Darrang College (Autonomous), Tezpur-784001

Syllabus for Postgraduate (NEP)

Sub: Botany

Approved by:

Board of Studies meeting held on 27-06-2026 &
Academic Council vide Resolution no. DC/AC/3/2026/06 dated 29th June 2026

PG DEPARTMENT OF BOTANY

DARRANG COLLEGE(AUTONOMOUS), TEZPUR

POSTGRADUATE SYLLABUS (NEP-2020)

PG-Sem 1 /FYUGP-Sem 7		CREDI T	PG-Sem 2 /FYUGP-Sem 8		CREDIT
BOT-1-DSC-4014	PLANT BREEDING , GENOMICS & BIOINFORMATICS	4	BOT-2-DSC-5014	MOLECULAR BOCHEMISTRY	4
BOT-1-DSC-4024	CONSERVATION ECOLOGY & BIODIVERSITY	4	BOT-2-DSC-5024	FUNGAL DIVERSITY , GENETICS & APPLICATION	4
BOT-1-DSC-4034	PLANT DISEASES, DIAGNOSTICS & MANAGEMENT	4	BOT-2-DSC-5034	ADVANCE TAXONOMY & MORPHOLOGY	4
BOT-1-DSE-4044(A)	ENVIRONMENTAL MICROBIOLOGY	4	BOT-2-DSE-4044(A)	PLANT TAXONOMY ,RESCOURCES, ECOLOGY & BIOSTATICS	4
BOT-1-DSE-4044(B)	PLANT GROWTH &MORPHOGENESIS	4	BOT-2-DSE-4044(B)	PLANT PHYSIOLOGY & PLANT PATHOLOGY	4
BOT-1-FSC-4054	**RESEARCH METHODOLOGY	4	BOT-2-FSC-4054	LABORATORY TECHNIQUES - THEORY & PRACTICE	4

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

PG PROGRAMME

Subject: Botany

Semester: 1st

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. 5thedition
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.

Masters Attributes

Course Objective:

This course will give an insight on various plant breeding approaches for crop improvement and related IPR related issues. It will provide a basic understanding on various tools available genomics and bioinformatics.

Course outcomes:

On successful completion of the course, students will be able to:

1. 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.
2. Apply novel plant breeding tools such as TALEN's, CRISPR-Cas9, and base editing in practical scenarios to improve crop species.
3. 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.

4. Evaluate the significance of intellectual property rights in plant breeding and assess the use of bioinformatics tools in genomics and functional genomics.
5. 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.

Theory Credit: 03
Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany Gauhati University, Guwahati-14

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, caring 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-	8	2	12	10

	global and regional scnenerio.				
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

Unit 6	**Protected Area Network:** Concept, History, Indian Scenario: Biospheres, National Parks and Wildlife Sanctuaries, need of forest and wetland conservation and managemnet, 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
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

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. PetrosGanatsas (2021). Forest Biodiversity, Conservation and Sustainability. Mdpi AG
12. Singh JS, Singh SP and Gupta SR (2014) Ecology, Environmental Science and Conservation. 4th Edition. S. Chand & Company Pvt. Ltd

Graduate Attributes

Course Objectives: After successful completion of this course, students will be able to:

Understand the principles and objectives of conservation ecology, including conservation ethics, genetic diversity, population dynamics, wildlife habitats, and species conservation strategies. Explain and evaluate various conservation approaches, such as in-situ, ex-situ, and hybrid conservation methods, and assess their applications in biodiversity management. Develop a comprehensive understanding of biodiversity, its levels, significance, ecosystem services, biodiversity hotspots, endemic species, and global conservation priorities. Analyze the major threats to biodiversity and critically examine national and international policies, legal frameworks, and conservation organizations involved in biodiversity protection. Apply biodiversity assessment and monitoring techniques for documenting species diversity, evaluating ecosystem health, and promoting sustainable utilization of biological resources. Understand the concept and significance of Protected Area Networks, including biosphere reserves, national parks, wildlife sanctuaries, forest and wetland conservation, and wildlife management practices, particularly in India and Northeast India. Develop practical skills in ecological and biodiversity data analysis using software tools such as Microsoft Excel and SPSS, including statistical interpretation and biodiversity assessment methodologies. Gain field-based experience in biodiversity assessment and conservation planning through vegetation analysis, field surveys, and visits to protected areas, fostering scientific and conservation-oriented decision-making.

