SYLLABUS FOR 1 YEAR P.G

IN

BOTANY

DEPARTMENT OF BOTANY

MADHABDEV UNIVERSITY, NARAYANPUR

ASSAM

(Approved in the BoS Botany, Held in 13.07.2026)

ONE YEAR POST GRADUATE PROGRAMME IN BOTANY

MADHABDEV UNIVERSITY

1. Programme Learning Outcome

P.O. 1: Knowledge on interdisciplinary concepts across various divisions of Life Sciences

P.O. 2: Scientific approach to address problems in plant science and use of plant based products for human welfare.

P.O. 3: Application of knowledge and skills in entrepreneurship.

P.O. 4: Develop new techniques/methods for solving complex biological problems

2. Teaching Learning Process

The programme allow to use varied pedagogical methods and techniques both within classroom and beyond.

(i) Lecture

(ii) Practical

(iii) Tutorial

(iv) Documentary on related topic

(v) Project Work/Dissertation

(vi) Group Discussion

(vii) Seminars/workshops/conferences

(viii) Field visits and Report/Excursions

(ix) Mentor/Mentee

3. Assessment

(i) Home assignment

(ii) Project Report

(iii) Seminars

(iv) Group Discussions

(v) In semester examinations

(vi) End Semester examinations

(vii) Dissertation

One Year PG Structure as per UGC Credit Framework

YEAR	SEMESTER	CORE / DSE	COURSE/ PAPER	CREDITS	TITLE OF THE COURSE/PAPER	TOTAL CREDITS
Year – 1	I	CORE	PBOC 101	3 + 1	Interactive Plant Physiology	20
		CORE	PBOC 102	3 + 1	Advanced Plant Genetics and Inheritance	
		CORE	PBOC 103	3 + 1	Biodiversity & Evolutionary Biology	
		ELEC / DSE (Any One)	PBOD 101	3 + 1	Plant Ecology – I	
			PBOD 102		Angiosperm Taxonomy – I	
			PBOD 103		Microbiology – I	
		Research Project	-	4	×	
	II	CORE	PBOC 201	3 + 1	Bioinformatics & Computational Biology	20
		CORE	PBOC 202	3 + 1	Advanced Biotechnology & Industrial Microbiology	
		CORE	PBOC 203	3 + 1	Bioinstrumentation & Laboratory Techniques	
		ELEC / DSE (Any One)	PBOD 201	3 + 1	Plant Ecology – II	
			PBOD 202		Angiosperm Taxonomy – II	
			PBOD 203		Microbiology – II	
		Research Project	-	4	×	

ESTD. 19XX

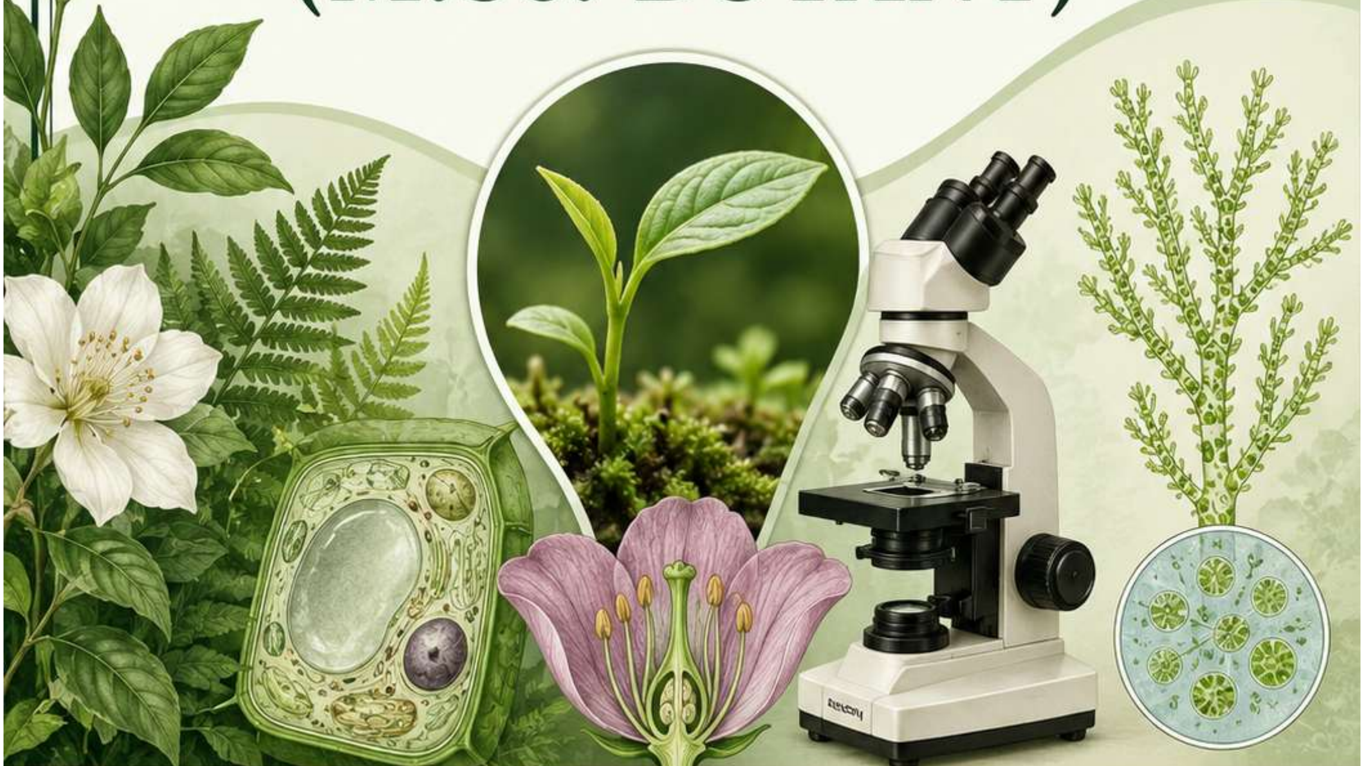
SYLLABUS

FOR

1ST SEMESTER

1 YEAR PG PROGRAMME

(M.Sc. BOTANY)



EXPLORE | LEARN | DISCOVER

SEMESTER: 1 YEAR PG 1st SEMESTER				
Course Code	PBOC 101			
Course Title	Interactive Plant Physiology			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	The course aims to provide a comprehensive understanding of the physiological and biochemical processes governing plant growth and development. The course also develops practical skills in experimental plant physiology under different environmental conditions.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Plant Metabolism**: Photosynthesis- Light harvesting complexes, mechanisms of electron transport, photoprotective mechanisms, CO_2 fixation – C_3, C_4 and CAM pathways; Respiration- Citric acid cycle, plant mitochondrial electron transport and ATP synthesis, alternate oxidase, photorespiratory pathway.	**6 H** **10 M**
II	**Solute transport and photoassimilate translocation**: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem, transpiration, mechanisms of loading and unloading of photoassimilates	**8 H** **8 M**
III	**Nitrogen metabolism and Secondary metabolites:** Nitrate and ammonium assimilation; amino acid biosynthesis, biological nitrogen fixation; Biosynthesis of terpenes, phenolics, alkaloids, phenylpropanoids, nitrogenous compounds and their roles, metabolic engineering in plants.	**7 H** **10 M**
IV	**Plant Hormones:** Biosynthesis, storage, breakdown and transport, physiological effects and mechanisms of action.	**8 H** **8 M**
V	**Sensory Photobiology:** Light perception, structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins, stomatal movement, photoperiodism and biological clock.	**8 H** **9 M**
VI	**Stress physiology:** Physiological and molecular responses of plants to biotic and abiotic stresses, innate immunity.	**8 H** **5 M**
	TOTAL	**45 H** **50 M**

