SYLLABUS FOR 2 YEAR P.G

IN

BOTANY

DEPARTMENT OF BOTANY

MADHABDEV UNIVERSITY, NARAYANPUR

ASSAM

(Approved in the BoS Botany, Held in 13.07.2026)

TWO YEAR POST GRADUATE PROGRAMME IN BOTANY

MADHABDEV UNIVERSITY

1. Programme Learning Outcome

The programme outcomes (specific skills, generic skills and attributes) that a post-graduate student of Botany will have at the end of the completion of M.Sc. degree in Botany are as follows:

PLO1. Disciplinary knowledge: Apply knowledge of Botany, Life Sciences, and related subjects to comprehend complex life processes and phenomena.

PLO2. Reflective thinking and problem solving: Identity, review, and analyse complex situations involving living forms (Plants). Design processes/strategies that meet the specified needs while taking into account plant health and safety, as well as cultural, societal, and environmental factors.

PLO3. Investigating complex problems: To provide valid conclusions, apply research based knowledge and research methods such as experiment design, data analysis and interpretation, and information synthesis.

PLO4. Social responsibility: Apply reasoning informed by contextual knowledge to evaluate societal, health, safety, legal, and cultural issues, as well as the responsibilities that come with them, in the context of professional engineering practice.

PLO5. Communication Skills: To have the ability to present and express information, thoughts, experiments and results clearly and concisely for effective communication of any issues related to plants.

PLO6.Understanding the environment: Understanding the impact of natural and anthropogenic activities in societal and environmental contexts, as well as demonstrating knowledge of, and need for sustainable development. Identify and justify the conservation of a variety of plants.

PLO7. Ethics: Apply ethical principles and commit to professional ethics, responsibilities, and work/research practice norms.

2. Programme Specific Outcomes (PSOs)

It is expected that a student after successfully completing four semesters of M.Sc. in Botany programme would be as follows:

PSO1. Students would be sufficiently skilled and empowered to solve the problems in the realms of Botany and its allied areas.

PSO2. They would have plethora of job opportunities in the field of Government Ministries, Departments, and agencies such as the Ministries of Environment & Forest, Climate Change, Agriculture, Science and Technology, Education and the Non-Governmental Organizations (NGOs) and the private sector.

PSO3. The bright and ignited mind may enter into research in the contemporary areas of Botany/Biological Sciences. The broad skills and the deeper knowledge in the field would make them highly successful and excellent researcher in advanced areas of research in the Biological sciences.

3. Teaching Learning Process

The programme allows using 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

Two 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	Research Methodology	22
		CORE	PBOC 102	3+1	Cellular Bioenergetics & Cell Signalling	
		CORE	PBOC 103	3+1	Functional Genomics & Chromosomal Architecture	
		CORE	PBOC 104	3+1	Bioethics, IKS & IPR	
		GENERIC	PBOG 101	3+1	Bioethics, IKS & IPR	
		FIELD REPORT/ EXCURSION		2	-	
	II	CORE	PBOC 201	3+1	Reproductive & Developmental Biology	24
		CORE	PBOC 202	3+1	Organismal Ecology and Environmental Interactions	
		CORE	PBOC 203	3+1	Immunology & Translational Pathobiology	
		CORE	PBOC 204	3+1	Pharmacognosy & Ethnobotany	
		GENERIC	PBOG 201	3+1	Pharmacognosy & Ethnobotany	
		Field Work / Project		4	-	
Year- 2	III	CORE	PBOC 301	3 + 1	Interactive Plant Physiology	20
		CORE	PBOC 302	3 + 1	Advanced Plant Genetics and Inheritance	
		CORE	PBOC 303	3 + 1	Biodiversity & Evolutionary Biology	
		ELEC / DSE	PBOD 301	3 + 1	Plant Ecology – I	

		(Any One)	PBOD 302		Angiosperm Taxonomy – I	
			PBOD 303		Microbiology – I	
		Project / Intern-ship	-	4	×	
Year – 2	IV	CORE	PBOC 401	3 + 1	Bioinformatics & Computational Biology	20
		CORE	PBOC 402	3 + 1	Advanced Biotechnology & Industrial Microbiology	
		CORE	PBOC 403	3 + 1	Bioinstrumentation & Laboratory Techniques	
		ELEC / DSE (Any One)	PBOD 401	3 + 1	Plant Ecology – II	
			PBOD 402		Angiosperm Taxonomy – II	
			PBOD 403		Microbiology – II	
		Research Project	-	4	×	

माधवदेव विश्वविद्यालय ★ MADHABDEV UNIVERSITY

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Estd: 2019

POST GRADUATE PROGRAMME

IN

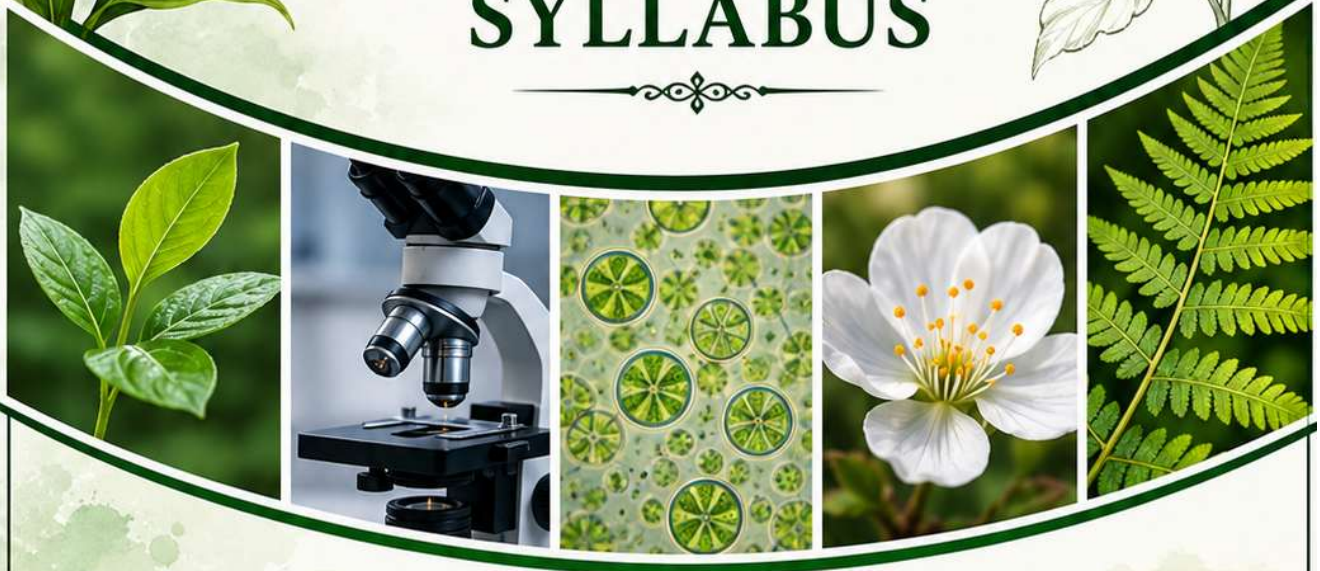
BOTANY

M.Sc. BOTANY

(Two Year Programme)

