

**DEPARTMENT OF BOTANY**  
**BIR TIKENDRAJIT UNIVERSITY**  
**Syllabus for M.Sc. Botany**

Course Code	Course Title	Marks		
		Internal assessment	Annual Exam	Total
<b>FIRST YEAR</b>				
BOT-101	Cell Biology and Fundamental Processes	20	80	100
BOT-102	Ecological Principles and Environmental Biology	20	80	100
BOT-103-P	Practical-I (practical of BOT-101 & BOT-102)	-	75	75
BOT-104	Angiosperm Taxonomy	20	80	100
BOT-105	Mycology and Plant Pathology	20	80	100
BOT-106-P	Practical-II (practical of BOT-104 & BOT-105)	-	75	75
BOT-107	Plant Biochemistry	20	80	100
BOT-108	Plant Anatomy, Embryology & Ethnobotany	20	80	100
BOT-109-P	Practical-III (practical of BOT-107 & BOT-108)	-	75	75
BOT-110	Plant Physiology	20	80	100
BOT-111	Cryptogams, Gymnosperms & Palaeobotany	20	80	100
BOT-112-P	Practical-IV (practical of BOT-110 & BOT-111)	-	75	75
	<b>Total Marks</b>			<b>1100</b>

**BOT-101: Cell Biology and Fundamental Processes**

1. Structure and function of membrane and cellular organelles: Structure of model biological membrane, lipid bilayer and membrane proteins, diffusion, osmosis, ion-channels and ion-pumps; Structure and function of nucleus, ribosomes, golgi bodies, mitochondria, endoplasmic reticulum, chloroplast, cytoskeleton, lysosome.

2. Cell cycle, cell division and cellular communication: Control of cell cycle events, Regulation of mitosis and meiosis, General Principles of cell communication, cell adhesion, gap junctions, integrins and neurotransmitters in cell communication.

3. DNA replication, Transcription and Translation: Mechanism of DNA replication, proof reading in DNA replication, mechanism of transcription and translation, eukaryotic mRNA processing, translational proof reading and post-translational modification of proteins

4. Regulation of gene expression: Organization of genes and chromosome, Structure and regulation of Lactose and tryptophan operons, Paradigm of gene regulation in phages and prokaryotes – Antitermination and Attenuation.

#### Recommended Books

1. De Robertis, EMF & EDP De Robertis. Cell and Molecular Biology, BI Waverly Pvt. Ltd. 1997.

2. Peter J. Russel. iGenetics: A Mendelian Approach.

3. Lodish, H. et al. Molecular Cell Biology, WH Freeman & Co, New York, 2000.

4. Lewin, B. Genes IX, Oxford University Press, 2012.

5. Becker, Kleinsmith, Hardin. The World of the Cell, (6<sup>th</sup> Ed), Pearson Education, 2007.

6. Stryer, L. Biochemistry, WH Freeman & Co, New York, 1995.

#### **BOT-102: Ecological Principles and Environmental Biology**

1. Basic Ecological Principles: Definition of ecology, Biotic and abiotic factors influencing organisms in various ecosystems, Concepts of limiting factors, Liebig's law of minimum, Shelford law of tolerance, Concept of habitat and niche, niche width and niche overlap, fundamental and realized niche.

2. Concept of Ecosystem: Structure and function of ecosystem, Trophic levels, Concept of trophic dynamic, Ecological pyramids, Food chain, Food webs-types and patterns of food webs, Energy flow in different ecosystems, Primary and secondary production of ecosystems, Biogeochemical cycles-concept, pattern and basic types, Cybernetic nature of ecosystem.

3. Population and Community Ecology: Population ecology – Demography, Growth models, Survivorship curves, Variation in natural population, Carrying capacity, Biotic potential, Mechanism of population regulation, r and k population strategies, Allelopathy. Community ecology – Classification and continuum concept, Community analysis, Communities coefficient,

Keystone species, Intra- and inter-specific species interaction, Ecological succession - types of succession mechanism of succession, concept of climax, example of succession.

