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Describe fundamental physiological processes such as water absorption and translocation, mineral nutrition, photosynthetic and respiratory pathways, plant growth regulators, and basic concepts of plant pathology including classification of plant diseases. • Explain physiological mechanisms regulating plant growth, development, flowering, dormancy, stress tolerance and the etiology, symptomatology and disease cycles of major plant pathogens including fungi, bacteria, viruses and nematodes. • Apply physiological techniques to measure water potential, photosynthesis, respiration and enzyme activity, and apply diagnostic methods such as isolation, Koch's postulates, microscopy and molecular tools to identify plant pathogens in laboratory and field conditions. • Analyze plant responses to abiotic and biotic stresses, host-pathogen interactions, defense mechanisms in plants, and disease epidemiology in relation to environmental factors and crop productivity. • Evaluate integrated disease management strategies, physiological manipulation for crop improvement and yield enhancement, and design experimental approaches for disease control, stress management and sustainable agriculture.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME
Subject: Botany
Semester: 2nd
Paper: BOT-2-DSE-5044(B) (Optional Paper 2)
Course Name: *Plant Physiology and Plant Pathology*
Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	Unit contents	LECTURE	TUTORIAL	Marks	TOTAL HOURS
Unit-1	Physiological & Molecular Basis of Plant Health • Water & Mineral Transport: Transpiration pull, stomatal regulation, root pressure, and the uptake of macro/micronutrients. • Photosynthesis & Respiration: Light reactions, the Calvin cycle, respiration (glycolysis, Krebs cycle), and their response to environmental stressors.	7	-	10	7

Unit-2	Molecular Basis of Plant Health • Plant Growth Regulators (PGRs): Auxins, gibberellins, cytokinins, ethylene, and abscisic acid. Their roles in cell elongation, dormancy, and stress tolerance. • Signal Transduction & Defence: Receptors, secondary messengers (e.g., calcium, ROS), and the molecular pathways regulating plant immunity.	7	-	10	7
Unit-3	Pathogen Biology & Etiology • Introduction to Pathogens: Classification and characteristics of plant-pathogenic fungi, bacteria, viruses, and <u>nematodes</u>. • Host-Pathogen Interactions: Mechanisms of pathogenesis, including the role of enzymes, toxins, and effector proteins. • Genetics of Plant Disease: The gene-for-gene hypothesis, vertical and horizontal resistance, and pathogenic variability.	7	-	10	7
Unit-4	Physiological Plant Pathology & Defense Mechanisms • Host Physiological Alterations: How infections disrupt photosynthesis, translocation, and respiration (e.g., wilting, hypertrophy). • Plant Defense Mechanisms: ◦ <i>Pre-existing (Passive):</i> Cuticles, epidermal layers, and inhibitory root exudates. ◦ <i>Induced (Active):</i> Phytoalexins, PR-proteins, hypersensitive response (HR), and systemic acquired resistance (SAR).	7	-	10	7

Unit-5	Epidemiology & Disease Management • Disease Forecasting: Environmental factors (temperature, humidity) influencing disease cycles and pathogen spread. • Integrated Pest & Disease Management (IPM): ◦ <i>Chemical:</i> Systemic and contact fungicides/bactericides. ◦ <i>Biological:</i> Use of <i>Trichoderma</i>, <i>Pseudomonas</i>, and mycoviruses. ◦ <i>Genetic:</i> Breeding and biotechnology for disease-resistant crop varieties	7	1	10	8
Unit-6	Plant Immune System and Advanced Diagnostics & Research PAMP triggered immunity (PTI) ; Effector Triggered Immunity (ETI); Role of Phytohormones (SA, JA, ethylene) in defence, Hypersensitive Response (HR) and systemic Acquired Resistance (SAR) e diagnostics and Research Techniques - Serological Techniques (ELISA, immunoflourscence), Next Generation Sequences (NGS) in pathogen detection. Data analysis and interpretation in Disease Research	8	1	10	9
PRACTICAL [Credit: 01]					

1. Determination of rate of transpiration and determination of Stomatal Index 2. Determination of relative water content (RWC) in diseased plant part like tuber or stem. 3. Determination of rate of photosynthesis in diseased plant and determination of leaf chlorophyll. 4. Study of role of phytohormones in escaping or initiating plant diseases. 5. Study of morphological, anatomical and reproductive features of some fungi growing in Assam. 6. Study of plant pathogenic fungi from diseased specimens (symptoms, causal organisms and their morphological and reproductive characters. 7. Study on symptoms of plant viral diseases. 8. Preparation of disease album of some infected specimens	30	40
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Title of the Course	Paper- 5 Laboratory Techniques-Theory & Practice
Paper Code	BOT-2-FSC-5054

Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	60 (End Semester Theory) + 20 (End Semester Practical) + 20 (Internal) [Sessional Exam+ Home Assignment+ Class Test/ Group discussion/ Seminar presentation + Attendance]
Course Outcomes	By the end of this course/module, students will be able to: • Describe laboratory safety rules, Good Laboratory Practices (GLP), handling and care of laboratory equipment, principles of sterilization, and documentation of experiments as per scientific ethics. • Explain the principles, working mechanisms, and applications of basic instruments like pH meter, centrifuge, colorimeter, spectrophotometer, microscope, autoclave, laminar airflow, and advanced tools like PCR, electrophoresis, and chromatography. • Apply techniques of preparation of solutions (molar, normal, percent), buffers, reagents and culture media, perform accurate weighing, pipetting, titration, microscopic observations, section cutting, staining, and slide preparation. • Analyze experimental data, interpret results of biochemical estimations, spectrophotometric readings, chromatographic separations and microbiological cultures, and troubleshoot common errors in laboratory procedures. • evaluate laboratory protocols for accuracy, safety and reproducibility, design independent experiments using appropriate techniques, and demonstrate competence in maintaining laboratory inventory, waste management and quality control for research and industry.
Contact hours	45 (Theory) + 30 (Practical)

PG PROGRAMME**Subject: Botany****BOT-2-FSC-5054****Laboratory Techniques-Theory & Practice**

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	Microscopy Principles and application of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Transmission and Scanning electron bright and darkfield microscopes, Electron microscopy, Fixation and staining techniques for electron microscope, Micrometry.	8	2	10	7
Unit-2	Laboratory Instruments Autoclaves, Centrifuges, Principles of Centrifugation, Types of Laboratory Centrifuges. Working Principle and Application of Hot Air Oven, Balances, Auto Pipettes, Applications of Microtomes, Laminar Flow Tables, BOD Incubator	7	-	10	7
Unit-3	Microbial Techniques Sterilization methods, Types of Microbial media: Microbial growth media: Minimal Media, Defined media, Complex media, Enriched media, Selective media, and Differential media. Staining techniques for microbes, Isolation of pure cultures of bacteria by streaking method. Enumeration of colony forming units (CFU) count by spread plate method. Culture transfer Techniques: Streaking, Serial dilution and Plating methods.	8	1	10	9
Unit-4	CHROMATOGRAPHY Basic principle and biological applications: Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography, Affinity chromatography.	7	-	10	7
Unit-5	SPECTROPHOTOMETRY Properties of Electromagnetic radiations; Beer Lambert's Law, Extinction Coefficient, Principle and Applications of UV-Visible light Spectroscopy. Atomic absorption and Flame emission spectroscopic techniques. Mass spectrometry: X-ray diffraction; X-ray crystallography; Principle & biological applications of IR & NMR.	8	-	10	8
Unit 6	ELECTROPHORESIS Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE. Immunoelectrophoresis, Isoelectrofocussing, Capillary Electrophoresis, Polymerase Chain Reaction, DNA sequencing.	7	-	10	7

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PRACTICAL [Credit: 01]		
1. Working with instruments- centrifuge, autoclave, laminar air flow, hot air oven, incubator, light microscope, spectrophotometer. 2. To separate protein using PAGE. 3. To separate phytochemicals by TLC. 4. To Estimate Protein Concentration By Lowry's Method. 5. Isolation, identification, and characterization of microbes.	30	40

Source of Study Material

1. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
2. Willard, H.H., Merritt L.L. Dean J.A. and Settle F.A., "Instrumental Methods of Analysis", 7th Ed., Wadsworth Publishing Co., 1986.
3. Campbell, I.D. and Dwek, R. A., "Biological Spectroscopy", Benjamin Cummings Publication Co. Inc., 1984.
4. Glasel, J. and Deutscher, M. B., "Introduction to Biophysical Methods for Protein and Nucleic acid Research", Academic Press, 1995
6. Cappucino, J. and Sherman, N. (2013). Microbiology: A Laboratory Manual. (10th ed.) Pearson Education Limited; ISBN 13: 9780321840226