1st SEMESTER

SYLLABUS



SEMESTER: 2 YEAR PG 1st SEMESTER				
Course Code	PBOC 101			
Course Title	Research Methodology			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to develop an understanding of the basic concepts, principles and significance of research in different disciplines and also to familiarize students with various types, approaches, and methods of research.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Research methodology**: Research concept, types. 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. Experimental designs: Formulation of research problem, sampling technique, methods selection, experimental set up, data generation/acquiring, Coding/decoding and reproducibility of data.	**11 H** **10 M**
II	**Scientific writing**: Different forms of scientific writing – article, notes, reports, review article, monographs. Dissertation/Thesis writing: format, content and chapterization, writing style, drafting titles & sub-titles, captions and legends. Proper description of methodology and research design, compilation and presentation of data with statistical analysis; Writing results, discussion and conclusions. Bibliography and references, referencing style. Appendices, Plagiarism.	**12 H** **15 M**
III	**Computer application**: Basics of MS word; Manuscript editing; Foot note and end note; Reference manager. MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Statistical tools: MS Excel, SPSS, R, Python, STATA. Power Point: preparation of presentations and scientific poster designing. Bioinformatics tools and its applications in biological sciences, Plagiarism detection software. AI in research.	**12 H** **15 M**
IV	**Biostatistics**: Biostatistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.	**10 H** **10 M**
TOTAL		**45 H** **50 M**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Identify a research problem and prepare a short research proposal/synopsis. 2. Data Tabulation and Statistical Analysis Using MS Excel. 3. Poster presentation on defined topics. 4. Prepare a scientific report with proper citation and referencing style. 5. Bio-statistical problems.	**30 H** **20 M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Design and conduct scientific experiments using appropriate sampling techniques, research methods, experimental setups, and data collection procedures. 2. Design and conduct scientific experiments using appropriate sampling techniques. 3. Apply computer applications and statistical tools such as MS Word, MS Excel, SPSS, R, Python, STATA, reference managers, and bioinformatics tools for data analysis, visualization, manuscript preparation, and scientific presentations. 4. Analyze and interpret biological and statistical data using biostatistical methods.	
Texts / References	1. Kothari, C. R. 2004. *Research methodology: Methods and techniques* (2nd ed.). New Age International Publishers. 2. Gurumani, N. 2007. Research methodology for biological sciences. MJP Publishers, Chennai. 3. Katz, MJ. 2009. From research to manuscript: A guide to scientific writing. Springer. 4. DePoy, E, Gitlin, L. 2015. Introduction to Research: Understanding and Applying Multiple Strategies. Elsevier. 5. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi. 6. Zar, J.H. 2012. Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 1st SEMESTER				
Course Code	PBOC 102			
Course Title	Cellular Bioenergetics & Cell Signalling			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	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 physicochemical principles, bioenergetics, molecular structure, and enzymatic processes that govern cellular functions. It also seeks to develop an understanding of cellular communication and signal transduction mechanisms underlying the regulation and coordination of biological systems.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Cellular interactions**: Van der Waals, electrostatic, hydrogen bonding, hydrophobic interactions; pH, buffer, reaction kinetics, thermodynamics, colligative properties	**7 H** **10 M**
II	**Bioenergetics:** Energy calculations of glycolysis and oxidative phosphorylation, coupled reactions, group transfer, biological energy transducers.	**8 H** **9 M**
III	**Enzyme catalysis**: Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes; Enzyme linked metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins	**10 H** **10 M**
IV	**Conformation Biology**: Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds); Conformation of nucleic acids (Structural characteristics of A, B and Z DNA; RNA conformation); Stability of Proteins and Nucleic acids	**9 H** **11 M**
V	**Cellular communications:** General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation, regulation of haematopoiesis.	**6H** **6 M**
VI	**Cell signaling**: Hormones and their receptors, cell surface receptors, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light-signaling in plants, bacterial chemotaxis and quorum sensing.	**5H** **4 M**
TOTAL		**45 H** **50 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks
	1. Estimation of amylase, catalase, or invertase activity and determination of the effect of substrate concentration, pH, and temperature on enzyme activity 2. Study of protein denaturation and renaturation under different physical and chemical conditions 3. Retrieval and visualization of protein and DNA structures from databases (e.g., PDB), identification of secondary structures, domains, motifs, and analysis of Ramachandran plots using online tools. 4. Demonstration of the effects of pH and temperature on protein structure. 5. Observation and interpretation of signaling pathways using animations/software tools, including G-protein coupled receptors (GPCRs), second messenger systems, and plant light-signaling pathways.	**30 H** **20 M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the physicochemical and bioenergetic principles underlying biological systems, including molecular interactions, thermodynamics, reaction kinetics, enzyme catalysis, and cellular energy transformations. 2. Analyze the structure–function relationships of biomolecules by interpreting the conformational properties and stability of proteins and nucleic acids, and their roles in cellular metabolism and regulation. 3. Apply concepts of cellular communication and signal transduction to understand receptor-mediated signaling, intracellular regulatory pathways, plant and bacterial signaling systems, and the coordination of physiological responses in living organisms.	
Texts / References	1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). Molecular biology of the cell (7th ed.). Garland Science. 2. Berg, J. M., Tymoczko, J. L., Gatto, G. J., Jr., & Stryer, L. (2023). Biochemistry (10th ed.). W. H. Freeman and Company. 3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Scott, M. P. (2021). Molecular cell biology (9th ed.). W. H. Freeman and Company. 4. Nelson, D. L., & Cox, M. M. (2021). Lehninger principles of biochemistry (8th ed.). W. H. Freeman and Company. 5. Voet, D., Voet, J. G., & Pratt, C. W. (2019). Fundamentals of biochemistry: Life at the molecular level (6th ed.). John Wiley & Sons.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 1st SEMESTER				
Course Code	PBOC 103			
Course Title	Functional Genomics & Chromosomal Architecture			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objective	To provide students with advanced knowledge of gene and chromosome organization, cell division and cell cycle regulation, DNA replication and repair, RNA biology, protein synthesis and degradation, and the molecular mechanisms controlling gene expression and epigenetic regulation in prokaryotic and eukaryotic systems.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	Organization of genes and chromosomes: Nucleus and its organization and dynamics, Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons	**6 H 8 M**
II	Cell division and cell cycle regulation: Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle, apoptosis, necrosis and autophagy.	**8 H 8 M**
III	Advanced DNA Biology: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.	**7 H 8 M**
IV	Advanced RNA Biology: Mechanism and regulation of transcription, transcriptional inhibitors, transcription factors and machinery, transcription activators and repressors, RNA polymerases, capping, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport, ribozyme, riboswitches, non-coding RNA	**8 H 8 M**
V	Protein synthesis, processing and degradation: Ribosome, mechanism of translation and its regulation, translational inhibitors, post- translational modification of proteins, protein trafficking and transport, protein degradation.	**8 H 8 M**
VI	Control of gene expression at transcription and translation level: Regulation of gene expression in phages, viruses, prokaryotes and eukaryotes, role of chromatin in gene expression and gene silencing, epigenetic regulation.	**8 H 10 M**
TOTAL		**45 H 50 M**