Course Outcomes (COs): After successful completion of this course, students will be able to:

Explain 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.

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.

Graduate Attributes

Course Objective:

This paper will focus on the comprehensive understanding of plant diseases, their diagnosis, and effective management strategies.

Course outcomes:

On completion of the course, students will-

8. 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.
9. 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.
10. 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.
11. 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.
12. 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.

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany Gauhati University, Guwahati-14

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.

Graduate Attributes

Course Objective:

The objective of this course is to provide a comprehensive understanding of environmental microbiology, emphasizing microbial communities in soil, water, and air, and their roles in soil health, water purification, and biogeochemical cycles. Students will learn both culture-dependent and culture-independent techniques for studying microbes, including growth media preparation, CFU counting, and advanced genomic methods. The course covers microbial interactions and their ecological significance, and includes practical skills in microbial enumeration, identification, and biochemical testing. It also highlights the application of microbiology in environmental engineering, preparing students for advanced studies or careers in the field.

Course outcomes:

On completion of the course, students will be able to-

1. List common soil microbes and explain their role in the nitrogen cycle.
2. Understand the concept of symbiosis and provide examples of how this interaction benefits soil health.
3. Perform CFU counting and use meta-genomics data to analyze microbial diversity in a soil sample.
4. Analyze results from the methylene blue reductase test to determine milk quality and identify the presence of specific microbial contaminants.

5. Evaluate different microbial bioremediation strategies for purifying polluted water and recommend the most effective method based on scientific evidence.

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany Gauhati University, Guwahati-14

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 Triacontanol, 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.

Graduate Attributes

Course Objective:

The course objective is to enable students to demonstrate a comprehensive understanding of plant photomorphogenesis, including the photochemical and biochemical properties of phytochromes, cryptochromes, and phototropins, as well as the mechanisms of action and roles of these photomorphogenetic receptors in plant development. Additionally, students will gain insights into biochemical changes during seed development, plant movement mechanisms, and post-harvest physiology with a focus on fruit ripening, preservation techniques, and nutritional changes. Furthermore, the course aims to familiarize students with plant growth regulators such as Triacontanol, Salicylic acid, Polyamines, and growth retardants like CCC, Maleic hydrazide, Trizoles, and TIBA, elucidating their roles and possible mechanisms of action. Finally, students will explore senescence, program med cell death (PCD), and applied plant physiology topics including foliar nutrition, chelators and soil conditioners, phytoremediation mechanisms and applications, as well as the role of tissue culture and mutants in advancing plant physiological studies.

Course outcomes:

On successful completion of the course, students will be able to:

1. Apply knowledge of the mechanism of action of photomorphogenesis receptors in plant responses to light.
2. Apply knowledge of tropic and nastic movements in plants and their adaptive roles.
3. Evaluate the advantages and disadvantages of chemical and non-chemical preservation techniques on nutritional changes in fruits and vegetables.
4. Evaluate the advantages and disadvantages of chemical and non-chemical preservation techniques on nutritional changes in fruits and vegetables.

Theory Credit: 03
Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14

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

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

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.

Graduate Attributes

Course Objective: The course aims to equip students with a comprehensive understanding of research methodology, covering key aspects such as identifying research gaps, formulating hypotheses, and designing reproducible experiments. Students will learn statistical analysis and data representation using software tools like MS Office, SPSS, and SigmaPlot. Additionally, they will receive training in scientific writing and ethical considerations, as well as field techniques including specimen collection and safety protocols. Basic knowledge of analytical techniques such as spectroscopy and microscopy will also be provided to support research endeavors.

Course outcomes:

On successful completion of the course, students will be able to:

1. 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.
2. Apply experimental design principles to formulate research problems, select sampling techniques, design experimental setups, and ensure reproducibility through proper data coding and decoding.
3. Apply statistical methods and use software tools for data analysis and presentation, understanding the impact of sample size on data validity.
4. Create diverse forms of scientific writing, understand research article components, develop writing strategies, and evaluate ethical considerations and plagiarism.
5. 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.