SYLLABUS FOR THE SECOND YEAR OF MASTERs PROGRAM IN BOTANY
ONE YEAR MASTER PROGRAMME IN BOTANY
UNDER NEP2020

SPECIALIZATION OPTIONAL 1: ANGIOSPERM TAXONOMY			
	Paper 1	BOT-AT-3-DSC-5064 (Level-500)	4
	Paper 2	BOT-AT-3-DSC-5074 (Level-500)	4

III	Paper 3	BOT-AT-3-DSC-5084 (Level-500)	4
	Practical 1	BOT-AT-3 -5094 (Level-500)	4
	Practical 2	BOT-AT-3-DSE-5104A (Level-500)	4

PG PROGRAMME

Subject: Botany

Semester- 3rd

Optional –I:: Angiosperm Taxonomy (Special Paper) Allotment of Marks and Credits

Course Level: 400-499, and subsequent level as per NEP structure

DSC 506 (Theory 1)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45

Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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	8	2	10	10
Unit-2	Phenetic Methods: Taxometric: Principles, OTUs, coding of characters, Measuring Resemblances, Cluster analysis, Application of Taxometric Phylogenetic Methods: Cladistic taxonomy, Character analysis, Cladogram construction and Analysis.	8	1	10	9
Unit-3	Taxonomic Structure: Concept of Taxa; Concept of Species, Genus, Family and Infra specific categories	8	-	10	8
Unit-4	Material basis of Taxonomy: Concept of Character; Character Correlation, Weighing, Variations; Isolation and Speciation.	8	-	10	8
Unit-5	Botanical Nomenclature: History, Principles and Major rules, Typification, Effective and Valid Publication, Authors' citation, Principles of Priority and Limitations, synonym, basionym, nomina conservanda, rejection of names, illegitimate names, nomen nudum, tautonym, later homonym	8	2	10	10

DSC 507(Theory II)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	Sources of Taxonomic Characters: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Serology., major areas.	7	1	10	8
Unit-2	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	9	1	10	10
Unit-3	Taxonomic Literature: Classical and recent literature of World in general and India in particular (World flora, indian flora); Taxonomic journals, Icones, Check list, Illustrations	9	-	10	9
Unit-4	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.	9	1	10	10
Unit-5	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.	8	-	10	8

DSC 508(Theory III)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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 megadiversity country; plant introduction and acclimatization.	8	1	10	9
Unit-2	Flora of North East India: Characteristics of flora of Northeast India; Endemic, Exotics and RET Plants of North East India, their multiplication and conservation.	7	1	10	8
Unit-3	Botanical Survey of India: History, Activities, Publications.	7	-	10	7

Unit-4	Origin and Evolution: Characteristic features of early Angiosperms; Origin of Angiosperms, Primitive and advanced angiosperms; Evolutionary trends in Angiosperms.	8	1	10	9
Unit-5	Phylogeny and Evolution of Angiospermic Taxa: Magnoliales, Ranunculales, Euphorbiales, Scrophulariales, Lamiales, Asterales, Alismatales, Orchidales, Poales, Zingiberales.	10	2	10	12

DSC-509 PRACTICAL-1[Credit: 01]

1. Morphological study on flowers of Primitive and Advance families (atleast two each).	30	40
2. Study on types/phylogeny of stamens, carpel and ovaries in different families.		
3. Study on special types of inflorescence and fruits.		
4. Practices on Nomenclatural problems.		
5. Taxonomic report on Orchid/Bamboo/Spice plant species diversity in a particular area of Assam.		

DSC-510 PRACTICAL-II [Credit: 01]

1. Floristic study of locally available angiospermic species/plants in and around Tezpur, their collections, analytical drawing and description, botanical keys and identification upto the rank of species.	30	40
2. Plotting of various centres of BSI, Botanical gardens and Herbaria in different regions of India.		
3. Collection and Preparation of herbarium specimens of common plants for familiarization of herbarium techniques.		
4. Collection and study on diversity of less known local fruits/vegetables of Assam.		
5. Field study report.		