<table>
<tr><th colspan="3">PRACTICAL</th></tr>
<tr><th>Exp. No.</th><th>Name of the experiment</th><th>Teaching hours & Allotted Marks</th></tr>
<tr><td></td><td>1. Separation of photosynthetic pigments by paper chromatography.
2. Measurement of transpiration rate using Ganong’s potometer.
3. Determination of stomatal frequency and stomatal index.
4. Effect of plant growth regulators on seed germination and seedling growth.
5. Determination of Relative Water Content (RWC) of Leaves.
6. Demonstration of xylem conduction using dye uptake method.
7. Demonstration of phototropic response under unilateral light</td><td>30 H
20 M</td></tr>
<tr><td>Course / Learning outcomes</td><td colspan="2">Upon successful completion of the course, the student should be able to:

1. Understand the major physiological and biochemical processes involved in plant growth and development.
2. Explain the mechanisms of water and nutrient transport, metabolism and describe the functions of plant hormones, photoreceptors, and stress response mechanisms in plants.
3. Perform basic plant physiology experiments and interpret the results using scientific methods.</td></tr>
<tr><td>Texts / References</td><td colspan="2">1. Taiz, L., & Zeiger, E. Plant Physiology. Sinauer Associates, Inc., Publishers.
2. Salisbury, F. B., & Ross, C. W. Plant Physiology. CBS Publishers and Distributors.
3. Jain, V. K. Fundamentals of Plant Physiology. Amit Pal Jain Agency, New Delhi.
4. Hopkins, W. G., & Hüner, N. P. A. Introduction to Plant Physiology. Wiley.
5. Pandey, S. N., & Sinha, B. K. Plant Physiology and Biochemistry. S. Chand Publishing.
6. Devlin, R. M., & Witham, F. H. Plant Physiology. CBS Publishers and Distributors.
7. Srivastava, G. C., & Prasad, N. K. (2010). Modern Methods in Plant Physiology. Amit Pal Jain Agency, New Delhi.
8. Ördög, V., & Stirk, W. A. Plant Physiology. Springer.</td></tr>
<tr><td colspan="3">MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations 20 Marks
Attendance 5 Marks
Assignment/Seminar/Activity 5 Marks</td></tr>
</table>

SEMESTER: 1 YEAR PG 1st SEMESTER

Course Code	PBOC 102			
Course Title	Advanced Plant Genetics and Inheritance			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	To develop comprehensive understanding and analytical skills in classical and molecular genetics, including inheritance patterns, gene mutations, genetic mapping, population genetics, chromosomal alterations, pedigree analysis, and their applications in plant, animal, microbial, and human genetics.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	Chromosomal and extrachromosomal inheritance: Principles of Mendelian inheritance, codominance, incomplete dominance, penetrance and expressivity, gene interactions, pleiotropy, genomic imprinting, linkage and cross-over, sex linked inheritance, inheritance of mitochondrial and chloroplast genes, maternal inheritance.	**10 H** **12 M**
II	Genes and mutations: Allele, multiple alleles, pseudoallele, complementation tests; Mutation types, causes and detection; mutant types – lethal, conditional, biochemical, loss of function, gain of function, dominant-negative; germinal verses somatic mutations.	**8 H** **10 M**
III	Genetic analysis: Linkage maps, mapping with molecular markers in plants, animals and bacteria, tetrad analysis, gene transfer in bacteria: transformation, conjugation, transduction, sex-duction, fine structure analysis of gene, development of mapping population in plants.	**10 H** **12 M**
IV	Quantitative genetics: Population genetics and Hardy-Weinberg equilibrium, polygenic inheritance, heritability and its measurements, molecular mapping.	**8 H** **6 M**
V	Structural and numerical alterations of chromosomes: Recombination, deletion, duplication, inversion, translocation, ploidy and their genetic implications. Pedigree analysis, LOD score for linkage testing, karyotypes, genetic disorders.	**9 H** **10 M**
TOTAL		**45 H** **50 M**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Study of Mendelian Inheritance Using different traits 2. Preparation and Observation of Human Karyotype 3. Pedigree Analysis of Genetic Traits 4. Demonstration of Crossing Over Using Beads or Paper Models 5. Estimation of Allele Frequency and Hardy–Weinberg Equilibrium 6. Observation of Polyploidy in Onion Root Tip Cells (any others cells)	**30 H** **20 M**
Course / Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the principles of chromosomal and extrachromosomal inheritance, including Mendelian and non-Mendelian patterns of genetic transmission. 2. Analyze gene interactions, mutations, linkage, crossing over and chromosomal abnormalities and interpret their roles in heredity and evolution. 3. Apply genetic analysis techniques such as linkage mapping, molecular markers, tetrad analysis, pedigree analysis and karyotyping in genetic studies. 4. Evaluate concepts of population and quantitative genetics, including Hardy–Weinberg equilibrium, polygenic inheritance and heritability estimation. 5. Develop practical, analytical and research-oriented skills by integrating classical and molecular genetics for applications in plant, animal, microbial and human genetics.	
Texts / References	1. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B. and Doebley, J. (2020). Introduction to Genetic Analysis. W. H. Freeman and Company, USA. 2. Pierce, B. A. (2021). Genetics: A Conceptual Approach. Macmillan Learning, USA. 3. Hartl, D. L. and Ruvolo, M. (2018). Genetics: Analysis of Genes and Genomes. Jones & Bartlett Learning, USA. 4. Gardner, E. J., Simmons, M. J. and Snustad, D. P. (2016). Principles of Genetics. John Wiley & Sons, USA. 5. Brown, T. A. (2017). Genomes. Garland Science, UK. 6. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M. and Losick, R. (2018). Molecular Biology of the Gene. Pearson Education, USA.	