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

OR

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

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 primery structure, end group analysis, sequencing, Solid phase synthesis b) Secondary: alpha-helix bets- structure, β-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]			
. Estimation of protein by UV Spectrophotometer by E280/E260 method 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.		30	40

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.

Graduate Attributes

Course Objective:

This paper will explain the detailed account on the diversity, genetics, and applications of Fungi.

Course outcomes:

On completion of the course, students will-

5.Demonstrate an understanding of the diversity of fungi, their global distribution, and the methods used for estimating and conserving fungal diversity.
6.Analyze the roles of different types of fungi in various ecosystems, including soil, plants, and their applications in agriculture and medicine.
7.Apply molecular genetic techniques to analyze fungal genomes, understand the mechanisms of genetic inheritance, and explore the molecular basis of fungal traits and behaviors.
8.Evaluate the significance of genetic elements, such as mating-type switching and retrotransposons, in fungal evolution and adaptation to different environments.
9.Design and propose biotechnological applications of fungi in food production, industrial processes, medicine, and environmental remediation, considering the principles of mycology and practical feasibility.

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany Gauhati University, Guwahati-14

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, Rananculales, 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		30		40	

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.		

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.

Graduate Attributes

Course Objective:

This course will provide an understanding of Advanced and Primitive Taxa; Classificatory Systems. Understand the taxonomy in relation to other branches of botany, nomenclature, identification and herbarium techniques.

Course outcomes:

1. Apply classificatory systems to classify Angiosperms, integrating morphological, anatomical, and molecular data.
2. Implement rules of botanical nomenclature to accurately name and describe plant taxa, ensuring compliance with priority and legitimacy guidelines.
3. Expertise in plant collection, herbarium preparation, taxa description, constructing botanical keys and knowledge on taxonomic literatures.
4. Analyze the correlation between plant taxonomy and disciplines such as morphology, anatomy, palynology, cytology, and phytochemistry, using phenetic and cladistic approaches.
5. Evaluate the contributions of herbaria, botanical gardens, museums, and organizations like the Botanical Survey of India in cataloging plant diversity and conservation.
6. Analyze theories of Angiosperm origin, classify primitive and advanced Angiosperms, and interpret evolutionary trends within specific Angiosperm orders.

Theory Credit: 03

Practical Credit: 01
No. of Required Classes: 75 (Theory: 45; Practical: 30)
No. of Contact Classes: 75 (Theory: 45; Practical: 30)
No. of Non-Contact Classes: Nil
Particulars of Course Designer (Name of Institution): P. G. Department of Botany,
Darrang College (Autonomous), Tezpur.

PG Programme
Subject: Botany
Semester: 2nd
Paper: BOT-2-DSE-5044(A) (Optional Paper 1)
Course Name: *Plant Taxonomy, Resources, Ecology and Biostatics*
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 clasifications; 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: Brassicaceae, Malvaceae, Tiliaceae, Rutaceae, Fabaceae, Cucurbitaceae, Lamiaceae, Apocynaceae, Poaceae and Orchidaceae	7	1	10	8
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). Ccommunity 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.	8	2	10	10

	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.				
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 quadrate method. 9. Estimation of dissolved oxygen content in eutrophic and oligotrophic water samples. 10. Morpho-anatomical adaptive features of hydrophytes and xerophytes.		30		40

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 nematodes. • **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:** ◦ *Pre-existing (Passive):* Cuticles, epidermal layers, and inhibitory root exudates. ◦ *Induced (Active):* 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):** ◦ *Chemical:* Systemic and contact fungicides/bactericides. ◦ *Biological:* Use of *Trichoderma*, *Pseudomonas*, and mycoviruses. ◦ *Genetic:* 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

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,	7	-	10	7

	Isoelectrofocussing, Capillary Electrophoresis, Polymerase Chain Reaction, DNA sequencing.				

PRACTICAL [Credit: 01]		
	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 Curmmings Publication Co. Inc., 1984.

4. Glasel, J. and Deutscher, M. B., "Introduction to Biophysical Methods for Protein and Nucleic acid Research", Academic Press, 1995

5. Cappucino, J. and Sherman, N. (2013). Microbiology: A Laboratory Manual. (10^{th} ed.) Pearson Education Limited; ISBN 13: 9780321840226