PRACTICAL

	Sl. No. and Name of the experiment	Teaching hours & Allotted Marks
	1. Preparation and observation of onion root tip squash to identify stages of mitosis. 2. Observation of meiotic stages preparing temporary slides of flower buds (e.g., *Tradescantia* or onion flower buds). 3. Demonstration of chromosome structure by preparation of charts or models showing chromosome organization, chromatin, euchromatin, and heterochromatin. 4. DNA isolation from plant material such as extraction of DNA from banana, onion, or pea. 5. Demonstration of DNA replication and transcription by use of paper models or clay models with explain of replication fork, transcription, and RNA synthesis. 6. Demonstration of ribosome structure, translation process, and genetic code using teaching models. 7. Comparative study of Prokaryotic and Eukaryotic gene organization by preparation of diagrams or charts showing operon system and eukaryotic gene structure. 8. Seminar and Assignment on gene regulation and epigenetics such as gene expression, gene silencing, and epigenetic modifications.	**30 hours / 20 Marks**
Course/ Learning outcomes	**After successful completion of the course, students will be able to**: 1. Understand the organization and regulation of genes, chromosomes, chromatin, and the cell cycle. 2. Explain the mechanisms of DNA replication, repair, recombination, and transcription. 3. Describe RNA processing, protein synthesis, post-translational modification, and protein degradation. 4. Analyse gene expression and epigenetic regulation in prokaryotic and eukaryotic systems.	
Texts / References	1. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). Molecular Biology of the Gene (7th ed.). Pearson Education, USA. 2. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). Molecular Biology of the Cell (7th ed.). Garland Science, Taylor & Francis Group, New York. 3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Scott, M. P. (2021). Molecular Cell Biology (9th ed.). W. H. Freeman and Company, New York. 4. Lewin, B., Krebs, J. E., Kilpatrick, S. T., & Goldstein, E. S. (2017). Lewin's Genes XII. Jones & Bartlett Learning, Burlington, Massachusetts. 5. Karp, G. (2019). Cell and Molecular Biology: Concepts and Experiments (9th ed.). Wiley, USA. 6. Snustad, D. P., & Simmons, M. J. (2015). Principles of Genetics (7th ed.). John Wiley & Sons, USA.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 1st SEMESTER				
Course Code	PBOC 104			
Course Title	Bioethics, Indian Knowledge System (IKS) and Intellectual Property Rights (IPR)			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objective	To provide students with advanced knowledge of fundamental concepts and principles of bioethics in biological sciences and research. It will familiarize students with the Indian Knowledge System (IKS) and its relevance in biological sciences, traditional healthcare, and sustainable practices. It will create ethical awareness and professional responsibility among students.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Fundamentals of Bioethics:** Definition, scope, and importance of bioethics; Historical development of bioethics; Ethical principles: autonomy, beneficence, non-maleficence, justice; Research ethics and scientific misconduct; Ethics in human and animal experimentation; Environmental ethics and sustainability.	**10 H 11 M**
II	**Bioethics in Modern Biological Sciences:** Ethical issues in biotechnology and genetic engineering; Ethics of stem cell research and cloning; Ethical concerns in assisted reproductive technologies; Bioethics in public health and epidemiology; Biosafety and biosecurity regulations; Case studies related to ethical dilemmas in biological sciences.	**8 H 10 M**
III	**Indian Knowledge System (IKS):** Concept and evolution of Indian Knowledge System; Traditional Indian knowledge related to plants, medicine, and agriculture; Ayurveda, ethnobotany, and indigenous healthcare practices; Traditional ecological knowledge and biodiversity conservation; Role of IKS in sustainable development; Documentation and preservation of indigenous knowledge with reference to NE India.	**10 H 10 M**
IV	**Intellectual Property Rights (IPR):** Concept, importance, and types of IPR; Patents, copyrights, trademarks, geographical indications, and trade secrets; Patent filing procedures and patentability criteria; Plant variety protection and farmers' rights; IPR issues related to biological resources and traditional knowledge; National and international organizations related to IPR.	**10 H 11 M**
V	**Biodiversity, Legal Frameworks & Contemporary Issues:** Convention on Biological Diversity (CBD); Nagoya Protocol and Access & Benefit Sharing (ABS); Biopiracy and protection of traditional knowledge; Indian Biological Diversity Act and related regulations; Ethical and legal issues in biodiversity utilization; Contemporary issues and emerging challenges in bioethics and IPR.	**7 H 8 M**