MODES OF IN-SEMESTER ASSESSMENT: **(30 Marks)**

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

<table>
<tr><td colspan="5">SEMESTER: 1 YEAR PG 1st SEMESTER</td></tr>
<tr><td>Course Code</td><td colspan="4">PBOC 103</td></tr>
<tr><td>Course Title</td><td colspan="4">Biodiversity & Evolutionary Biology</td></tr>
<tr><td>Category of Course</td><td colspan="4">CORE</td></tr>
<tr><td rowspan="3">Credits & Hours of Teaching</td><td></td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>Credits</td><td>3</td><td>1</td><td>3</td></tr>
<tr><td>Hours of Teaching</td><td>45</td><td>30</td><td>75</td></tr>
<tr><td>Total Marks</td><td colspan="4">50 (ES) + 20 (PR) + 30 (IA) = 100</td></tr>
<tr><td>Course Objectives</td><td colspan="4">The objective of this course is to provide a comprehensive understanding of biodiversity, including its patterns, measurement, and global distribution. It aims to explain evolutionary processes, population biology, and animal behaviour that shape life forms on Earth. The course also focuses on conservation biology, including threats to biodiversity and strategies for in-situ and ex-situ conservation. Additionally, it introduces important environmental acts, policies, and sustainable management of biological resources.</td></tr>
<tr><td colspan="5">Course Content</td></tr>
<tr><td colspan="5">THEORY</td></tr>
</table>

Units	Course Content	Teaching hours & Allotted Marks
I	**Introduction to biodiversity**: germplasm, gene pool, and population biology, Centres of origin and biodiversity hotpots, Patterns of species distribution: biomes, gradients, island biogeography and species-area relationship, measuring biodiversity	**6 H** **8 M**
II	**Biodiversity and Conservation**: Biodiversity and its importance; Threats to biodiversity; IUCN categories of threat; Conservation genetics; Population viability analysis (PVA); Ex-situ and in-situ conservation strategies; Community-based conservation and the role of indigenous knowledge; International and national conservation policies and legislation.	**10 H** **8 M**
III	**Act and Policies:** Biodiversity Act 2002; Agricultural biodiversity; International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA); Conservation strategies for seed gene bank; Climate change and conservation of plant genetic resources; Strategies on PPVFR and Biodiversity Acts.	**9 H** **12 M**
IV	**Biodiversity and Animal Behaviour**: Introduction to animal behaviour- Proximate and ultimate causes of behaviour; Foraging behaviour; Communication; Conflict and aggression; Migration, dispersal, and navigation; Social behaviour; Sexual selection and mating systems; Parental care.	**8 H** **10 M**
V	**Evolution of Life and Life Forms**: Origin of life and early evolution; Evolution of cellular structures, functions and multicellularity; Mechanisms of evolution - Natural selection, genetic drift, gene flow, and mutation; Mechanisms of speciation; Extinction events and their role in shaping biodiversity; Adaptive radiation and convergent evolution; Coevolution and evolutionary arms races; Human evolution. Geological time scale	**7 H** **7 M**

<table>
<tr><td>VI</td><td>Microevolution and macroevolution: mechanisms and forces; monophyly and polyphyly; anagenesis, cladogenesis, and stasigenesis; phyletic gradualism and punctuated equilibrium. Evolution at genes, proteins, and genome level, Polyploidization, subfunctionalization and neofunctionalization, molecular clock</td><td>5 H
5 M</td></tr>
<tr><td colspan="2">TOTAL</td><td>45 H
50 M</td></tr>
<tr><td colspan="3">PRACTICAL</td></tr>
<tr><td>Exp. No.</td><td>Name of the experiment</td><td>Teaching hours & Allotted Marks</td></tr>
<tr><td></td><td>1. Identification of local flora and fauna, field sampling using quadrat/transect methods, and calculation of basic diversity indices.
2. Study of endemic species, conservation strategies, and visits/reports on protected/regional areas or zoo.
3. Hardy–Weinberg problems, population growth curves, and basic models of natural selection and phylogeny.
4. Observation of foraging, communication, mating, and social behaviour in selected organisms.
5. Chromosomal studies from permanent slides/ supplied micrographs
6. Demonstration on altruism</td><td>30 H
20 M</td></tr>
<tr><td>Course / Learning outcomes</td><td colspan="2">Upon successful completion of the course, the student should be able to:
1. Understand the concepts of biodiversity, its patterns, measurement, and global distribution including biodiversity hotspots and biomes.
2. Explain evolutionary mechanisms, population dynamics, animal behaviour, and processes that drive species adaptation and diversity.
3. Gather knowledge on conservation biology, including threats to biodiversity, IUCN categories, and in-situ and ex-situ conservation strategies.
4. Develop an understanding of national and international biodiversity laws, policies, and sustainable management of biological resources.</td></tr>
<tr><td>Texts / References</td><td colspan="2">1. Text Book of Biodiversity by K. Krishnamurthy, Publisher: Science Publishers, Inc Post office Box 669, Enfield, New Hampshire, 03784, USA
2. Biodiversity: An Introduction (Second Edition) by Kevin J. Gatson and John I Spicer, Publisher: Blackwell Science Ltd, Blackwell publishing Company
3. Principals of Population Genetics (Fourth edition) by Daniel L. Hartl and Andrew G. Clark, Publisher: Sinauer Associates, Inc.; 4th edition (December 31, 2006)
4. An Introduction to Evolutionary Ecology by Andrew Cockburn, Publisher: Wiley-Blackwell Publisher</td></tr>
<tr><td colspan="3">MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations 20 Marks
Attendance 5 Marks
Assignment/Seminar/Activity 5 Marks</td></tr>
</table>

SEMESTER: 1 YEAR PG 1st SEMESTER				
Course Code	PBOD 101			
Course Title	Plant Ecology – I (Principles and Concepts of Plant Ecology)			
Category of Course	DSE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	The course aims to provide students with a comprehensive understanding of the fundamental principles and advanced concepts of plant ecology, emphasizing the interactions between plants and their environment across different levels of biological organization. It introduces ecological tools and approaches used in studying ecosystem diversity, complexity, and environmental monitoring.			

Course Content

THEORY

Units	**Course Content**	**Teaching hours & Allotted Marks**
I	Definition, division of plant ecology, tools used in studying ecosystem diversity and complexity, environmental monitoring; development of plant ecology at national and international level.	**6 H** **8 M**
II	Population characteristics and dynamics, species interaction and competition, ecads, ecophenes and ecotypes, Population Growth Model: Logistic and Exponential growth Equations, Carrying Capacity	**8 H** **10 M**
III	Life Tables, Survivorship Curve, r & k selection, population regulation, gene ecology, Concept of ecospecies and coenospecies.	**10 H** **7 M**
IV	Lotka Volterra equaltions and related scenarios, Predator pray dynamics, Competitions and outcome of competitions, Resource partitioning, Gauss's law, Bergmann's rule, Allen's rule, Gloger's rule, Foster's rule, Rensch's rule, Hesse's rule	**6 H** **10 M**
V	Niche Concept, concept of ecotone, flagship, umbrella, and keystone species; Concept, mechanism (Facilitation, Inhibition, Tolerance) and theories of succession; Speciation- Allopatric, Peripatric, Parapetric, Sympatric	**9 H** **9 M**
VI	Ecosystem Ecology: Trophic Levels and Enegy Flow Models, Ecological pyramids, Biogeochemical cycles (Carbon, Nitrogen, Phosphorus, Sulphur); Nitrogrn fixation, nitrification, and denitrification pathways	**6 H** **6 M**
TOTAL		**45 H** **50 M**