4. Environmental Factors: Light, temperature and fire and their interactions with living components. Soil and belowground interactions, Soil composition, Soil texture, Structure and soil developmental process, Factors of soil formation, Soil physico-chemical characters, Soil profile and horizons, Podzolization, Laterization, Calcification, Salinization and Gleization, Soil organic matter and humus, Biodiversity of soil. Environmental pollution, types of pollution, Air pollution – major air pollutants and sources, causes and effects, factors affecting distribution of air pollutants, Global climate change, Control of air pollution, Water pollution – types of water pollutants, their sources and effects, ground water pollution, control of water pollution.

#### Recommended Books

1. Odum, EP (1983) Fundamentals of Ecology, Sanders, Philadelphia.
2. Kormondy, J. Concepts of Ecology, Oxford & IBH, 1984.
3. Daubenmire RF. Plants and Environment. Willey Eastern Pvt. Ltd., New Delhi.
4. Peter H, Raven PH & Berg LR, 2005, Environment, 5<sup>th</sup> Edition. John Wiley & Sons Inc., New York.
5. Smith RL (1996) Ecology and Field Biology. Harper Collins, New York.
6. Singh JS, Singh SP & Gupta SR (2006) Ecology, Environment and Resource Conservation. Anamaya Publishers, New Delhi.

### **BOT-103-P: Practical I (practical of BOT-101 & BOT-102)**

#### **Cell Biology and Fundamental Processes**

- I. Mitotic and meiotic in Onion/Rheo.
- II. Preparation of bacterial competent cells.
- III. Transformation of *Escherichia coli* with standard plasmids and calculation of transformation efficiency.
- IV. Transduction of genes using retroviral vector.

#### **Ecological Principles and Environmental Biology**

- I. Determination of minimum size of quadrat necessary for the study of grassland communities.
- II. Determination of frequency values of grassland species. Classification of species into frequency classes. Composition of the result with Raunkiaer's standard frequency diagram.

- III. Determination of density of different species in grassland.
- IV. Determination of abundance of different species in grassland.
- V. Effect of population density on standing crop per unit area in different field situations.
- VI. Primary productivity estimation of grassland and aquatic ecosystems by harvest and light bottle method respectively.
- VII. Temperature measurement of soil, air and water. Measurement of moisture regime of air (Relative humidity).
- VIII. Basic physical and chemical properties of soil: pH, nitrate and carbonate.
- IX. Determination of pH values of polluted and unpolluted water samples.
- X. Estimation of dissolved oxygen content of water samples.
- XI. Estimation of dissolved carbon dioxide contents of water samples.

#### **BOT-104: Angiosperm Taxonomy**

1. Introduction in Angiosperms: General morphology of angiosperms, Origin of angiosperms, Relationship and evolution of basal angiosperms, monocots and eudicots.
2. Basics of Plant Systematics: International Code of Botanical Nomenclature (ICBN), Rules of priority and typification, Ranks of taxa, Cladistics, Preparation and preservation techniques for Herbaria, The role of the herbarium, The role of field studies, Importance of Plant Systematics.
3. Systems of Plant Classification: Artificial, Natural and Phylogenetic systems, Experimental Taxonomy, Cytotaxonomy, Chemotaxonomy, Numerical taxonomy, Classification systems of Linnaeus, Bentham and Hooker, Hutchinson, Angiosperm Phylogeny Group (APG).
4. Angiosperm families: Taxonomical studies of the following families – Ranunculaceae, Brassicaceae, Malvaceae, Fabaceae, Asteraceae, Cucurbitaceae, Solanaceae, Poaceae, Liliaceae, Rosaceae, Euphorbiaceae, Musaceae, Orchidaceae, Nymphaeaceae, Chloanthaceae, Acoraceae, Piperaceae.

#### Recommended Books

1. Hooker JD. Flora of British India.
2. Angiosperm Phylogeny Group (APG). (1998). An ordinal classification for the families of flowering plants. Ann. Missouri Bot. Gard. 85:531-533.
3. APG II (2003). An update of the angiosperm phylogeny group classification for the orders and families of flowering plants. APG II. Bot. J. Linnean Soc. 141: 399-436.