SPECIALIZATION OPTIONAL 2 : ECOLOGY & WILDLIFE BIOLOGY

	Paper 1	BOT-EW-3-DSC-5064 (Level-500)	4
	Paper 2	BOT-EW-3-DSC-5074 (Level-500)	4
	Paper 3	BOT-EW-3-DSC-5084	4

III	(Level-500)	
Practical 1	BOT-EW-3-DSC-5094 (Level-500)	4
Practical 2	BOT-EW-3-DSC-5104 (Level-500)	4

Optional –II:: Plant Ecology (Special Paper) Allotment of Marks and Credits

DSC 506 (Theory I)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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.	6	1	10	7
Unit-2	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 metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Ecological amplitude of a species and adaptation - ecads, ecotypes, ecospecies.	9	2	10	11
Unit-3	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)	7	-	10	7
Unit-4	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.	8	-	10	8
Unit-5	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, rainfall estimation, pollution studies, soil conservation, watershed 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.	10	2	10	12

DSC 507 (Theory II)**THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45**

Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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.	8	1	10	9
Unit-2	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.	8	-	10	8
Unit-3	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.	7	-	10	7
Unit-4	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	8	1	10	9
Unit-5	Methods for biodiversity monitoring, megadiversity 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.	10	2	10	12

DSC 508 (Theory III)**THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45**

Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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.	8	1	10	9
Unit-2	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.;	8	2	10	10
Unit-3	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.	8	-	10	8
Unit-4	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.	8	1	10	9
Unit-5	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.	8	-	10	8

DSC-509 PRACTICAL-1[Credit: 01]

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, base deficiency by rapid soil test method. 6. Analysis of water quality- DO,COD,BOD, pH, hardness, alkalinity, conductivity, free CO₂, chloride, phosphate. Estimation of litter contribution in different forest stands; estimation of litter decomposition rate by litter bag technique, soil respiration.	30	40
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DSC-510 PRACTICAL-I1[Credit: 01]

1. Determination of IVI; lifeform and biological spectrum; phenology; diversity indices in various plant communities. 2. Determination of gross and net primary productivity of aquatic ecosystem by light and dark method; estimation of phytoplankton biomass in terms of chlorophyll. 3. To study primary productivity for herbaceous community by Harvest method; Leaf Area Index. 4. To find out seed output and reproductive capacity of herbaceous plants. 5. To find out allelopathic effects of weeds on cultivated plants. 6. Morpho-anatomical variation of plant species as affected by environmental changes. 7. Ecological data collection for computer use.	30	40
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SPECIALIZATION OPTIONAL 3 : MYCOLOGY AND PLANT PATHOLOGY

	Paper 1	BOT-MPP-3-DSC-5064 (Level-500)	4
	Paper 2	BOT-MPP -3-DSC-5074 (Level-500)	4
III	Paper 3	BOT-MPP -3-DSC-5084 (Level-500)	4
	Practical 1	BOT-MPP-3-DSC-5094 (Level-500)	4
	Practical 2	BOT-MPP-3-DSE-5104 (Level-500)	4

Optional III:: Mycology and Plant Pathology (Special Paper)

Allotment of Marks and Credits

DSC 506 (Theory I)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45

Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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.	7	1	10	10
Unit-2	Fungal reproduction: different mode of reproduction in fungi, different reproductive structures, parasexuality, degeneration of sex, heterothallism. Spore dispersal mechanism in fungi.	7	1	10	8
Unit-3	Fungal physiology, growth, nutrition, development and metabolism in fungi, nutritional specialization in parasitic fungi.	6	-	10	8
Unit-4	Ecology of fungi, distribution of fungi, role of fungi in biogeochemical cycling, fungi of terrestrial and aquatic environments, fungi of extreme environments.	6	-	10	8
Unit-5	Fungal biotechnology: Genetically modified fungi, fungi as biocontrol agent, Edible and poisonous mushrooms, cultivation of mushrooms, industrially important fungi as a	8	2	10	11

	source of antibiotics, organic acids, enzymes and proteins, IPR.				
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DSC 507 (Theory II)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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.	7	1	10	8
Unit-2	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.	7	1	10	7
Unit-3	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).	6	-	10	10
Unit-4	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,	6	-	10	10

	Enzymes, toxins and growth regulators in plant disease development.				
Unit-5	Symptomatology, disease cycle, control measures and management of some important plant diseases of Assam caused by fungi, bacteria, virus and nematode.	8	2	10	9

DSC 508 Theory III)**THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45**

Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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.	7	1	10	8
Unit-2	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.	8	1	10	9
Unit-3	Aerobiology and Plant diseases: Air microflora, air sampling techniques, factors affecting the distribution of air microflora, air-borne plant diseases, aero-allergens	6	-	10	6
Unit-4	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.	8	2	10	10
Unit-5	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.	10	2	10	12

DSC-509 PRACTICAL-1[Credit: 01]