TOTAL		**45 H 50 M**
PRACTICAL		
	Name of the experiment	**Teaching hours & Allotted Marks**
	1. Preparation of assignments and seminar presentations on bioethical issues. 2. Case study analysis on ethical dilemmas in biological sciences. 3. Survey and documentation of indigenous traditional knowledge. 4. Demonstration of patent search using online databases. 5. Preparation of a model patent draft. 6. Group discussion on biopiracy and biodiversity laws. 7. Field visit/report related to traditional medicinal knowledge or biodiversity conservation.	**30 hours / 20 Marks**
Course/ Learning outcomes	**After successful completion of the course, students will be able to**: 1. Understand the ethical principles governing biological research and applications. 2. Explain the significance of Indian traditional knowledge systems in modern science and sustainability. 3. Demonstrate knowledge of various forms of Intellectual Property Rights (IPRs). 4. Analyze ethical and legal issues related to biotechnology, biodiversity, and indigenous knowledge. 5. Develop awareness regarding research integrity, biosafety, and biosecurity	
Texts / References	1. Beauchamp, T.L. & Childress, J.F. Principles of Biomedical Ethics. Oxford University Press. 2. Sateesh, M.K. Bioethics and Biosafety. I.K. International Publishing House. 3. Nambisan, P. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology. Academic Press. 4. Subbarayappa, B.V. The Roots of Ancient Medicine: An Historical Outline. 5. Jha, A.K. Intellectual Property Rights and Globalization. 6. Singh, K. Intellectual Property Rights in India. 7. Gupta, A.K. Traditional Knowledge and Intellectual Property. 8. Government of India. National Education Policy (NEP) 2020. 9. The Biological Diversity Act, Government of India. 10. WIPO Publications on Intellectual Property Rights.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 1st SEMESTER				
Course Code	PBOG 101			
Course Title	Bioethics, Indian Knowledge System (IKS) and Intellectual Property Rights (IPR)			
Category of Course	GENERIC			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objective	To provide students with advanced knowledge of fundamental concepts and principles of bioethics in biological sciences and research. It will familiarize students with the Indian Knowledge System (IKS) and its relevance in biological sciences, traditional healthcare, and sustainable practices. It will create ethical awareness and professional responsibility among students.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Fundamentals of Bioethics:** Definition, scope, and importance of bioethics; Historical development of bioethics; Ethical principles: autonomy, beneficence, non-maleficence, justice; Research ethics and scientific misconduct; Ethics in human and animal experimentation; Environmental ethics and sustainability.	**10 H 13 M**
II	**Bioethics in Modern Biological Sciences:** Ethical issues in biotechnology and genetic engineering; Ethics of stem cell research and cloning; Ethical concerns in assisted reproductive technologies; Bioethics in public health and epidemiology; Biosafety and biosecurity regulations; Case studies related to ethical dilemmas in biological sciences.	**8 H 10 M**
III	**Indian Knowledge System (IKS):** Concept and evolution of Indian Knowledge System; Traditional Indian knowledge related to plants, medicine, and agriculture; Ayurveda, ethnobotany, and indigenous healthcare practices; Traditional ecological knowledge and biodiversity conservation; Role of IKS in sustainable development; Documentation and preservation of indigenous knowledge with reference to NE India.	**10 H 10 M**
IV	**Intellectual Property Rights (IPR):** Concept, importance, and types of IPR; Patents, copyrights, trademarks, geographical indications, and trade secrets; Patent filing procedures and patentability criteria; Plant variety protection and farmers' rights; IPR issues related to biological resources and traditional knowledge; National and international organizations related to IPR.	**10 H 11 M**
V	**Biodiversity, Legal Frameworks & Contemporary Issues:** Convention on Biological Diversity (CBD); Nagoya Protocol and Access & Benefit Sharing (ABS); Biopiracy and protection of traditional knowledge; Indian Biological Diversity Act and related regulations; Ethical and legal issues in biodiversity utilization; Contemporary issues and emerging challenges in bioethics and IPR.	**7 H 6 M**

TOTAL		**45 H 50 M**
PRACTICAL		
	Name of the experiment	**Teaching hours & Allotted Marks**
	1. Preparation of assignments and seminar presentations on bioethical issues. 2. Case study analysis on ethical dilemmas in biological sciences. 3. Survey and documentation of indigenous traditional knowledge. 4. Demonstration of patent search using online databases. 5. Preparation of a model patent draft. 6. Group discussion on biopiracy and biodiversity laws. 7. Field visit/report related to traditional medicinal knowledge or biodiversity conservation.	**30 hours / 20 Marks**
Course/ Learning outcomes	**After successful completion of the course, students will be able to**: 1. Understand the ethical principles governing biological research and applications. 2. Explain the significance of Indian traditional knowledge systems in modern science and sustainability. 3. Demonstrate knowledge of various forms of Intellectual Property Rights (IPRs). 4. Analyze ethical and legal issues related to biotechnology, biodiversity, and indigenous knowledge. 5. Develop awareness regarding research integrity, biosafety, and biosecurity	
Texts / References	1. Beauchamp, T.L. & Childress, J.F. Principles of Biomedical Ethics. Oxford University Press. 2. Sateesh, M.K. Bioethics and Biosafety. I.K. International Publishing House. 3. Nambisan, P. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology. Academic Press. 4. Subbarayappa, B.V. The Roots of Ancient Medicine: An Historical Outline. 5. Jha, A.K. Intellectual Property Rights and Globalization. 6. Singh, K. Intellectual Property Rights in India. 7. Gupta, A.K. Traditional Knowledge and Intellectual Property. 8. Government of India. National Education Policy (NEP) 2020. 9. The Biological Diversity Act, Government of India. 10. WIPO Publications on Intellectual Property Rights.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

POST GRADUATE PROGRAMME

IN

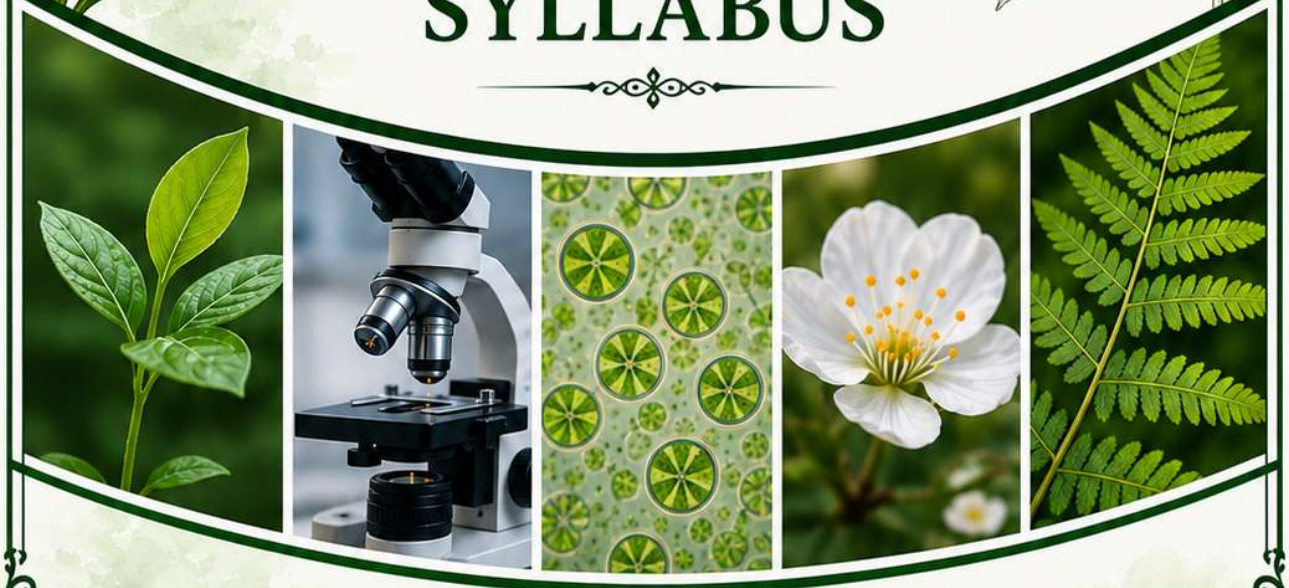
BOTANY

M.Sc. BOTANY

(Two Year Programme)