4. APG III (2009). An update of the angiosperm phylogeny group classification for the orders and families of flowering plants. APG III. Bot. J. Linnean Soc. 161: 105-121.
5. APG IV (2016). An update of the angiosperm phylogeny group classification for the orders and families of flowering plants. APG IV. Bot. J. Linnean Soc. 181: 1-20.
6. Lawrence GHM. Taxonomy of vascular plants, The Macmillan Co. New York, USA.

### **BOT-105: Mycology and Plant Pathology**

1. Virology: Origin of viruses, structure of virus particles – capsid organization, helical and isosahedral symmetry, nucleic acid structure, nomenclature and classification of plant viruses, genome organization, gene expression and replication strategies of different groups of RNA and DNA viruses, reverse transcription, Viroids and prions.
2. Bacteriology: Prokaryotic cell organization, Structure of cell wall, Structure and function of cytoplasmic membrane, Prokaryotic ribosome, Classification of bacteria and characteristics of important groups of bacteria, Mechanism of genetic transfer in bacteria – transformation, transduction and conjugation.
3. Mycology: Fungi as a separate kingdom, Classification of fungi and characteristics of important groups of fungi, Variations in asexual and sexual reproduction, sexuality pattern, Life cycle pattern, Parasexual cycle, Lichens – vegetative and reproductive structures.
4. Principles of Plant Pathology: History of plant pathology, Important historical events that occurred due to plant diseases, Classification of diseases, Environmental effect on plant disease development, Mode of perennation and dispersal of plant pathogens, Principles of plant disease management.

#### Recommended Books

1. Dubey HC. 2012. An Introductory to Fungi, Scientific Publishers (India) New Delhi.
2. Dubey RC and Maheshwari DK. 2013. An Introductory to Mycology, New Age International (P) Limited, New Delhi.
3. Mehrotra RS and Agarwal A. 2017. Plant Pathology. Mc Graw Hill Education, New Delhi.
4. Webster J and Weber RWS. 2007. Introduction to fungi, Cambridge Univ. Press, Cambridge.
5. Hull R. 2002. Mathew's Plant Virology, Academic Press.
6. Ram Reddy S and Reddy SM. 2007. Essentials of Virology, Scientific Pub., India.
7. Moat Ag et al., (eds) 2001. Berger's Manual of Systematic Bacteriology (2<sup>nd</sup> Ed.), Wiley-Liss.

## **BOT-106-P: Practical II (practical of BOT-104 and BOT-105)**

### **Angiosperm Taxonomy**

- I. Detailed taxonomic study of minimum 15 species of plants growing in different types of habitats.
- II. Identification of economically important plants and their products.
- III. Field study and report: field trips are to be arranged in different forest types of Manipur. The detailed field report along with herbaria of collected materials on herbarium sheets are to be submitted.

### **Mycology and Plant Pathology**

- I. Determination of the symptoms of viral and bacterial diseases of important crop plants and vegetables.
- II. Vegetative, reproductive and anatomical features of fungal genera, belonging to different fungal groups (Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina).
- III. Vegetative, reproductive and anatomical features of different forms of lichen.
- IV. Pathological studies of common fungal diseases of crop plants and vegetables found in Manipur.
- V. Gram staining of bacteria.

## **BOT-107: Plant Biochemistry**

1. Enzymes and bioenergetics: Principles of catalysis, Enzymes and enzyme kinetics, Michaelis-Menten equation, Enzyme regulations, Mechanism of enzyme catalysis, Isozyme, Prosthetic groups and coenzymes. Laws of thermodynamic and their significance in free energy changes in biological system, Energy rich phosphate compounds, Electron Transport System and its coupling to ATP synthesis. Stabilizing interactions, Hydrogen bonds, Hydrophobic interaction, Vander Waal's Bond, Electrostatic bond, Reverse turns, Peptide bonds.
2. Conformation of proteins (Ramachandran's plot, Secondary, Tertiary and Quaternary structure), Structure of amino acid, Protein synthesis and processing, Formation of initiation complex, Initiation factors and their regulation, Elongation and elongation factors, Termination codon, Protein folding and sub-unit assembly, Post-translational process.