1. Study of vegetative and reproductive structure of different fungal specimens	30	40
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2. Study of disease symptoms and causal organisms 3. Isolation and identification of pathogen from diseased plant materials 4. In vitro inhibition of plant pathogens by different plant extracts 5. Estimation of spore population and root colonization of mycorrhiza		
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<u>DSC-510 PRACTICAL-1I</u> [Credit: 01]		
1. Extraction of cellulase/pectinase/xylanase from diseased plants 2. Proving of Koch's postulate at least one disease 3. Study of the effect of fungicides and plant extracts on the germination and growth of plant pathogenic fungi 4. Isolation and enumeration of microbes from soil samples 5. Study of effect of physical and chemical factors on the growth of plant pathogens.	30	40

SPECIALIZATION OPTIONAL 4 : PLANT PHYSIOLOGY AND BIOCHEMISTRY			
	Paper 1	BOT-PPB-3-DSC-5064 (Level-500)	4
	Paper 2	BOT-PPB-3-DSC-5074 (Level-500)	4
III	Paper 3	BOT-PPB-3-DSC-5084 (Level-500)	4
	Practical 1	BOT-PPB-3-DSC-5094 (Level-500)	4
	Practical 2	BOT-PPB-3-DSC-5104 (Level-500)	4

Optional –4:: Plant Physiology and Biochemistry (Special Paper) Allotment of Marks and Credits

DSC 506 (Theory I)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	Membrane transport and translocation of water and solutes: Membrane transport of proteins. Root microbe interactions in facilitating nutrient uptake.	6	-	10	6
Unit-2	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.	7	1	10	8
Unit-3	The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development- genetic and molecular analysis, role of vernalization.	6	-	10	6
Unit-4	Post-harvest physiology: Ripening of fruit and its regulation, post-harvest management. Metabolism of leafy vegetables during storage.	6	-	10	6
Unit-5	Stress physiology: Plant responses to water deficit, salinity, metal ion stress, freezing and heat stress, effect of elevated CO ₂ 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.	8	2	10	10
Unit6	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.	9	-	10	9

DSC 507 (Theory II)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45

Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	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.	8	1	10	9
Unit-2	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	7	1	10	8
Unit-3	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.	7	-	10	7
Unit-4	Organic acid metabolism: Metabolism and roles of oxalic acid, ascorbic acid and malic acid.	6	-	10	6
Unit-5	Secondary metabolites: Shikimate Pathway and its role in biosynthesis of Secondary Metabolites. Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.	7	-	10	7
Unit-6	Phosphorus nutrition – Forms of phosphorus in soil. Phosphorus uptake, factors controlling 'P' uptake, 'P' fractions in plants. Role of Pyrophosphate in plant metabolism.	7	1	10	8

DSC 508 (Theory III)

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45

Unit No	Unit contents	Lecture	Tutorial	Marks	Total Hours
Unit-1	Growth and morphogenesis: photomorphogenesis: phytochromes and cryptochromes and their photochemical and biochemical properties; phytochrome biosynthesis, cellular localization, roles, mechanism of action of photomorphogenetic receptors.	7	1	10	8
Unit-2	Plant developments: Biochemical changes during development of seeds; phototropism, geotropism and nastic movements.	6	1	10	7
Unit-3	Senescence and PCD- Biochemical changes during senescence of leaves and petals and regulation of senescence. Programmed Cell Death.	6	-	10	6
Unit-4	Enzyme kinetics: Km value, enzyme inhibition, factors responsible for enzyme interaction, abzyme and ribozyme	8	-	10	8
Unit-5	A brief idea about role of tissue culture, and mutants in physiological studies.	6	-	10	6
Unit-6	Plant Growth Regulators – A brief idea about discovery, role and possible mechanism of action of Triacntanol, Brassins, Salicylic acid, Jasmonates and Polyamines. A brief idea about role of plant growth retardants- CCC, Maleic hydrazide, Trizoles and TIBA.	10	-	10	10

<u>DSC-509 PRACTICAL-1</u> [Credit: 01]		
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 oil seeds.	30	40

<u>DSC-510 PRACTICAL-1I</u> [Credit: 01]		
1 Study of effect of PEG induced water stress on seed germination 2 Measurement of RWC and Osmotic potential 3 Study of protein/ amino acid profile in plants under stress. 4 Study of effect of fungal infection on peroxidase activity. 5 Study of free radicals scavenging enzymes, Catalase and super oxide dismutase. 6 Study of free proline accumulation in plants under stress. 7 Study of seed germination under stress condition.	30	40