<table>
<tr><th colspan="3">PRACTICAL</th></tr>
<tr><th>Exp. No.</th><th>Name of the experiment</th><th>Teaching hours & Allotted Marks</th></tr>
<tr><td></td><td>1. To determine the minimum size and number of quadrat necessary for sampling herbaceous vegetation.
2. To study the percentage frequency of species in different stands and comparison with Raunkiaer’s Frequency Classes thereof.
3. To study the floristic composition of different stands with respect to biotic disturbances as grazed, protected and extensively disturbed areas.
4. To study the Importance Value Index (IVI) of species in different stands.
5. To study the Leaf Area Index (LAI) of different species in a community.
6. To study the impact of pollution on plant growth
7. To study the primary productivity of a fresh water ecosystem by light and dark bottle method.
8. Field Study Report
9. Weed Album submission</td><td>30 H
20 M</td></tr>
<tr><td>Course / Learning outcomes</td><td colspan="2">Upon successful completion of the course, the student should be able to:
1. Explain the fundamental concepts, principles, and scope of plant ecology, including ecosystem diversity, environmental monitoring, and ecological adaptations.
2. Analyze population dynamics, species interactions, ecological niches, succession processes, and evolutionary mechanisms influencing plant communities.
3. Evaluate ecosystem structure and functioning through trophic relationships, energy flow pathways, ecological pyramids, and biogeochemical cycles.</td></tr>
<tr><td>Texts / References</td><td colspan="2">1. Odum, E. P., & Barrett, G. W. (2005). Fundamentals of ecology (5th ed.). Thomson Brooks/Cole.
2. Kormondy, E. J., & Brown, D. E. (1998). Fundamentals of human ecology. Prentice Hall.
3. Smith, T. M., & Smith, R. L. (2015). Elements of ecology (9th ed.). Pearson Education.
4. Begon, M., Townsend, C. R., & Harper, J. L. (2006). Ecology: From individuals to ecosystems (4th ed.). Blackwell Publishing.
5. Chapman, J. L., & Reiss, M. J. (1999). Ecology: Principles and applications (2nd ed.). Cambridge University Press.</td></tr>
<tr><td colspan="3">MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations 20 Marks
Attendance 5 Marks
Assignment/Seminar/Activity 5 Marks</td></tr>
</table>

SEMESTER: 1 YEAR PG 1st SEMESTER				
Course Code	PBOD 102			
Course Title	Plant Taxonomy - I			
Category of Course	DSE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	This course aims to provide students with a comprehensive understanding of the principles, methodologies, and applications of modern plant taxonomy and Systematics. It introduces the conceptual foundations of biological classification, species concepts, and taxonomic hierarchy, while exploring the historical development and contemporary approaches to plant classification, including the APG system			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Basics of Taxonomy**: Concept, Aims and Principles, Alpha and Omega taxonomy; Concept of Phenetic, Phyletic, and Phylogenetic classification; Classificatory Systems: Pre- and Post Darwinian Classifications, Recent development of classificatory system in Angiosperms- APG System	**5 H** **8 M**
II	**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.	**9 H** **10 M**
III	**Taxonomic Structure**: Concept of Taxa; Concept of Species, Genus, Family and Infra specific categories.	**7 H** **7 M**
IV	**Material basis of Taxonomy:** Concept of Character; Character Correlation, Weighing, Variations; Isolation and Speciation.	**6 H** **7 M**
V	**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	**12 H** **11 M**
VI	**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	**6 H** **7 M**
	TOTAL	**45 H** **50 M**

<table>
<tr><th colspan="3">PRACTICAL</th></tr>
<tr><th>Exp. No.</th><th>Name of the experiment</th><th>Teaching hours & Allotted Marks</th></tr>
<tr><td></td><td>1. Taxonomic studies of locally available species.
2. Field visit (local).
3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).
4. Submission of herbarium (single specimen locally available)</td><td>30 H
20 M</td></tr>
<tr><td>Course / Learning outcomes</td><td colspan="2">Upon successful completion of the course, the student should be able to:
1. Explain the principles, objectives, and historical development of plant taxonomy and evaluate different systems of classification, including contemporary APG classifications.
2. Apply phenetic and phylogenetic methodologies, including taxometric and cladistic approaches, for the analysis and interpretation of taxonomic relationships among plants.
3. Analyze taxonomic characters, species concepts, taxonomic hierarchy, and mechanisms of speciation in the context of plant diversity and evolution.</td></tr>
<tr><td>Texts / References</td><td colspan="2">1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics.
4. Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
5. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
6. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York</td></tr>
<tr><td colspan="3">MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations 20 Marks
Attendance 5 Marks
Assignment/Seminar/Activity 5 Marks</td></tr>
</table>

SEMESTER: 1 YEAR PG 1st SEMESTER				
Course Code	PBOD 103			
Course Title	Microbiology - I			
Category of Course	DSE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	To understand microbial diversity and classification and to study microbial physiology and metabolism. The students can understand microbial genetics and molecular mechanisms. It will also help the students to explore plant-microbe interactions and applied microbiology.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Microbial Diversity and Classification** History and development of microbiology; Classification of micro-organisms (bacteria, archaea, fungi, viruses, protozoa, algae); Bacterial cell structure and ultrastructure - Cell wall types, capsule, flagella and pili; Growth and nutrition of micro-organisms; Culture media and culture techniques.	**9 H 10 M**
II	**Microbial Physiology and Metabolism** Microbial metabolism overview; Carbohydrate metabolism - Glycolysis, TCA cycle, pentose phosphate pathway; Energy generation - Respiration, fermentation, chemo-lithotrophy, nitrogen metabolism, secondary metabolites.	**9 H 10 M**
III	**Microbial Genetics and Molecular Biology** Structure and organization of microbial genomes; DNA replication in bacteria; Transcription and translation in prokaryotes; Gene regulation - Lac operon, trp operon; Mutations and DNA repair mechanisms; Horizontal gene transfer, transformation, transduction, conjugation; Plasmids and transposons.	**9 H 10 M**
IV	**Virology and Immunology** Structure and classification of viruses; Bacteriophages; Viral replication cycles - Lytic cycle, lysogenic cycle; plant viruses and transmission; Basics of immunology, innate immunity, antigen-antibody interactions; Vaccines and immune responses	**9 H 10 M**
V	**Microbial Ecology and Plant–microbe Interactions** Microbial ecology and environmental microbiology; Soil microbiology; Plant-microbe interactions; Rhizosphere micro-organisms, nitrogen fixation, mycorrhiza; Plant growth promoting rhizobacteria (PGPR); Biogeochemical cycles - nitrogen cycle, carbon cycle, biocontrol agents and biofertilizers.	**9 H 10 M**
TOTAL		**45 H 50 M**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Microscopy and staining techniques involving various microflora. 2. Media preparation, isolation and pure culture of bacteria or fungi from soil. 3. Observation of various fungal cultures. 4. Gram Staining involving gram-positive and gram-negative bacteria. 5. Study of microbial growth curve using appropriate micro-organism. 6. Effect of temperature, pH and carbon source on microbial growth. 7. Antibiotic Sensitivity Test using paper disk method. 8. Demonstration of bacterial transformation using Plasmid DNA. 9. Demonstration of ELISA to detect antigen–antibody interaction for microbial diagnosis.	**30 H** **20 M**
Course / Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Isolate, culture, identify, and characterize diverse microorganisms from environmental and biological samples. 2. Perform microbial growth, physiological, and metabolic studies using standard microbiological techniques. 3. Demonstrate immunological and virological techniques used in pathogen detection and diagnosis.	
Texts / References	1. Black, J.G. (2019). Microbiology - Principles and Explorations, 10th Edition. John Wiley & Sons. 2. Brock, M.T.M. (2018). Biology of Microorganisms, 15th Edition. Pearson International Press. 3. Collins, C.H. (2019). Collins and Lyne's Microbiological Methods, 9th Edition. Oxford University. 4. Hewlett, M.J., Bloom, D.C. and Camerini, D. (2021). Basic Virology, 4th Edition. Wiley Blackwell. 5. Pollack, R.A., Findlay, L., Mondschein, W. And Modesto, R.R. (2018). Laboratory Exercises In Microbiology, 5th Edition. Wiley 6. Willey, J., Sandman, K. And Wood, D. (2023). Prescott's Microbiology, 12th Edition. Mcgraw Hill.	