3. Carbohydrate metabolism, structure and function, Lipid acid biosynthesis and degradation, Nucleotide metabolism, Vitamins structure and occurrence of Ascorbic acid and  $\beta$ -carotene.
4. Signal transduction – an overview, secondary messenger, phospholipids signaling, receptors and G-proteins, role of nucleotides, calcium calmodulin cascade.

#### Recommended Books

1. Lehninger AI, Nelson DL, Cox MM. Principles of Biochemistry. WH Freeman 5<sup>th</sup> edition 2008.
2. Stryer Lupert. Biochemistry WH Freeman, 2002
3. Weil JH. General Biochemistry, New Age International Ltd. 1990.
4. Goodwin TW, Mercer El. Plant Biochemistry, Pergamon Press, Oxford 2<sup>nd</sup> edition 1990.
5. Buchanan BB, Gruissem W, Jones RL. Biochemistry and Molecular Biology of Plants. Wiley Blackwell, Sussex, UK, 2015.

#### **BOT-108: Plant Anatomy, Embryology and Ethnobotany**

1. Introduction to Plant Anatomy: Meristems, Stelar evolution, Organization of cambium, Xylem and Phloem in angiospermic root, stem and leaf, Nodal anatomy, Leaf, Lateral roots and wood development, Fruit and seed dormancy.
2. Ecological anatomy and anomalies: Ecological adaptive features of hydrophytes, epiphytes and xerophytes, Anomalous structures of stem, Anomalous secondary growth.
3. Angiosperm embryology: Microsporogenesis, Megasporogenesis, Embryo-sac types, Pollination, Fertilization, Endosperm development. Experimental embryology: Haploid production, importance of haploids, Embryo culture, Polyembryony, Somatic embryogenesis.
4. Ethnobotany: Introduction,, history, scope of ethnobotany and significance, Definition of terms, Data collection for ethnobotanical study, Classification of ethnobotanically important plants, Collection and identification of economically important medicinal plants, Conservation practices and measures for sustainable utilization of ethnobotanically important plants.

#### Recommended Books

1. Bhojwani SS and Bhatnagar SP. The Embryology of Angiosperms. Fifth edition.
2. Pandey BP. Plant Anatomy. S Chand Limited. 2001.
3. Pandey SN and Chadha A. Plant Anatomy and Embryology. Vikas Publishing House Pvt. Ltd. 2009.

4. Lawrence GHM. Taxonomy of Vascular Plants. The Macmillan Co., New York, USA.
5. Crawford DJ. 2003. Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.

### **BOT-109-P: Practical III (practical of BOT-107 and BOT-108)**

#### **Plant Biochemistry**

- I. Separation of chloroplast pigments by paper chromatography.
- II. Preparation of sticks and Bead Model of a given dipeptide.
- III. Detection of free amino acids with the help of paper chromatography.
- IV. Enzyme assay (invertase and amylase)

#### **Plant Anatomy, Embryology and Ethnobotany**

- I. Preparation of permanent and temporary plant sections to study anomalous structures.
- II. Study of anatomical features of monocot and dicot roots, stems and leaves.
- III. Microscopic studies of different types of pollen and ovules.
- IV. Collection survey, information, identification, categorization and study of ethnobotanically important plants. Field report and record submission – Herbarium, Photographs. Calculation and Fidelity Level from important data.

#### **B-110: Plant Physiology**

1. Functional properties and Transportation of water and solute, Cell wall potential, Diffusion, Osmosis, Kinetic theory, Water loss by transpiration, Stomatal physiology, Mechanism of xylem and phloem transport, Phloem loading and unloading, Passive and active solute transport.
2. Structure and properties of photosynthetically system, Structure of chloroplast, Photosynthetic pigment and light harvesting complexes, Emerson's effect, Assimilation of CO<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> and CAM cycle.
3. Energy Liberation and Utilization: Glycolysis, Citric acid cycle, Fermentation, Pasteur's effect, Electron Transport System and Phosphorylation, Hexose Monophosphate Shunt, Glyoxylate cycle.
4. Nitrogen Fixation an overview, Biological Nitrogen Fixation, Nodule formation and nod factors, Mechanism of nitrate uptake and reduction, Ammonia assimilation. Biosynthesis and mechanism of action of Phytohormones – Auxin, Cytokinin, Gibberellin, Ethylene and ABA.