2nd SEMESTER

SYLLABUS



SEMESTER: 2 YEAR PG 2nd SEMESTER				
Course Code	PBOC 201			
Course Title	Reproductive & Developmental Biology			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objectives	This course aims to provide knowledge of the fundamental principles of developmental biology, including cell differentiation, embryogenesis, morphogenesis, and organogenesis in plants and animals. It also focuses on plant anatomy, secondary growth, and palynology, along with their practical applications in agriculture, biotechnology, environmental studies, and forensic science. The course helps students understand developmental mechanisms and develop analytical and observational skills in biological sciences			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation, morphogenetic gradients, cell fate and cell lineages, stem cells, genomic equivalence and the cytoplasmic determinants, imprinting, mutants and transgenics in analysis of development.	**6 H** **10 M**
II	Gametogenesis, fertilization and early development: Male gametophyte development, embryo sac development and double fertilization in plants, embryogenesis, establishment of symmetry in plants, seed formation, embryo and endosperm developmental dynamics and germination.	**8 H** **8 M**
III	Morphogenesis and organogenesis in model organisms: Cell aggregation and differentiation in Dictyostelium, axes and pattern formation in Drosophila; organogenesis - vulva formation in *Caenorhabditis elegans*, eye lens induction, post embryonic development - larval formation, metamorphosis; environmental regulation of normal development; sex determination.	**10 H** **10 M**
IV	Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem, shoot and root development, leaf development and phyllotaxy, transition to flowering, floral meristems, organogenesis and floral development.	**6 H** **10 M**
V	Periderm: Origin and activity, Rytidome, protective tissue in Monocotyedons, bark and cork; Cambium- Origin, function, behavior, Secondary growth in dicot stem.	**7 H** **6 M**
VI	Applications Palynology: Pollen morphology, ultrastructure, pollen chemistry, viability, storage and adaptation of palynology: aeropalynology and pollen allergy, melissopalynology, forensic palynology, palaeopalynology and hydrocarbon exploration.	**8 H** **6 M**

TOTAL		**45 H 50 M**
PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Study of different stages of mitosis and meiosis using temporary slides. 2. Observation of embryonic developmental stages in plants and animals through prepared slides/charts/models. 3. Study of pollen morphology, pollen viability, and pollen germination by staining techniques. 4. Identification and study of male gametophyte and embryo sac development in flowering plants. 5. Study of seed structure, stages of seed germination, and embryogenesis in dicot and monocot plants. 6. Observation of morphogenesis and organogenesis in model organisms through charts, specimens, and virtual demonstrations. 7. Study of shoot apical meristem, root apical meristem, and leaf arrangement (phyllotaxy). 8. Preparation and identification of transverse sections of dicot stem showing secondary growth and cambial activity. 9. Study of periderm, bark, cork, and protective tissues in monocot and dicot plants. 10. Analysis of pollen grains for applications in palynology including aeropalynology, melissopalynology, and forensic palynology. 11. Demonstration of tissue culture, stem cells, mutants, and transgenic techniques through laboratory visits/videos/models. 12. Submission of practical records, diagrams, and field/laboratory reports.	**30 hours/ 20 Marks**
Course/ Learning outcomes	After completing this course, students will be able to- 1. Explain the basic concepts and mechanisms of development in plants and animals, including embryogenesis, differentiation, and organogenesis. 2. Understand plant anatomical structures, secondary growth, and the role of cambium and periderm. 3. Gain knowledge of pollen biology and applications of palynology in various scientific fields. 4. Enhance their analytical, observational, and practical skills in developmental biology and plant sciences.	
Texts / References	1. Gilbert, S. F., & Barresi, M. J. F. (2020). Developmental biology (12th ed.). Sinauer Associates/Oxford University Press. 2. Wolpert, L., Tickle, C., & Arias, A. M. (2019). Principles of development (6th ed.). Oxford University Press. 3. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2018). Plant physiology and development (6th ed.). Sinauer Associates. 4. Evert, R. F. (2006). Esau's plant anatomy: Meristems, cells, and tissues of the plant body—Their structure, function, and development (3rd ed.). John Wiley & Sons.	