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

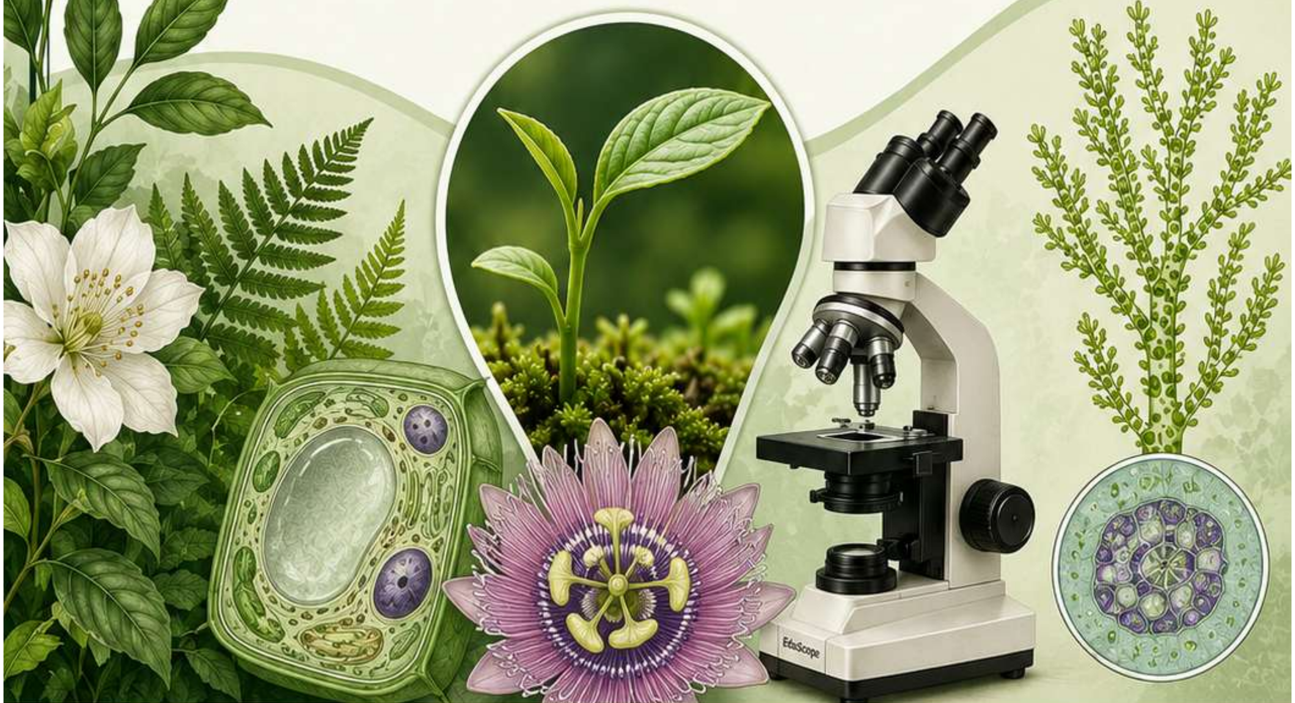
ESTD. 19XX

SYLLABUS

FOR

2ND SEMESTER

1 YEAR PG PROGRAMME
(M.Sc. BOTANY)



EXPLORE | LEARN | DISCOVER

SEMESTER: 1 YEAR PG 2nd SEMESTER				
Course Code	PBOC 201			
Course Title	Bioinformatics & Computational Biology			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	To provide students with fundamental knowledge of bioinformatics resources, sequence analysis, molecular modelling, protein structure prediction, drug design and systems biology, along with their applications in genomics, phylogeny, healthcare and personalized medicine.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	Major Bioinformatics Resources: Sequence databases, gene expression databases, 3D structure database, pattern sequence databases.	**6 H** **7 M**
II	Basic Concepts of Sequence Analysis: Database searches, BLAST and FASTA, sequence identity and similarity, definitions of homologues, orthologues, paralogues, repeat finding, scoring matrix, pairwise sequence alignments, multiple sequence alignments (MSA), application in taxonomy and phylogeny, comparative genomics.	**8 H** **12 M**
III	Gene annotation & Molecular modelling: Prediction of gene function using homology, context, structures, networks; Genetic variation- polymorphism, deleterious mutations; Phylogenetics; 3-D structure visualization and simulation, Basic concepts in molecular modelling.	**10 H** **10 M**
IV	Classification and comparison of protein 3D structures: Anatomy of proteins – Hierarchical organization of protein structure, Secondary and tertiary structure prediction, homology/comparative modelling, fold recognition, threading approaches, and ab initio structure prediction methods, AI-based methods of structure prediction (eg. AlphaFold).	**10 H** **9 M**
V	Drug design: Chemical databases like NCI /PUBCHEM, Fundamentals of Receptor-ligand interactions, Structure-based drug design, Ligand based drug design: Structure-Activity Relationship, QSARs and pharmacophores, in silico predictions of drug activity and ADMET.	**6 H** **7 M**
VI	Systems Biology: Data science applications in biology, health and drug discovery, mathematical modelling of metabolic pathways and disease, digital health, personalized medicine.	**5 H** **5 M**
	TOTAL	**45 H** **50 M**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Study of Biological Databases 2. Study gene expression databases. 3. Sequence Similarity Search Using BLAST 4. Multiple Sequence Alignment (MSA) 5. Construction of Simple Phylogenetic Tree 6. Gene Function Prediction Using Homology 7. Visualization of Protein 3D Structure **8.** Retrieval of Chemical Information from PubChem	**30 H** **20 M**
Course / Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Identify and use major bioinformatics databases and online biological resources. 2. Perform sequence alignment and analyse biological sequences using bioinformatics tools such as BLAST and FASTA. 3. Interpret gene functions, genetic variations and phylogenetic relationships using computational methods. 4. Analyse and compare protein 3D structures and apply molecular modelling concepts. 5. Apply systems biology and data science concepts in biological research, health and drug discovery.	
Texts / References	1. Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis (2nd ed.). Cold Spring Harbor Laboratory Press. 2. Lesk, A. M. (2019). Introduction to Bioinformatics (5th ed.). Oxford University Press. 3. Pevsner, J. (2015). Bioinformatics and Functional Genomics (3rd ed.). Wiley-Blackwell. 4. Branden, C., & Tooze, J. (1999). Introduction to Protein Structure (2nd ed.). Garland Publishing. 5. Pandey, G. N. (2010). A Textbook of Bioinformatics. S. Chand Publishing. 6. Merz, K. M., Jr., Ringe, D., & Reynolds, C. H. (2010). Drug Design: Structure- and Ligand-Based Approaches. Cambridge University Press.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: 1 YEAR PG 2nd SEMESTER				
Course Code	PBOC 202			
Course Title	Advanced Biotechnology & Industrial Microbiology			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	The syllabus gives an introduction of the fundamental principles of biotechnology engineering including material and energy balances, transport phenomena, and thermodynamic concepts relevant to biological systems. It will develop understanding of microbial growth kinetics, fermentation technology, industrial bioprocess engineering and familiarize learners with enzyme technology, immobilized biocatalysts, protein engineering, and applications of microbial technology in biotechnology industries.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Biotechnology Principles**: Material and energy balance, Steady state energy and material balance, Properties of substances, Introduction to transport phenomena, momentum transfer, heat and mass transfer, Introduction to mass transfer equipment.	**6 H** **6 M**