### Recommended Books

1. Taiz L and Zeiger E. Plant Physiology, Sinauer Associates, Inc Pub, Massachusetts, 2008.
2. Bidwell RGS. Plant Physiology, Macmillan Pub Co., Inc, New York. 1979.
3. Leopold AC and Kriedemann PE. Plant Growth and Development McGraw-Hill, New York.
4. Lehninger AI, Nelson DL, Cox MM. Principles of Biochemistry. WH Freeman 5<sup>th</sup> edition 2008.

### **BOT-111: Cryptogams, Gymnosperms and Palaeobotany**

1. Phycology: Classification of algae, Diagnostic features of algal phyla, Range of thallus organization, Modes of reproduction, Evolution of sexual reproduction in algae, Life cycle patterns, algalization technology, Role of blue green algae (BGA) in soil fertility of rice/paddy field.
2. Bryophyta: Classification and evolutionary trends in bryophytes, Comparative account of gametophytes and sporophytic structures, Bryophytes as pollution indicators, Economic importance.
3. Pteridophyta: Classification, origin and evolution of early vascular plants, Life cycle with reference to haploid and diploid phases, Study of *Lycopodium*, *Selagenella*, *Marsilea*, *Isoetes* and *Pteris*, Evolution of stele, Telome concept, Apogamy and apospory, Heterospory and seed habit, Economic importance.
4. Gymnosperms: Classification, Distribution in India, Embryogeny and evolution of pollination mechanism, Economic importance. Palaeobotany: Geological time scale, Fossilization process and types of fossils, Techniques for studying fossils, Salient features of Pteridospermales.

### Recommended Books

1. Fritsch FE. The structure and reproduction of Algae, Vol. I & II. Cambridge University Press, London.
2. Prescott GW. The Algae-A Review. Bishen Singh, Mahendra Pal Singh, Dehradun and Otto Koaltz Science Publishers Koenig Stein, Germany.
3. Chapman VJ and Chapman DJ. The Algae. Macmillan Press, London.
4. Bhatnagar SP and Moitra AK. Gymnosperms. New Age International (P) Ltd. Publishers, New Delhi.
5. Chamberlain CJ. Gymnosperms, Structure and Evolution. Univ of Chicago Press, Chicago.

6. Steward WN and Rothwell GW. Palaeobotany and Evolution of Plants. Cambridge Univ Press, USA.

7. Sundara Rajan S. Introductory to Pteridophyta, New Age International Pvt. Ltd. New Delhi.

### **BOT-112-P: Practical IV (practical of BOT-110 and BOT-111)**

#### **Plant Physiology**

I. To determine the Osmotic Pressure (O.P.) and Diffusion Pressure Deficit (D.P.D.) of vacuolar sap of *Tradescantia* and *Rhoe* leaves by plasmolytic method (50%) plasmolysis.

II. To determine the rate of transpiration of plant twig by weight, photometer, or Cobalt chloride method.

III. To determine the structure, size and frequency of stomata in mesophytic and erophytic leaves by micrometres.

IV. To compare cuticular transpiration with stomatal transpiration in leaves of mesophytic plant by Backman's Double Belljar Method.

V. To separate green leaf pigments by paper chromatography.

VI. To study the effect of (i) CO<sub>2</sub> concentration, (ii) light quality and (iii) light intensity on the rate of photosynthesis in an aquatic plants by Wilmott's bubbler.

VII. To perform Hill reaction in isolation chloroplast using 2,6-Dichloro phenol indophenols (DCPIP).

VII. To measure the rate of photosynthesis in leaves and aerobic respiration in germinating seedlings by Air Stream Method.

#### **Cryptogams, Gymnosperms and Palaeobotany**

I. Vegetative and reproductive features of one genus from each algal class.

II. Vegetative and reproductive features and anatomical details of genera from Bryophytes.

III. Vegetative and reproductive features and anatomical details of genera from Pteridophytes.

IV. Morphological and anatomical features of the vegetative and reproductive parts of the following Gymnosperms – *Cycas* and *Pinus*.

V. Studies on permanent slides of fossil Pteridophytes and/or Gymnosperms.