	5. Hesse, M., Halbritter, H., Zetter, R., Weber, M., Buchner, R., Frosch-Radivo, A., & Ulrich, S. (2009). Pollen terminology: An illustrated handbook. Springer. 6. Erdtman, G. (1969). Handbook of palynology: Morphology, taxonomy, ecology. Hafner Publishing Company.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 2nd SEMESTER				
Course Code	PBOC 202			
Course Title	Organismal Ecology and Environmental Interactions			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	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 ecological principles governing the interactions between organisms and their environment across different levels of biological organization. It introduces the concepts of population, community, and ecosystem ecology, emphasizing ecological processes such as population dynamics, species interactions, energy flow, and nutrient cycling. The course further explores the impacts of human activities on natural ecosystems, including climate change, habitat fragmentation, pollution, and biological invasions.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Introduction:** Levels of organization- individual, population, community, ecosystem, biosphere; Abiotic and biotic ecological factors, Ecological adaptations.	**6 H** **8 M**
II	**Population Ecology:** Population growth models- Exponential growth, logistic growth, density-dependent and density-independent factors, life tables, survivorship curves; Population dynamics- Age structure, sex ratio, life history strategies (r-selected vs. K-selected); Metapopulations- Habitat fragmentation, connectivity, and extinction risk.	**8 H** **8 M**
III	**Community Ecology**: Community structure - Food webs, trophic levels, keystone species; Species interactions - Competition, predation, mutualism, parasitism; Succession- Primary and secondary succession, community stability.	**10 H** **10 M**
IV	**Ecosystem Ecology**: Energy flow in ecosystems- Primary production, trophic levels, energy pyramids; Biogeochemical cycles- Carbon, nitrogen, phosphorus, water cycles; Ecosystem services and human impacts.	**6 H** **10 M**
V	**Human Impacts on Ecosystems**: Anthropogenic pressures: Land use and land-cover change; Climate change, pollution, invasive species.	**7 H** **8 M**
VI	**Ecological Calculations:** Mark Capture Recapture, Population measurement, Biomass prediction, indices of plant community, Island Biogeography	**8 H** **6 M**
TOTAL		**45 H** **50 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks
	1. Estimation of Population Density and Frequency of Plant Species for calculating IVI 2. Determination of Species Diversity and Community Structure 3. Population Estimation by Mark–Capture–Recapture Method 4. Measurement of above-ground biomass and estimation of primary productivity in a selected ecosystem. 5. Analysis of primary and secondary succession using case studies, models, photographs, or digital simulations. 6. Computer-assisted or model-based demonstration of species–area relationships, habitat fragmentation, connectivity, and extinction–colonization dynamics.	**30 hours/ 20 Marks**
Course/ Learning outcomes	After completing this course, students will be able to- 1. Explain the fundamental principles of organismal ecology and evaluate the influence of abiotic and biotic factors on the distribution, adaptation, and survival of organisms 2. Analyze population, community, and ecosystem dynamics by interpreting population growth models, species interactions, ecological succession, energy flow, biogeochemical cycles, and ecosystem services. 3. Apply quantitative ecological methods and ecological indices to assess biodiversity, population structure, biomass, island biogeography, and the impacts of anthropogenic activities on ecosystem stability and conservation.	
Texts / References	1. Begon, M., Townsend, C. R., & Harper, J. L. (2021). Ecology: From individuals to ecosystems (5th ed.). Wiley-Blackwell. 2. Cain, M. L., Bowman, W. D., & Hacker, S. D. (2022). Ecology (6th ed.). Oxford University Press. 3. Molles, M. C., Jr., & Sher, A. A. (2019). Ecology: Concepts and applications (8th ed.). McGraw-Hill Education. 4. Ricklefs, R. E., & Relyea, R. A. (2019). The economy of nature (8th ed.). W. H. Freeman and Company. 5. Smith, T. M., & Smith, R. L. (2015). Elements of ecology (9th ed.). Pearson Education	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 2nd SEMESTER				
Course Code	PBOC 203			
Course Title	Immunology & Translational Pathobiology			
Category of Course	CORE			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objective	Understand the fundamentals of immunity, host–pathogen interactions, cancer biology, microbial physiology, antimicrobial resistance and membrane structure and transport mechanisms.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity, B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering.	6 H / 8 M
II	Antigen antibody interactions: MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial, parasitic and viral infections, congenital and acquired immunodeficiencies, vaccines.	8 H / 10 M
III	Host pathogen interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behaviour by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.	7 H / 8 M
IV	Cancer Biology: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth. Programmed cell death, aging and senescence in plants	7 H / 8 M
V	Microbial physiology: Growth kinetics, strategies of cell division, stress response, antimicrobial resistance (AMR), Mechanism of actions of antibiotics, Culture media for growing pathogenic and non pathogenic microbes	9 H / 8 M
VI	Microbial membrane physiology: Cell wall, physical structure of model membranes in prokaryotes, lipid bilayer, membrane proteins, diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.	8 H /8 M
TOTAL		**45 H /50 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks

	1. Differential Staining of Human Blood Cells (Innate and Adaptive Immunity) 2. Antigen–Antibody Agglutination Test 3. Study of Microbial Growth Curve 4. Effect of Antibiotics on Bacterial Growth (Antimicrobial Resistance) 5. Observation of Osmosis Using Dialysis Membrane (Membrane Physiology) 6. Detection of Programmed Cell Death in Plant Tissues	**30 H /20 M**
Course/ Learning outcomes	After completion of the course, students will be able to: 1. Differentiate between innate and adaptive immunity and explain the role of immune cells, antibodies and epitopes in immune responses. 2. Interpret antigen–antibody interactions and explain the mechanisms of immune regulation, hypersensitivity, autoimmunity, immunodeficiency and vaccination. 3. Evaluate the interaction between hosts and pathogens and describe pathogen-induced diseases in plants and animals. 4. Explain the genetic and cellular basis of cancer, including carcinogenesis, metastasis, programmed cell death, aging and senescence. 5. Demonstrate knowledge of microbial growth, antimicrobial resistance mechanisms and the preparation and use of microbial culture media. 6. Describe membrane organization, transport systems, membrane proteins and intracellular transport processes in microbial cells.	
Texts / References	1. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2017). Janeway's Immunobiology (9th ed.). Garland Science, New York. 2. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2021). Cellular and Molecular Immunology (10th ed.). Elsevier, Philadelphia. 3. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2021). Brock Biology of Microorganisms (16th ed.). Pearson Education, USA. 4. Weinberg, R. A. (2014). The Biology of Cancer (2nd ed.). Garland Science, New York. 5. Indian Authors 6. Dubey, R. C., & Maheshwari, D. K. (2018). A Textbook of Microbiology (5th ed.). S. Chand Publishing, New Delhi. 7. Verma, P. S., & Agarwal, V. K. (2019). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand Publishing, New Delhi. 8. Arora, M. P. (2019). Cell Biology, Genetics, Molecular Biology and Evolution. Himalaya Publishing House, Mumbai.	

SEMESTER: 2 YEAR PG 2nd SEMESTER	
Course Code	PBOC 204
Course Title	Pharmacognosy and Ethnobotany
Category of Course	CORE

Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objective	This course will introduce students to the principles, history, scope, and importance of Pharmacognosy and Ethnobotany. It will provide comprehensive knowledge regarding medicinal plants, crude drugs, and bioactive phytochemicals. It will familiarize students with indigenous knowledge systems and traditional healthcare practices of India. This may helps to develop practical skills in identification, collection, preservation, and processing of medicinal plant materials and promote awareness regarding biodiversity conservation.			

COURSE CONTENTS

THEORY

Units	COURSE CONTENTS	Teaching Hours/Marks allotted
I	**Introduction to Pharmacognosy** Definition, history, scope, and importance of Pharmacognosy; Classification of crude drugs based on morphology, taxonomy, and chemical nature; Sources of crude drugs: plant, animal, mineral, marine, and microbial origin; Collection, cultivation, processing, storage, and preservation of crude drugs; Adulteration and evaluation of crude drugs.	**10H/15M**
II	**Medicinal Plants and Phytochemistry** Study of important medicinal plants and their therapeutic uses; Primary and secondary metabolites; Classification and significance of alkaloids, glycosides, flavonoids, tannins, terpenoids, and essential oils; Methods of extraction, isolation, and identification of phytochemicals.; Role of medicinal plants in pharmaceutical and herbal industries.	**8H/10M**
III	**Ethnobotany and Traditional Knowledge** Definition, history, scope, and objectives of Ethnobotany; Ethnobotanical studies among tribal and rural communities of India; Traditional systems of medicine: Ayurveda, Siddha, Unani, Folk Medicine, and Homeopathy; Documentation and preservation of indigenous knowledge; Role of ethnobotany in healthcare and community development	**9H/10M**
IV	**Applied and Economic Ethnobotany** Ethnobotanical uses of plants in food, beverages, fibre, dyes, gums, resins, oils, and rituals; Medicinal plants used in common ailments and traditional therapies; Economic importance of medicinal and aromatic plants; Bioprospecting, biopiracy, biodiversity laws, and Intellectual Property Rights (IPR); Ethnobotany in sustainable rural development.	**10H/10M**
V	**Conservation and Sustainable Utilization** Threats to medicinal plant diversity; Conservation strategies: in situ and ex situ conservation; Sustainable harvesting and cultivation practices; Herbal drug standardization and quality control; Recent advances and future prospects in Pharmacognosy and Ethnobotany.	**8H/5M**
TOTAL		**45H / 50M**

Exp. No.	Name of the Experiment	Teaching Hours &

		Allotted Marks
	1. Identification and study of locally available medicinal plants. 2. Preparation of herbarium specimens of medicinal plants. 3. Microscopic examination of crude drugs. 4. Extraction of phytochemicals using different methods. 5. Detection of alkaloids, tannins, flavonoids, and essential oils. 6. Preparation of ethnobotanical survey reports. 7. Field visit to herbal gardens, medicinal plant conservation centres, or local communities.	30H /20M
Course/ Learning outcomes	Upon successful completion of the course, the students should able to- 1. Explain the concepts, scope, and applications of Pharmacognosy and Ethnobotany. 2. Identify important medicinal plants and evaluate their therapeutic importance. 3. Describe major phytochemical groups and their medicinal significance. 4. Understand the role of traditional medicine and indigenous knowledge systems in healthcare. 5. Demonstrate practical knowledge in herbarium preparation, crude drug identification, and phytochemical extraction. 6. Analyze issues related to conservation, bioprospecting, and intellectual property rights associated with medicinal plants.	
Texts / References	1. Trease, G.E. and Evans, W.C. Pharmacognosy. Saunders Elsevier. 2. Kokate, C.K., Purohit, A.P. and Gokhale, S.B. Pharmacognosy. Nirali Prakashan. 3. Jain, S.K. Manual of Ethnobotany. Scientific Publishers. 4. Harborne, J.B. Phytochemical Methods. Chapman and Hall. 5. Shah, B. and Seth, A.K. Textbook of Pharmacognosy and Phytochemistry. Elsevier. 6. Cotton, C.M. Ethnobotany: Principles and Applications. John Wiley & Sons. 7. Sofowora, A. Medicinal Plants and Traditional Medicine in Africa. Spectrum Books	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 2nd SEMESTER				
Course Code	PBOG 201			
Course Title	Pharmacognosy and Ethnobotany			
Category of Course	GENERIC			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	50 (ES) + 20 (PR) + 30 (IA)=100			
Course Objective	This course will introduce students to the principles, history, scope, and importance of Pharmacognosy and Ethnobotany. It will provide comprehensive knowledge regarding medicinal plants, crude drugs, and bioactive phytochemicals. It will familiarize students with indigenous knowledge systems and traditional healthcare practices of India. This may helps to develop practical skills in identification, collection, preservation, and processing of medicinal plant materials and promote awareness regarding biodiversity conservation.			

COURSE CONTENTS

THEORY

Units	COURSE CONTENTS	Teaching Hours/Marks allotted
I	**Introduction to Pharmacognosy** Definition, history, scope, and importance of Pharmacognosy; Classification of crude drugs based on morphology, taxonomy, and chemical nature; Sources of crude drugs: plant, animal, mineral, marine, and microbial origin; Collection, cultivation, processing, storage, and preservation of crude drugs; Adulteration and evaluation of crude drugs.	**10H/15M**
II	**Medicinal Plants and Phytochemistry** Study of important medicinal plants and their therapeutic uses; Primary and secondary metabolites; Classification and significance of alkaloids, glycosides, flavonoids, tannins, terpenoids, and essential oils; Methods of extraction, isolation, and identification of phytochemicals.; Role of medicinal plants in pharmaceutical and herbal industries.	**8H/10M**
III	**Ethnobotany and Traditional Knowledge** Definition, history, scope, and objectives of Ethnobotany; Ethnobotanical studies among tribal and rural communities of India; Traditional systems of medicine: Ayurveda, Siddha, Unani, Folk Medicine, and Homeopathy; Documentation and preservation of indigenous knowledge; Role of ethnobotany in healthcare and community development	**9H/10M**
IV	**Applied and Economic Ethnobotany** Ethnobotanical uses of plants in food, beverages, fibre, dyes, gums, resins, oils, and rituals; Medicinal plants used in common ailments and traditional therapies; Economic importance of medicinal and aromatic plants; Bioprospecting, biopiracy, biodiversity laws, and Intellectual Property Rights (IPR); Ethnobotany in sustainable rural development.	**10H/10M**
V	**Conservation and Sustainable Utilization** Threats to medicinal plant diversity; Conservation strategies: in situ and ex situ conservation; Sustainable harvesting and cultivation practices; Herbal	**8H/5M**

	drug standardization and quality control; Recent advances and future prospects in Pharmacognosy and Ethnobotany.	
TOTAL		**45H / 50M**
Exp. No.	**Name of the Experiment**	**Teaching Hours & Allotted Marks**
	1. Identification and study of locally available medicinal plants. 2. Preparation of herbarium specimens of medicinal plants. 3. Microscopic examination of crude drugs. 4. Extraction of phytochemicals using different methods. 5. Detection of alkaloids, tannins, flavonoids, and essential oils. 6. Preparation of ethnobotanical survey reports. 7. Field visit to herbal gardens, medicinal plant conservation centres, or local communities.	30H /20M
Course/ Learning outcomes	Upon successful completion of the course, the students should able to- 1. Explain the concepts, scope, and applications of Pharmacognosy and Ethnobotany. 2. Identify important medicinal plants and evaluate their therapeutic importance. 3. Describe major phytochemical groups and their medicinal significance. 4. Understand the role of traditional medicine and indigenous knowledge systems in healthcare. 5. Demonstrate practical knowledge in herbarium preparation, crude drug identification, and phytochemical extraction. 6. Analyze issues related to conservation, bioprospecting, and intellectual property rights associated with medicinal plants.	
Texts / References	1. Trease, G.E. and Evans, W.C. Pharmacognosy. Saunders Elsevier. 2. Kokate, C.K., Purohit, A.P. and Gokhale, S.B. Pharmacognosy. Nirali Prakashan. 3. Jain, S.K. Manual of Ethnobotany. Scientific Publishers. 4. Harborne, J.B. Phytochemical Methods. Chapman and Hall. 5. Shah, B. and Seth, A.K. Textbook of Pharmacognosy and Phytochemistry. Elsevier. 6. Cotton, C.M. Ethnobotany: Principles and Applications. John Wiley & Sons. 7. Sofowora, A. Medicinal Plants and Traditional Medicine in Africa. Spectrum Books	

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

माधवदेव विश्वविद्यालय ★ MADHABDEV UNIVERSITY

सत्यम् शिवम् सुन्दरम्

Estd: 2019

POST GRADUATE PROGRAMME

IN

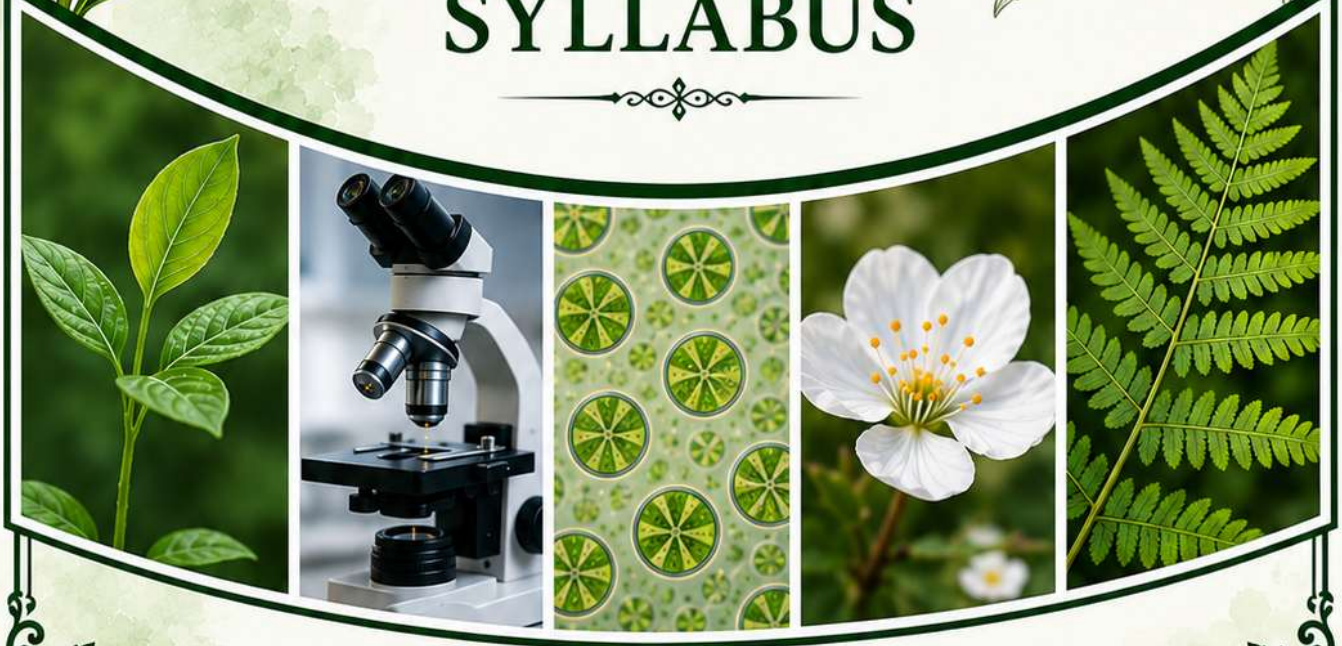
BOTANY

M.Sc. BOTANY

(Two Year Programme)

3rd SEMESTER

SYLLABUS



SEMESTER: 2 YEAR PG 3rd SEMESTER				
Course Code	PBOC 301			
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**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	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	**30 H** **20 M**
Course / Learning outcomes	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.	
Texts / References	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.	

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

SEMESTER: 2 YEAR PG 3rd SEMESTER				
Course Code	PBOC 302			
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**

<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. 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)</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 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.</td></tr>
<tr><td>Texts / References</td><td colspan="2">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.</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: 2 YEAR PG 3rd SEMESTER				
Course Code	PBOC 303			
Course Title	Biodiversity & Evolutionary 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	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.			

Course Content

THEORY

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**

VI	**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	**5 H** **5 M**
TOTAL		**45 H** **50 M**
PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	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	**30 H** **20 M**
Course / Learning outcomes	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.	
Texts / References	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	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 3rd SEMESTER				
Course Code	PBOD 301			
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**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	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	**30 H** **20 M**
Course / Learning outcomes	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.	
Texts / References	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.	

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

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

SEMESTER: 2 YEAR PG 3rd SEMESTER				
Course Code	PBOD 302			
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**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	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)	**30 H** **20 M**
Course / Learning outcomes	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.	
Texts / References	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	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

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

SEMESTER: 2 YEAR PG 3rd SEMESTER				
Course Code	PBOD 303			
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

MADHABDEV UNIVERSITY

सत्यम् शिवम् सुन्दरम्

Estd: 2019

POST GRADUATE PROGRAMME

IN

BOTANY

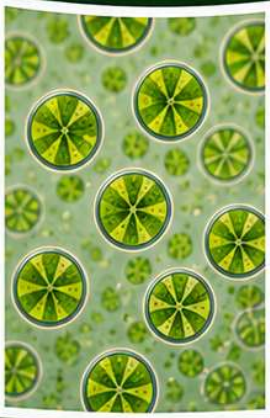
M.Sc. BOTANY

(Two Year Programme)

4th SEMESTER

SYLLABUS





SEMESTER: 1 YEAR PG 4th SEMESTER				
Course Code	PBOC 401			
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: 2 YEAR PG 4th SEMESTER				
Course Code	PBOC 402			
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: 2 YEAR PG 4th SEMESTER				
Course Code	PBOC 403			
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** **18/20 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: 2 YEAR PG 4th SEMESTER				
Course Code	PBOD 401			
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: 2 YEAR PG 4th SEMESTER				
Course Code	PBOD 402			
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**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	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.	**30 H** **20 M**
Course / Learning outcomes	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.	
Texts / References	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.	

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

SEMESTER: 2 YEAR PG 4th SEMESTER				
Course Code	PBOD 403			
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