II	**Thermodynamics in Biological Systems:** First and second law of thermodynamics, Biological systems as open non-equilibrium systems, Failure of classical thermodynamics in describing biological processes, Concepts of thermodynamics flux and force, Concept of entropy production, Constitutive equations, Thermodynamics of coupled biochemical reactions, Thermodynamic analysis of oxidative phosphorylation, Glycolytic oscillations.	**8 H** **10 M**
III	**Bioprocess Engineering and Technology**: Principles of microbial growth and factors affecting growth, Growth kinetics and substrate utilization in batch, fed-batch and continuous systems, Introduction to bioreactors: batch and fed-batch, plug flow, continuous, enzyme reactors, Sterilization, Mass and energy balance in microbial process-effects of dissolved oxygen, Mass transfer of oxygen, aeration and agitation, fluid rheology, Fermentation technology for antibiotics, organic acids, alcohol, bioplastics, vitamins, enzymes; biotransformation of steroids, Process flow sheet and process economics.	**10 H** **12 M**
IV	**Microbial Technology:** Enzymes in organic solvents and ionic liquids, biocatalysts, enzyme engineering, random and rational approach to protein	**6 H**

	engineering, Biocatalysis, techniques of immobilization of enzymes and whole cells: design, operation and kinetics of immobilized enzyme reactors, diffusional resistance and Thiele modulus.	**8 M**
V	**Downstream processing in Biotechnology**: Biomass removal and disruption, Precipitation by salts, solvents, Membrane based purification, Adsorption and chromatography, Extraction (solvent, aqueous two-phase, super critical), Drying.	**8 H** **8 M**
VI	**Bioprocess designing**: General design information, Process flow sheet, Scale-up and scale-down issues, Scale up of downstream processes. Selection and specifications of bioprocess equipment.	**7 H** **6 M**
	TOTAL	**45 H** **50 M**
	PRACTICAL	
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Chromatographic Separation of Biomolecules. 2. Protein Precipitation by Ammonium Sulfate. 3. Determination of Enthalpy Change in Biochemical Reactions. 4. Estimation of Oxygen Uptake Rate (OUR) and Carbon Dioxide Evolution Rate (CER) 5. Comparative studies of ethanol production using different substrates. 6. Growth Curve Analysis of Microorganisms. 7. Microbial production of citric acid using *Aspergillus niger* 8. Bioprocess Equipment Design Study: fermenters, agitators, spargers, and heat exchangers 9. Demonstration of Batch Fermentation and Microbial Growth Kinetics 10. Demonstration of Enzyme Immobilization and Activity Assay	**30 H** **20 M**
Course / Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the principles of material and energy balance, transport phenomena, and thermodynamics associated with biological systems. 2. Analyse microbial growth kinetics and evaluate the performance of different types of bioreactors and fermentation systems. 3. Apply concepts of enzyme engineering, immobilization techniques, and biocatalysis in industrial biotechnology processes. 4. Demonstrate understanding of downstream processing methods including extraction, chromatography, membrane separation, and drying techniques. 5. Design and interpret process flow sheets and assess scale-up, equipment selection, and operational parameters in bioprocess industries. 6. Evaluate industrial biotechnology processes from technical, economic, and process-efficiency perspectives.	

Texts / References	1. Bioprocess Engineering Principles, 2nd edition By Pauline M Doran, Academic Press, 2012. 2. Biochemical Engineering Fundamentals, 2nd edition by James Bailey and David Ollis, McGraw Hill Education, 2017. 3. Principles of Fermentation Technology, 3rd edition by Peter F Stanbury, Allan Whitaker and Stephen J Hall, Butterworth-Heinemann, 2016. 4. Bioseparations Science and Engineering Hardcover, 2nd edition by Roger G. Harrison, Paul W. Todd, Scott R. Rudge and Demetri P. Petrides, Oxford Univ Pr on Demand, 2015. 5. Crueger's Biotechnology: A Textbook Of Industrial Microbiology, 3rd Edition by Crueger & Aneja, Medtech, 2017. 6. Enzyme Technology by Martin F. Chaplin and Christopher Bucke, Cambridge University Press, 1990. 7. Bioprocess Engineering: Basic Concepts, 2nd edition by Shuler and Kargi, Pearson Education India, 2024. 8. Fundamentals of Biochemical Engineering by Rajiv Dutta, Springer, 2017.

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: 1 YEAR PG 2nd SEMESTER				
Course Code	PBOC 203			
Course Title	Bioinstrumentation & Laboratory Techniques			
Category of Course	Core			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	PG: 50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to provide comprehensive knowledge of bioinstrumentation and modern laboratory techniques used in biological sciences. It is designed to develop an understanding of the principles, operation, calibration, maintenance and applications of analytical and diagnostic instruments commonly employed in research laboratories.			

Course Content

THEORY

Units	**Course Content**	**Teaching hours & Allotted Marks**
I	Microscopic and Electrophysiological techniques: Visualization of cells and subcellular components by light microscopy and advanced microscopic techniques, resolving power of microscopes, microscopy of living cells, scanning and transmission microscopes, sample preparation techniques for microscopy. Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.	**8 H** **10 M**
II	Molecular Biology Techniques: Isolation, separation and analysis of biological macromolecules (DNA, RNA, proteins, carbohydrates and lipids), chromatography, electrophoresis and centrifugation. Spectroscopy (UV/visible, fluorescence, circular dichroism, NMR and ESR), molecular structure determination using X-ray diffraction, cryo-electron microscopy and NMR, Molecular analysis using light scattering, different types of mass spectrometry methods and surface plasma resonance.	**8 H** **10 M**
III	Metabolomics Techniques: Structure and organization of prokaryotic and eukaryotic genomes, Comparative genomics, Global gene expression analysis, Comparative transcriptomics, Differential gene expression; protein interaction analysis and mapping, targeted and untargeted metabolic profiling, DNA finger printing and its applications, DNA bar coding, Single-cell sequencing, single-cell omics.	**8 H** **9 M**
IV	Radiolabeling and Immunotechniques: Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines. Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.	**8 H** **8 M**

V	Field Biology and Bioethics: Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behaviour, habitat characterization: ground and remote sensing methods. Intellectual property rights, types of IP, Patent databases; Biological safety measures, biosafety levels, regulatory guidelines, animal ethics, research ethics, publication ethics.	**7 H** **7 M**
VI	Statistical Methods: Concepts of precision and accuracy in experimental measurements, signal to noise ratio, probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X2 test; basic introduction to multivariate statistics	**6 H** **6 M**
TOTAL		**45 H** **50 M**
PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. To study and gain expertise on differential and cytological staining techniques. 2. To separate proteins on the basis of their size and charge. 3. To separate and identify the amino acids in a mixture by thin layer chromatography. 4. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs. 5. Demonstration of ELISA. 6. To separate proteins using PAGE. 7. To separation DNA (marker) using AGE. 8. Quantification of Vitamin C. 9. Bio-statistical problems.	**30 H** **20 M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Know the principle and application of various instruments used in biological science. 2. Make a strategy on molecular techniques for the improvement in any trait or its well being based on the techniques learned during this course. 3. To know the physico-chemical techniques to separate biomolecules, use UV-Vis or fluorescence spectroscopy to study biomolecular concentration or demonstrate interaction which can also be validated using microscopic techniques. 4. Analyze and interpret biological and statistical data using biostatistical methods.	

Texts / References	1. L. Veerakumari 2011. Bioinstrumentation, 1st edition, MJP publishers. 2. P .Palanivelu 2001. Analytical biochemistry and separation techniques-A laboratory manual, 2nd edition, Tulsi books centre. 3. Freifelder, 1982. Physical biochemistry- application to biochemistry and molecular biology, 2nd edition, W.H.Freeman and company, San Fransisco. 4. Keith Wilson and John Walker 2009. Principles and techniques of biochemistry and molecular biology.7th Edition,Cambridge University Press, Cambridge, UK. 5. R. Katoch 2011. Analytical techniques in biochemistry and molecular biology,Springer, New York. 6. D. L. Spector, R. D. Goldman 2006. Basic methods in microscopy: protocols and concepts from cells: a laboratory manual.Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: 1 YEAR PG 2nd SEMESTER				
Course Code	PBOD 201			
Course Title	Plant Ecology – II (Applied Systems Ecology)			
Category of Course	DSE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	This course aims to provide a comprehensive understanding of soil-plant interactions, phytogeographical patterns, biodiversity conservation, and contemporary ecological challenges. The course introduces students to soil formation, rhizosphere ecology, ecosystem restoration, species distribution, endemism, and island biogeography			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Soil and Plant Relationship**: Soil formation and soil horizons, soil nutrients and plants; rhizosphere population, role of soil microorganisms in functioning and restoration of ecosystem, major soil types of India with special reference to Assam.	**6 H** **8 M**
II	**Phytogeography and Island Biogeography**: Static and dynamic phytogeography, MacArthur and Wilson Theory of Biogeography; Species diversity indices; Endemism: concept, age and area hypothesis, endemic flora of the world with special reference to Assam	**8 H** **10 M**
III	**Conservation Biology:** Biodiversity Hotspots, Threats to Biodiversity (HIPCO), IUCN categories, *In situ* and *Ex situ* Conservation, Threatened species of North East India, National Parks Of India and its associated peculiarities, State tree/flower/animals of India.	**10 H** **7 M**
IV	Ecological significance of plant adaptation, major biomes of the world, Environmental calendar and protocols, Ramsar sites, EIA, Environmental Concerns of North East India, indicator species.	**6 H** **10 M**
V	**Applied Ecology**: Bioremediation of environmental pollution, weeds in natural and agro ecosystems, forest management, NTFPs, sustainable agriculture, agri-silviculture, Secondary metabolites, allelopathy and Kairopathy, biomagnifications and bioaccumulation of hazardous chemicals in food chains, Bioactive compounds of plant origin	**9 H** **9 M**
VI	**Deep Ecology**: definition, deep ecology platform, development, sources of deep ecology, deep ecology movement, misconception in deep ecology, criticism of deep ecology, links with other philosophies.	**6 H** **6 M**

TOTAL		**45 H** **50 M**
PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. To study the Species Diversity Index (SDI) in a grassland community 2. To study the Stomatal Index (SI) of some species growing in various habitats. 3. To determine the Similarity Index (SI) and Dissimilarity Index (DI) of species in different habitats. 4. To study the productivity of plants by leaf – disc –method. 5. To study the effect of sampling size on the vegetation analysis. 6. To study the root shoot ratio of plants growing in different habitats. 7. To study the texture, colour, humus and organic matter content in different soil samples. 8. Conduct a EIA for assessing feasibility of a dam in your nearby river 9. Assessment of NTFPs of your nearby forest 10. Field Study Report	**30 H** **20 M**
Course / Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the relationships between soil properties, microbial communities, and plant growth in natural and managed ecosystems. 2. Analyze patterns of plant distribution, species diversity, endemism, and biogeographical processes at regional and global scales. 3. Evaluate biodiversity threats and apply appropriate in situ and ex situ conservation strategies for sustainable ecosystem management.	
Texts / References	1. The Theory of Island Biogeography. MacArthur, R.H. & Wilson, E.O. The Theory of Island Biogeography. Princeton University Press. 2. Soil Microbiology, Ecology and Biochemistry. Paul, E.R. Soil Microbiology, Ecology and Biochemistry. Academic Press. 3. Forest Ecology and Management. Barnes, B.V., Zak, D.R., Denton, S.R. & Spurr, S.H. Forest Ecology. Wiley. 4. Biodiversity and Conservation. Groom, M.J., Meffe, G.K. & Carroll, C.R. Principles of Conservation Biology. Sinauer Associates.	

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: 1 YEAR PG 2nd SEMESTER				
Course Code	PBOD 202			
Course Title	Angiosperm Taxonomy- II			
Category of Course	DSE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	The course emphasizes biosystematics, molecular taxonomic tools, taxonomic literature, botanical exploration, and computerized data management in taxonomy. It further explores the origin, evolution, and phylogenetic relationships of angiosperms, enabling students to critically evaluate evolutionary trends and classification systems.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Sources of Taxonomic Characters**: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Serology, major areas.	**6 H** **8 M**
II	**Modern Approach to Taxonomy**: Molecular Approach in taxonomy, Diagnostic tools, Polymerase Chain Reaction (PCR) analysis, applications of molecular markers in plant taxonomy. **Biosystematics**: Definition, importance and categories; Role of computers in taxonomic studies, commonly available software.	**8 H** **10 M**
III	**Taxonomic Literature**: Classical and recent literature of World in general and India in particular (World flora, Indian flora); Taxonomic journals, Icones, Check list, Illustrations.	**10 H** **7 M**
IV	**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.	**6 H** **10 M**
V	**Origin and Evolution**: Characteristic features of early Angiosperms; Origin of Angiosperms, Primitive and advanced angiosperms; Evolutionary trends in Angiosperms.	**9 H** **9 M**
VI	**Phylogeny and Evolution of Angiospermic Taxa**: *Magnoliales, Rananculales, Euphorbiales, Scrophulariales, Lamiales, Asterales, Alismatales, Orchidales, Poales, Zingiberales.*	**6 H** **6 M**
TOTAL		**45 H** **50 M**

<table>
<tr><th colspan="3">PRACTICAL</th></tr>
<tr><th>Exp. No.</th><th>Name of the experiment</th><th>Teaching hours & Allotted Marks</th></tr>
<tr><td></td><td>1. Taxonomic studies of locally available species.
2. Field visit (local).
3. Mounting of a properly dried and pressed
4. Specimen of any wild plant with herbarium label (to be submitted in the record book).
5. Submission of herbarium (single specimen locally available)
6.</td><td>30 H
20 M</td></tr>
<tr><td>Course / Learning outcomes</td><td colspan="2">Upon successful completion of the course, the student should be able to:
1. Evaluate the significance of morphological, anatomical, cytological, embryological, phytochemical, and molecular characters in plant taxonomy and classification.
2. Apply modern taxonomic tools, including PCR-based techniques, molecular markers, and computer-assisted analyses, in systematic studies.
3. Utilize taxonomic literature, floras, monographs, revisions, and botanical keys for plant identification and biodiversity documentation.</td></tr>
<tr><td>Texts / References</td><td colspan="2">1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics.
4. Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
5. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
6. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.</td></tr>
<tr><td colspan="3">MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
Two Sessional Examinations 20 Marks
Attendance 5 Marks
Assignment/Seminar/Activity 5 Marks</td></tr>
</table>

SEMESTER: 1 YEAR PG 2nd SEMESTER				
Course Code	PBOD 203			
Course Title	Microbiology- II			
Category of Course	DSE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	3
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA) = 100			
Course Objectives	The course introduces learners to the role of microorganisms in human health, disease, diagnosis and epidemiology. It will develop an understanding of antimicrobial agents, antibiotic mechanisms, resistance development, and pharmaceutical regulations.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Medical Microbiology** Microbial flora of the healthy human host; Host-microbe interaction: the process of infection, natural resistance and nonspecific defence mechanisms; Theoretical aspect of the immune response; Microbial agents of diseases: bacteria, viruses, fungi, protozoa; General principles of diagnostic microbiology; Collection, transport and processing of clinical samples; Epidemiological principles in prevention and control of diseases; Brief overview of gut microbiome; Prebiotic and probiotic.	**9 H** **10 M**
II	**Pharmaceutical Microbiology** Chemotherapeutic agents and chemotherapy; Characteristics of an ideal chemotherapeutic agent; Antibiotics and their mode of action: inhibition of cell-wall synthesis, damage to cytoplasmic membrane, inhibition of nucleic acid and protein synthesis, inhibition of specific enzyme systems; Development of resistance to antibiotics; Government regulatory practices and policies for pharmaceutical industry.	**9 H** **10 M**
III	**Industrial Microbiology** Theory and principles of industrial fermentation; Batch, fed-batch and continuous cultures; Microbial growth and product formation kinetics; Media formulation and sterilization, isolation, preservation and improvement of industrially important micro-organisms; Industrial uses of bacteria, industrial uses of yeasts, industrial uses of molds; Algal biomass cultivation, harvesting and extraction of value-added compounds; Production of lipids and carbohydrate for production of biodiesel and bioethanol from algal biomass.	**10 H** **11 M**

IV	**Microbial Biotechnology** Microorganisms as tools: microbial enzymes, bacterial transformation, cloning and expression; Everyday applications of microbes: food products, therapeutic proteins, antibiotics, vaccines; Fungi in food processing; fungi for biomass pretreatment for ethanol production; Fungi in agriculture application.	**9 H** **10 M**
V	**Agricultural Microbiology** Plant microbiology and plant pathology; Study of microorganisms found in soil; Study the role of microbes in veterinary medicine; Aero-microbiology and epidemiology: the study of airborne microorganisms, incidence, spread, control of disease; AM fungi; Biocontrol agents, bacterial and myco-pesticides.	**8 H** **9 M**
TOTAL		**45 H** **50 M**
PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Collection and microscopic observation of microbial samples from skin, oral cavity, or other non-invasive sites. 2. Testing antiseptics and disinfectants using agar well diffusion methods. 3. Enumeration of microbial contaminants in pharmaceutical sample using Plate-Count Method. 4. Cultivation of microalgae under controlled laboratory conditions and estimation of biomass productivity. 5. Qualitative estimation of cellulase activity of fungi by Congo Red Dye Method 6. Isolation and Characterization of Plant Growth Promoting Rhizobacteria from rhizosphere. 7. Isolation of fungal plant pathogens from the plant infected tissues. 8. Demonstration of the Polymerase Chain Reaction (PCR) to amplify a specific DNA from a microbial sample followed by visualization of the amplified products using Agarose Gel Electrophoresis. 9. Demonstration of Bench-Scale Fermentation and monitoring of microbial growth kinetics. 10. Demonstration of collection, transport, and processing of clinical specimens.	**30 H** **20 M**
Course / Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Apply standard microbiological techniques for isolation, cultivation, and observation of microorganisms.	

	2. Assess antimicrobial activity and microbial quality of pharmaceutical products. 3. Perform basic algal cultivation and enzyme screening assays. 4. Isolate and characterize agriculturally important microorganisms and plant pathogens. 5. Understand molecular, clinical, and industrial microbiological techniques and their applications.
Texts / References	1. Wood, D., Willey, J. and Sandman, K. (2022). Prescott's Microbiology, 12th edition. Mcgrawhill Exclusive. 2. Brooks, G.F., Butel, J., Caroll, K., Morse, S. A. and Mietzner, T.A., (2012). Jawetz, Melnick, & Adelberg's Medical Microbiology, 26th Edition. McGraw-Hill. 3. Hanlon, G. and Hodges, N.A. (2013). Essential Microbiology For Pharmacy And Pharmaceutical Science, 1st edition. Wiley-Blackwell. 4. Crueger, W., Crueger, A. and Aneja, K.R. (2017). Crueger's Biotechnology: A Textbook Of Industrial Microbiology, 3rd Edition. Medtech. 5. Denyer, S.P., Hodges, N., Gorman, S.P. and Gilmore, B.F. (2013). Hugo & Russell's Pharmaceutical Microbiology, 8th edition. Wiley India Pvt Ltd. 6. Waites, M. J., Morgan, N. L., Rockey, J. S. and Higton, G. (2001). Industrial Microbiology: An Introduction, 1st edition. Wiley-Blackwell.

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks