Annexure 9.1

**Avinashilingam Institute for Home Science and Higher Education for Women**
(Deemed to be University under Category A by MHRD, Estd. u/s 3 of UGC Act 1956)
Re-accredited with A+ Grade by NAAC. Recognised by UGC Under Section 12 B
Coimbatore - 641 043, Tamil Nadu, India

## Department of Botany

## M. Sc. Botany

### Programme Outcomes

1. Acquire in-depth understanding of fundamental and advanced topics in botany, from lower to higher plants, along with specialized areas of study
2. Develop hands-on skills through laboratory and fieldwork, applying theoretical knowledge to practical situations
3. Utilize scientific principles to design and conduct research experiments in both basic and applied sciences, using statistical tools for valid conclusions
4. Ability to work effectively both independently and in teams with strong communication skills in speaking and writing
5. Manage research projects effectively in multidisciplinary environments and engage in lifelong learning
6. Understand and address the ethical issues in plant research and conservation, and recognize the influence of human activities on plant biodiversity and ecosystems.

### Programme Specific Outcomes

1. Acquire comprehensive knowledge of plant biology, from lower to higher plants, and develop hands-on skills through laboratory and fieldwork to apply theoretical concepts in practical research.
2. Design and conduct research in botany, using scientific methods and statistical tools to analyze data and derive valid conclusions.
3. Understand ethical issues in plant research and conservation, recognize human impacts on ecosystems, and manage multidisciplinary projects in professional development

**Scheme of Instruction and Examination**
**(For students admitted from 2025 – 2026 & onwards))**

| *Part* | *Subject Code* | *Name of paper/component* | *Hours of Instruction/ week* | | *Scheme of Examination* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | *Theory* | *Practical* | *Duration of exam* | *CIA* | *CE* | *Total* | *Credit* |
| **First Semester** | | | | | | | | | |
| I | 25MBOC01 | Plant Biodiversity-I (Phycology, Mycology and Bryophytes) | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC02 | Plant Biodiversity -II (Pteridophytes, Gymnosperms and Palaeobotany) | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC03 | Plant Biodiversity-I & Plant Biodiversity-II - Practical - I | - | 4 | 3 | 40 | 60 | 100 | 2 |
| | 25MBOC04 | Microbiology and Plant Pathology | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC05 | Genetics and Plant Breeding | 3 | - | 3 | 40 | 60 | 100 | 3 |
| | 25MBOC06 | Bioinstrumentation and Biostatistics | 3 | - | 3 | 40 | 60 | 100 | 3 |
| | 25MBOC07 | Microbiology and Plant Pathology, Genetics and Plant Breeding & Bioinstrumentation and Biostatistics - Practical - II | - | 4 | 3 | 40 | 60 | 100 | 2 |
| II | | CSS/ Adult Education / Community Engagement and Social Responsibility | 2 | - | - | - | - | - | - |
| | | Library | 2 | - | - | - | - | - | - |
| **Second Semester** | | | | | | | | | |
| I | 25MBOC08 | Anatomy of Angiosperms | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC09 | Taxonomy of Angiosperms and Economic Botany | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC10 | Anatomy of Angiosperms & Taxonomy of Angiosperms and Economic Botany - Practical -III | | 4 | 3 | 40 | 60 | 100 | 2 |
| | 25MBOC11 | Embryology of Angiosperms | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC12 | Plant Physiology | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC13 | Embryology of Angiosperms & Plant Physiology - Practical -IV | | 4 | 3 | 40 | 60 | 100 | 2 |
| II | | Interdisciplinary Course | 4 | - | 3 | 100 | | 100 | 4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Professional Certification Course | - | - | - | - | - | - | 2 |
| | 25MXCSS1/ 25MXAED1/ 25MXCSR1 | CSS / Adult Education / Community Engagement and Social Responsibility | 2 | - | 2 | - | - | 100 | 2 |
| | **Internship during Summer Vacation (1 month )** | | | | | | | | |
| **Third Semester** | | | | | | | | | |
| I | 25MBOC14 | Biochemistry | 3 | - | 3 | 40 | 60 | 100 | 3 |
| | 25MBOC15 | Plant Biotechnology | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC16 | Biochemistry & Plant Biotechnology - Practical-V | - | 4 | 3 | 40 | 60 | 100 | 2 |
| | 25MBOC17 | Cell and Molecular Biology | 4 | - | 3 | 40 | 60 | 100 | 4 |
| | 25MBOC18 | Ecology, Evolution and Phytogeography | 3 | - | 3 | 40 | 60 | 100 | 3 |
| | 25MBOC19 | Cell and Molecular Biology & Ecology, Evolution and Phytogeography-Practical- VI | - | 4 | 3 | 40 | 60 | 100 | 2 |
| | 25MBOC20 | Mini Project | 1 | - | - | 100 | - | 100 | 2 |
| | 25MBOC21 | Ethnobotany (Self -Study Course) | 2 | - | 3 | 100 | | 100 | 2 |
| | 25MBOC22 | Internship | - | - | - | | - | 100 | 2 |
| II | | Multidisciplinary Course | 2 | - | 3 | 100 | | 100 | 2 |
| | 25MBOSC1 | Sustainability Course Intellectual Property Rights | 3 | - | 3 | 100 | - | 100 | Remarks |
| Fourth Semester | | | | | | | | | |
| I | 25MBOC23 | Research Thesis/project/patent | | 30 | | 100 | 100 | 200 | 20 |
| | | | | | | | **Total Credits** | | **96** |

**Other courses to be undergone by the students**

*** MOOC courses- 2 to 4 Credits – Credit transfer may be claimed.**

**Minimum 96 + 2 Credits to earn the degree**

** Students who exit at the end of 1st year shall be awarded a **Postgraduate Diploma**.

**Other Courses offered by the Department**

- **IDC**- 25MBOI01- Microbial Technology and Herbal Drugs
- **MDC**- 25MBOM01- Value- Added Plant Products of Industrial Importance
- **Professional Certification Course** -25MBOPC1- Medicinal Plant Processing

**Note: Minimum 96 + 2 credits to earn the degree**

# Plant Biodiversity-I

## (Phycology, Mycology and Bryophytes)

**Semester – I**
**25MBOC01**

**Hours of instruction/week: 4**
**No. of Credits: 4**

**Objectives:**

- To identify and classify algae, fungi and bryophytes based on their characteristics.
- To understand the life cycles and reproductive methods of algae, fungi and bryophytes.
- To know the economic and environmental significance of algae, fungi and bryophytes.

**Unit1:Phycology–I**

Classification of algae- Comparative survey of important systems- Fritsch-Smith, Criteria for algal classification, Ultra structure of prokaryotic and eukaryotic algal cells and their components- cell wall, flagella, eye spot, chloroplast, pyrenoid, pigments and reserve foods. Reproduction-Lifecycle patterns and alternation of generations, - Single cell protein,Economic importance of algae **(Self-study).** **12hrs**

**Unit 2: Phycology – II**

General account of thallus structure, cell-ultra structure, reproduction, relationship and evolutionary trends of Cyanophyta- *Microcystis*, *Oscillatoria* :Chlorophyta- *Volvox*, *Coleochaete*, Xanthophyta- *Vaucheria*, Phaeophyta- *Ectocarpus* and Rhodophyta- *Polysiphonia* . Fossil algae **(Self-study).** **12hrs**

**Unit 3: Mycology - I**

Classification by Alexopoulos and Mims (1996), recent trends in classification of fungi. General features, occurrence, distribution, cell-ultra structure, unicellular and multicellular organization, hyphal growth, cell wall composition, nutrition, reproduction, heterothallism, parasexuality **(Self-Study).** **12hrs**

**Unit 4: Mycology- II**

The characteristics and life cycle of the following: Mastigomycotina- *Plasmodiophora*, Zygomycotina- *Rhizopus*, Ascomycotina- *Aspergillus*, Basidiomycotina- *Puccinia* and Deuteromycetes- *Fusarium*. Lichens- classification, thallus organization, reproduction, role in environmental pollution and economic importance of lichens **(Self-Study)** **12hrs**

**Unit 5:Bryophytes**

General characters, classification, Origin and evolution of Bryophytes- gametophytic and sporopytic, reproduction- vegetative and sexual, spore dispersal mechanisms and ecology. Gametophytic and soporophytic organization only of Hepaticopsida: *Marchantia*; Anthocerotopsida: *Anthoceros*; Bryopsida: *Pogonatum*. Fossil Bryophytes. Economic importance of bryophytes **(Self-Study)** **12hrs**

**Total hours 60 hrs**

**Text Books**


1. Bandey B P (2022).College Botany- Volume I S.Chand and Company Ltd, New Delhi.
2. Dube H. C(2024). An Intfoduction to Fungi, 4th Edition, Scientific Publishers
3. Sambamurthy (2019). A Textbook of Algae, Wiley India
4. Vashista, B.R. Sinha, A.K. and V.P. Singh, (2013). Botany- Algae, S. Chand and Company Ltd, New Delhi
5. O.P. Sharma. (2002).Text book of Fungi. Tata McGraw-Hill Publications,New Delhi
6. O.P. Sharma. (2021).Text book of Bryophyta. MedTech Science Press, A Division of Scientific International


**Reference Books**


1. Srivatsa N (2021). Textbook of Algae. University publication and distributors, Pune.
2. Sundara Rajan. (2023).College Botany (8th Edition), Himalaya Publishing House.
3. Smith G M. (2005). Cryptogamic Botany. McGraw Hill Book Company, New York
4. Fritsch F E. (2006). The structure and reproduction of Algae. Wiley and Sons, New York
5. Vashista, B.R., Sinha, A.K., and Adarsh Kumar (2010). Botany for Degree students. Bryophyta. S.Chand Company. Chennai.


**Course Outcomes:**

1. Knowledge on the classification, morphology and life cycles of various algal cells.
2. Assessment of reproduction strategies and evolutionary trends in algae
3. Identification and explain the classification of fungi
4. Knowledge in the description and comparison of the characteristics and life cycle of major fungal groups and lichen
5. Recognition on the characteristics, classification and life cycles of bryophytes

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | M | H | H | H | H | H | L |
| CO 2 | H | H | M | H | H | H | H | L | M |
| CO 3 | H | H | M | H | H | H | M | L | L |
| CO 4 | H | H | M | H | H | H | M | L | L |
| CO 5 | H | H | M | H | H | H | H | H | M |

# Plant Biodiversity-II

## (Pteridophytes, Gymnosperms and Palaeobotany)

**Semester - I** **Hours of instruction/week: 4**

**25MBOC02** **No. of Credits: 4**

**Course Objectives:**

- To gain knowledge about the primitive plants
- To know about the evolutionary trends in plants
- To understand the importance of plant fossils

**Unit 1** **Pteridophytes – I**

Introduction, classification of Pteridophytes (Reimers), origin and evolution, affinities of Pteridophytes with Bryophytes and Gymnosperms. Stelar system and sorus evolution *in Pteridophytes,* alternation of generations. Heterospory and seed habit **(Self-study)** — **12 hrs**

**Unit 2** **Pteridophytes – II**

Morphology, structure and reproduction of *Psilotum*, *Selaginella*, *Equisetum*, *Ophioglossum*, *Adiantum, Osmunda* and *Marsilea* and Economic importance of Pteridophytes **(Self-study).** — **12 hrs**

**Unit 3** **Gymnosperms - I**

Introduction, classification of Gymnosperms (Sporne), Affinities with angiosperms, comparative study of morphology, anatomy, reproduction and phylogeny of Coniferales - *Cupressus*, Gingkoales –*Gingko* and Taxales-*Taxus* **(Self-Study)**. — **12 hrs**

**Unit 4** **Gymnosperms - II**

Comparative study of the morphology, anatomy, reproduction and phylogeny of Podocarpales- *Podocarpus*, Araucariales- *Araucaria* **(Self-study)**, Ephedrales- *Ephedra* and Gnetales- *Gnetum* and Economic importance of Gymnosperms. — **12 hrs**

**Unit 5** **Palaeobotany**

Geological time scale, Process of fossilization and types of fossils-compressions, impressions, molds, incrustations, petrifications and casts, methods of studying fossils and significance of the study of fossils. A brief account of fossil pteridophytes- *Sphenophyllum* and *Lepidocarpon,* Gymnosperms-*Lyginopteris* and *Heterangium.* Fossil fuels and fossil pollen analysis **(Self-study).** — **12 hrs**

**Total Hours** **60 hrs**

**Text Books :**


1. Krishnamurthy, K.V. (2018). An Advanced Textbook on Biodiversity – Principles and Practices. Oxford &IBH Publishing.
2. Annie Ragland. Kumaresan, V. and Arumugam, N. (2021). Algae, Fungi, Bryophytes, Microbiology and Plant Pathology.Saras Publications.
3. A.V.S.S. Sambamurthy (2013). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany. IK International Pvt. Ltd.
4. Charles Joseph Chamberlain (2022). Gymnosperms- Structure and Evolution. Surjeet Publications.
5. Singh, V., Pande, P.C. and Jain, D.K. (2019). A textbook of Botany. Rastogi Publications
6. Ram Krishna Mandal (2012). Biodiversity and Ecology. Discovery Publishing House Pvt. Ltd.
7. Vasishta, P.C., Sinha, A.K. and Anilkumar (2018). Botany for Degree Students Gymnosperms. S. Chand and Company Pvt. Ltd.
8. John M. Coulter. And Charles J. Chamberlain (2019). Morphology of Gymnosperms. Alpha Editions.


**Reference Books:**


1. Meyen S.V. 1987. Fundamentals of Paleobotany,Champman and Hall, New York.
2. John,(2003). Text book of pteridophyta, dominant publishers. New Delhi
3. Johri, R.M., Snehlata and Sandhya Sharma (2010). A textbook of Pteridophyta. Dominant publishers


**Course Outcomes:**

1. Understand diversity and evolution of Pteridophytes
2. Knowledge on structure, reproduction and economical importance of Pteridophytes
3. Understand diversity, structure and reproduction of Gymnosperms
4. Knowledge on the economical importance of Gymnosperms
5. Understand fossils of Pteridophytes and Gymnosperms and their ecological and economic importance

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | H | H | H | H | H | H | H |
| CO 2 | H | H | H | H | H | H | H | H | H |
| CO 3 | H | H | H | H | H | H | H | H | H |
| CO 4 | H | H | H | H | H | H | H | H | H |
| CO 5 | H | H | H | H | M | H | H | H | H |

## Plant Biodiversity-I & Plant Biodiversity-II –Practical -I

**Semester – I** **Hours of instruction/week: 4**
**25MBOC03** **No. of credits: 2**

**Objectives:**

- To identify the diagnostic features of plant groups.
- To analyse and compare morphological structures of plant groups
- To understand and illustrate plant characteristics and fossil morphology

**Unit 1:Plant Biodiversity – I** **10 hrs**

Algae: Study of the diagnostic features and identification of the following genera based on morphological, anatomical and reproductive parts of *Microcystis*, *Oscillatoria*, *Volvox*, *Coleochaete*, *Vaucheria*, *Ectocarpus* and *Polysiphonia.*

**Unit 2: Plant Biodiversity – I** **10 hrs**

Fungi: Detailed study of the vegetative and reproductive structures of *Plasmodiphora*, *Rhizopus*, *Aspergillus*, *Puccinia* and *Fusarium*and Lichens

**Unit 3: Plant Biodiversity – I** **10 hrs**

Bryophytes: Detailed study of the structure of gametophytes and sporophytes of the following genera: Hepaticopsida: *Marchantia*; Anthocerotopsida: *Anthoceros*; Bryopsida: *Pogonatum*

**Unit 4: Plant Biodiversity – II** **15 hrs**

**Pteridophytes-** Detailed study of the vegetative and reproductive structures of *Psilotum, Selaginella, Equisetum, Ophioglossum, Adiantum, Osmunda* and *Marsilea*

**Unit 5: Plant Biodiversity – II** **15 hrs**

**Gymnosperms- S**tudy of morphology, anatomy, reproduction and phylogeny of Coniferales - Cupressus, *Gingkoales –Gingko,* Taxales- *Taxus* and Gnetales- *Gnetum*

**Paleobotany-** A detailed study of the morphology and *Sphenophyllum and Lepidocarpon, Gymnosperms-Lyginopteris and Heterangium*

Total hours **60hrs**

**Text Books**

1.B.P.Pandey (2016), Modern Practical Botany Volume I Sixth edition S. Chand Publications, New Delhi

2. Ashok Bendre and Ashok Kumar (2019), A Text Book of Practical Botany, Volume- I, 10th Edition, Rastogi Publications

**Reference Books**


1. Kalpana Datar (2016) A Text Book of Practical Botany, Lambert Academic Publishing
2. Vasishta, P.C., Sinha, A.K. and Anilkumar (2018). Botany for Degree Students Gymnosperms. S. Chand and Company Pvt. Ltd.


**Course Outcomes:**

1. Identification of algal genera based on diagnostic features
2. Knowledge on the identification of fungal and lichen specimen
3. Understanding on the gametophytes and sporophyte structures of bryophytes
4. Understanding on pteridophyte vegetative and reproductive structures
5. Capability of assessing the morphology and reproductive features of gymnosperms and selected fossil plants.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | H | H | H | H | H | H | H |
| CO 2 | H | H | H | H | H | H | H | H | H |
| CO 3 | H | H | H | H | L | H | H | H | H |
| CO 4 | H | H | L | M | L | M | H | L | M |
| CO 5 | H | H | M | L | L | M | H | L | M |

# Microbiology and Plant Pathology

**Semester – I** **Hours of instruction/week: 4**
**25MBOC04** **No. of Credits: 4**

**Objectives:**

- To understand the nature, structure, industrial and other uses of microorganisms.
- To gain knowledge in the field of usefulness and significance of microbes.
- To know the epidemiology and control measures of plant diseases.

**Unit 1: Microbial media and staining** **12 hrs**

Media-types, preparation. Sterilization- physical (heat and pasteurization, radiation, filtration, chemical sterilizing agents. Stains and dyes. Techniques of pure culture (**Self- study**).

**Unit 2: Bacteria and Virus** **12 hrs**

Bacteria- Bergey's system of classification, morphology and fine structure, respiration, reproduction. Viruses: classification, morphology, shape, size, structure, reproduction (**Self-study**). Human pathogens – *Salmonella typii*, Candida, Corona

***Unit 3:*** **Microbial interaction** **12 hrs**

Mutualism, parasitism. Nitrogen fixation - Asymbiotic and Symbiotic nitrogen fixation. Symbiotic nitrogen fixing systems- root nodulating symbiotic bacteria (process of root nodule formation- curling and deformation of root hairs, formation of infection threads and nodule formation, development of nodule). Metabolism of nitrogen fixation (**Self-study**).

**Unit 4: Bioremediation and Industrial microbiology** **12 hrs**

Sewage treatment and disposal. Methods- primary treatment, secondary treatment, tertiary treatment. Biodegradation of environmental pollutants, pesticide biodegradation, synthetic polymer biodegradation (**Self- study**). Spoilage of food and vegetables. Food preservation. Microbiology of milk and milk products. Fermentation- alcoholic fermentation- ethyl alcohol- Wine, Beer. Industrial production of citric acid. Production of antibiotics- penicillin.

**Unit 5: Plant Pathology** **12 hrs**

Introduction and History of Plant Pathology, Plant diseases - classification, plant diseases (Bacteria, fungi, virus). Epidemiology and control measures of the following plant diseases. Bacterial blight of peas, sheath blight of rice, cucumber mosaic disease. Biotic and abiotic causes. of plant diseases. Host parasite interaction and methods of plant disease management strategies.

**Total hours 60hrs**

**Text books**


1. Vasantha Kumari R. (2016). Text book of Microbiology, Wolters, Kluwer Publication, Hariyana.
2. Baveja C. P. (2017). Text book of Microbiology. Arya Publication, New Delhi.
3. R. Vasanthakumari (2016). Textbook of Microbiology. Wolters Kluwer 3rd Edition
4. R.S. Mehrotra and Ashok Aggarwal (2017). Plant Pathology. 3rd Edition, Mc Graw Hill Education

5. R.S. Singh (2021). Introduction to Principles of Plant Pathology. 4th Edition. CBS Publishers
6. A & P's Text book of Microbiology (2022). Textbook of Microbiology 12th Edition
7. N. Arumugam, L. M. Narayanan and Dulsy Fatima (2022). Immunology and Microbiology, Saras Publication

**Reference Books**

1. Powar, C.B. and Dagianwalla, H.F (2001). General Microbiology. Himalaya Publishing House, New Delhi.
2. Rao (2002). Soil Microbiology, OIBH Publishers.
3. J.Nicklin, K.G.Cook and R.Killington. (2003). Microbiology, Second edition, Viva Books Pvt Ltd, New Delhi.
4. Prabakaran (2004). Introduction to soil and Agricultural Microbiology, Himalaya Publishers.
5. D. P. Tripathi (2022). Plant Pathology at a Glance (Encyclopedia of Plant pathology), 2nd Edition, Scientific Publishers
6. Kumar, Deepak, T. Ritika, D. Shukla, N. Afraq and R. Khan (2024). New Microbiology Technology. GEH Press

**Course Outcomes:**

1. Basic knowledge on classification, morphology and reproduction of bacteria and virus.
2. Knowledge on microbial methodologies and techniques
3. Knowledge on types of microbial interaction
4. Awareness on Sewage treatment and disposal
5. Understanding on plant diseases and its control measures.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | M | H | H | M | M | H | H | H |
| CO 2 | H | H | H | H | H | M | H | H | H |
| CO 3 | H | H | H | H | H | M | H | H | H |
| CO 4 | H | M | H | H | H | H | H | L | L |
| CO 5 | H | H | H | H | H | M | H | L | H |

# Genetics and Plant Breeding

**Semester - I**
**25MBOC05**
**Objectives:**

**Hours of instruction/week: 3**
**No. of Credits: 3**

- To understand the basic principles of heredity
- To acquire knowledge about numerical variations in chromosomes
- To learn about the principles of breeding.

**Unit 1: Physical Basis of Heredity**

Introduction, Mendelian principles - segregation, Independent assortment, Dominance, Non-Mendelian Inheritance –Co-dominance, incomplete dominance. Exceptions of Mendelian principles - gene interactions – Epistasis, pleiotropy and polygenic traits. Branches of Genetics (outline only) **(Self-study).** **8 hrs**

**Unit 2: Multiple Alleles, Sex Determination and Cytoplasmic inheritance**

Characters of multiple alleles – Self-sterility in Nicotiana – *Pseudo alleles* **(Self-study)** Pseudoallelism in plants – Sex determination in plants, theories of sex determination Cytoplasmic inheritance – Characteristics and detection of Cytoplasmic inheritance – Plastogenes and plastid inheritance in plants – Inheritance of mitochondria – Emphrussi's experiment. **8 hrs**

**Unit 3: Linkage and Crossing Over**

Introduction – Difference in linkage and Independent assortment – Coupling and repulsion – Views of classical geneticists of linkage (Sutton, Bateson and Punnett, Morgan) – Chromosome theory of linkage – Kinds of linkage**(Self-study)** – Chromosome mapping –Bacterial chromosome mapping – Introduction of crossing over – Mechanism – Theories – Somatic Co factors – Significance. **10 hrs**

**Unit 4: Polyploidy and Chromosomal Aberrations**

Numerical variations in chromosomes – Aneuploidy – Types – Euploidy – Types – Origin of polyploidy – Induction of polyploidy – Kinds of polyploidy (auto and allo) – Effects of polyploidy – Significance – Role of mutation - Types of chromosomal aberrations – Deletion – Deficiency – Duplication – Translation – Significance of each type – Shifts –Isochromosomes**(Self-study)**. **10 hrs**

**Unit 5: Plant Breeding**

Introduction – Historical account – Natural and Artificial Selection – Hybridization – Objectives – Techniques – Methods – Hybrid vigour – Mutation Breeding – Breeding for Disease Resistance – *Significance of Plant Breeding* **(Self-study)**. Gene pool and gene frequency – Hardy and Weinberg law – Characteristics of quantitative inheritance – Kernel colour in wheat – Ear length of Maize. **9 hrs**

**Total Hours** **45 hrs**

**Text Books**


1. Nina Duran. (2022). Plant Genetics and Breeding. Larsen and Keller Education.
2. Sanjeev Kumar Yadav, Jaya Rathore, Yadav, P.K. and Ashish Singh. (2021). Elements of Fundamental Genetics. Akinik Publications.
3. Krishna Kumar Singh. (2021). Genetics and Plant Breeding. Namya Press.
4. Hari Har Ram (2019). Plant Breeding and Genetics. New India Publishing Agency, New Delhi.
5. Ahluwalia K.B 2009 (First Edition). Genetics. New Age International Private Ltd. Publishers, NewDelhi.
6. Gupta. P.K (2013). Genetics and Cytogenetics. 7th Edition. Rastogi Publications. Meerut, UP.
7. Mahabal Ram (2014). Plant Breeding Methods. PHI Learning PVT. Ltd., New Delhi


**Reference Books**


1. Sultan Singh and Pawar, I.S (2007). Genetic Basis and Methods of Plant Breeding Paperback, CBS in New York.
2. Jack Brown and Peter Caligari (2008).Plant Breeding. John Wiley & Sons, United States
3. George Acquaah, (2012).Principles Plant Genetics and Breeding. Wiley-Blackwell; 2nd Revised edition London.
4. Vankata R. Prakash Reddy (2016). Key Notes on Genetics and Plant Breeding, Daya Publishing House, New Delhi.
5. Rolf H. J. Schlegel (2017).History of Plant Breeding. CRC Press, Taylor & Francis Group, United states.
6. Robert W Allard Principles of Plant Breeding.John Wiley & Sons Inc.1999


**Course Outcomes**

1. Knowledge on the principles of Mendelian genetics
2. Knowledge on non-Mendelian inheritance patterns in plants
3. Understanding the chromosome theory of linkage and crossing over
4. Knowledge on ploidy and chromosomal aberrations
5. Knowledge on the historical evolution of plant breeding and the importance of hybridization and mutation breeding

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | H | H | H | M | H | H | H |
| CO 2 | H | H | H | H | H | M | H | H | H |
| CO 3 | H | H | H | H | H | M | H | H | H |
| CO 4 | H | H | H | H | H | M | H | H | H |
| CO 5 | H | H | H | H | H | M | H | H | H |

# Bioinstrumentation and Biostatistics

**Semester I**
**25MBOC06**

**Hours of instruction/week: 3**
**No. of Credits: 3**

**Objectives:**

- To develop a strong understanding of instrumentation systems and their applications.
- To acquire knowledge of data interpretation using statistical methods.
- To comprehend mathematical concepts, numerical analysis, and statistical techniques.

**Unit 1: Microscopy**

Principles and Applications : Microscopy (light, phase contrast, confocal, electron microscopy – TEM and SEM) Distillation of water, Soxhlet extractor, supercritical fluid solvent extractor (SFSE), Lyophilization and Rotary evaporator (**Self study**). **9 hrs**

**Unit 2: Separation of compounds**

Chromatography –Paper chromatography, TLC (Thin Layer Chromatography), HPLC (High Performance Liquid Chromatography), HPTLC (High-Performace Thin-Layer Chromatography) and GLC (Gas liquid chromatography). Electrophoretic techniques (Northern, Western and Southern blots), SDS PAGE. Immunoassays – ELISA (Enzyme-Linked Immunosorbent Assay) (**self study**). **9 hrs**

**Unit 3: Spectroscopy and Centrifugation**

Optical properties – Colorimeter, Spectrophotometer (Beer-Lamberts Law, UV, FT-IR, NMR,X-Ray); Centrifugation – principles and different types (**self study**). **9 hrs**

**Unit 4: Biostatistics.**

Bio statistics – definition – Scope and limitations. Sampling methods -basic principles – variables – Collection of data - Primary and secondary data – Classification of data and types, Tabulation (one-way, two-way and Manifold). Frequency distribution – Discrete, Continuous. Graphical representation – Types of Diagrams (One, two, three dimensional diagrams and *pictograms* (**Self-study**). **9 hrs**

**Unit 5: Descriptive statistics**

Measures of central tendency – Mean, Median and mode. Measures of dispersion – Standard deviation and standard error. Hypothesis testing – test of significance – test in large and small sample – t-test, F-test and Chi square test - Correlation and *Regression analysis* (**Self-study**). **9 hrs**

**Total Hours 45 hrs**

**Text Books**


1. Shilpy Shakya. (2022). Molecular Biology, Bioinstrumentation & Biotechniques. Book Rivers.
2. Frank Lowber James. (2022). Elementary Microscopical Technology – A manual for students of Microscopy. Legare Street Press.
3. Veerakumari, L. (2019). Bioinstrumentation, MJP Publishers, New Delhi.
4. N.K.R.Dutta. (2002). Fundamentals of Biostatistics - Practical approach,Kanishka publishers, New Delhi.
5. S.P.Gupta, (2003). Statistical Methods, Sultan Chand and Sons, New Delhi.
6. John G Webster (2009). Bioinstrumentation, Wiley Publication.


**Reference Books**


1. J. H. Zar,, (1999) Biostatistical analysis, 4th Edition, Pearson Education Inc, New York.
2. Glover and Mitchell, (2008),An introduction to Biostatistics,. McGraw Hill publications
3. Biostatistics (1983). A foundation for analysis in health Science, Wiley and Sons, New York.
4. Reilly, M.J. (2016), Bioinstrumentation, CBS Publishers & Distributors, Pune.


**Course Outcomes:**

1. Practical knowledge in the principles and techniques of microscopy, distillation, Soxhlet extraction, SFSE, lyophilization, and rotary evaporation.
2. Understanding chromatographic and electrophoretic techniques in plant research.
3. Understanding of spectroscopy and centrifugation methods.
4. Improving research quality through effective sampling methods, data collection, frequency distribution, and graphical representation.
5. Proficiency in statistical techniques, including measures of central tendency, standard deviation, standard error, and hypothesis testing.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | M | L | M | L | H | M | L |
| CO 2 | H | M | H | M | L | L | H | H | M |
| CO 3 | H | H | M | L | H | M | M | H | H |
| CO 4 | M | H | H | H | H | M | H | H | H |
| CO 5 | L | M | H | H | H | H | M | H | H |

## Microbiology and Plant Pathology, Genetics and Plant Breeding & Bioinstrumentation and Biostatistics -Practical – II

**Semester - I**
**25MBOC07**

**Hrs of instruction/week: 4**
**No. of Credits: 2**

**Course Objectives:**

- To develop practical skills in microbiological techniques, plant disease identification, and pathogen control.
- To understand genetic principles, hybridization techniques, and pollen viability testing for plant breeding applications.
- To gain hands-on experience in bioinstrumentation techniques and statistical data analysis for biological research.

**Unit1: Microbiology**

Preparation of Media, Isolation of microorganism from soil, water and infected tissue. Preparation of Agar slants and Agar deep. Staining methods- Simple staining and Gram staining. **10 hrs**

**Unit 2: Plant Pathology**

Identification of plant diseases, Causes, symptoms and control measures of Bacterial blight of peas, sheath blight of rice, cucumber mosaic disease. **10 hrs**

**Unit 3: Genetics**

Dihybrid cross, Interaction of factors-dominance, co-dominance, Incompletedominance, complementary, supplementary and epistasis **10 hrs**

**Unit 4: Plant Breeding**

Hybridization techniques -Emasculation – different types- Solitary flower, 'V' cut method, Slit method, Round cut method and Bagging. Incompatibility – Pollen viability test- Brewbaker's medium preparation and Staining test in acetocarmine **15 hrs**

**Unit 5: Bioinstrumentation& Biostatics**

Demonstration on working Principles and Techniques of pH, Centrifugation, Distillation, Chromatography Demonstration on working Principles and Techniques of PCR, Calorimetry and Spectrophotometry. **15hrs**

Solving bio statistical problems: Standard deviation and standard error; ANOVA, Chi-square test; F- test; t-test, Correlation and Regression.

**Total Hours 60 hrs**

**Text Books:**


1. Emanuel Goldman, Lorrence H. Green. 2023. Practical Handbook ofMicrobiology. (n.d.). United Kingdom: CRC Press, Taylor & Francis Group.
2. Apurba. S. Sastry. 2021. Essentials of Practical Microbiology. Jaypee Brothers Medical Publishers
3. Sanjeev Kumar. 2022. Fundamentals Of Plant Pathology. (2022). United States: New India Publishing Agency.
4. Vijay Yadav. 2015. A colour Handbook on Practical Plant Pathology. New India Publishing Agency.
5. Bineeta Singh and G.M. Lal, 2021. Practical Manual of Genetics and Plant Breeding. Satish Serial Publishing House
6. S.K. Gupta.2019. Practical Plant Breeding. M/S Agrobios (India)
7. Veerakumari, L. (2019). Bioinstrumentation, MJP Publishers, New Delhi.
8. Agarwal, A., Yadav, R., Mathur, N., Karumanchi, S.K. and P. Chandra. 2024. Text book of Biostatistics and Research Methodology. Shashwat Publication.


**Reference Books:**


1. Jha, D.K. 2014. Laboratory Manual on Plant Pathology. Pointer Publishers.
2. Tomar Amit. 2020. Practical Manual on Fundamentals of Plant Breeding. Scholars' Press.
3. Reilly, M.J. (2016), Bioinstrumentation, CBS Publishers & Distributors, Pune.


**Course Outcomes:**

1. Perform microbial isolation, media preparation, and staining techniques for effective microorganism identification.
2. Identify plant diseases, understand their causes and symptoms, and apply appropriate control measures.
3. Demonstrate proficiency in bioinstrumentation techniques and apply biostatistical tools for data analysis.
4. Analyze genetic interactions through dihybrid crosses, dominance, co-dominance, and epistasis.
5. Apply plant breeding techniques, including emasculation methods, pollen viability testing, and incompatibility assessment.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | M | L | M | L | H | M | L |
| CO 2 | H | M | H | M | L | M | H | H | M |
| CO 3 | H | H | M | L | H | M | M | H | H |
| CO 4 | M | H | H | H | H | M | H | H | H |
| CO 5 | L | M | H | H | H | H | M | H | H |

# Anatomy of Angiosperms

**Semester –II** **Hours of instruction/week: 4**
**25MBOC08** **No. of Credits: 4**

**Objectives:**

- To understand the tissues present in the cell
- To know about the anatomical structures of angiospermic plants
- To know about various ecological adaptations

**Unit 1: Introduction to Plant Anatomy**

Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy. Cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Cell wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances (**Self-study**). **12hrs**

**Unit 2: Meristems and Tissues**

Meristematic Tissue- Characteristics, Classification and General account and theories of organization of apical meristems of shoot apex and root apex. Permanent tissues - simple - parenchyma collenchymas, sclerenchyma (**Self-study**). Complex- xylem and phloem and Secretory tissues – External secretory tissue – glandular trichomes, nectaries and hydathodes. Internal secretory tissue – Secretory cells, cavities and laticifers **12hrs**

**Unit 3: Tissue system**

Epidermal tissue system – Epidermis, Stomata and Trichomes. Ground tissue system – Cortex, Endodermis, Pericycle and Pith, Vascular Tissue System- constituents of vascular bundle and its types and Nodal Anatomy. Wood anatomy – Heart wood, sap wood, annual rings, tyloses, dendrochronology, fundamental or, vascular tissue system (**Self-study**).Nodal anatomy of dicots and monocots **12hrs**

**Unit 4: Primary structure of plants**

Primary Structure of Dicot and Monocot-Root, Stem, Leaf (**Self-study**). Primary Vascular Tissue- procambium, Cambium – Origin, interfascicular and interfascicular cambium, Development, structure and role of cambium in wound healing, budding and grafting. **12hrs**

**Unit 5: Secondary growth and ecological adaptations**

Secondary growth in dicot and monocot stem- Development of vascular tissue system, types of wood, and cork development (phellogen, phelloderm and periblem) Anomalous secondary growth in dicot stem – *Bignonia*, *Mirablis* and *Bougainvillaea* and monocot stem – *Dracaena* Ecological Adaptations – Hydrophytes (**Self-study**), Xerophytes and Halophytes. **12hrs**

**Total Hours** **60hrs**

**Text Books**:

1. Aisha S. Khan (2017). Flowering plants: Structure and Industrial products Wiley Publisher (ebook)
2. Dr. P.C. Sharma (2018) Anatomy of Angiosperms. Arjun Publishing House, New Delhi.
3. Dr. P.P. Sharma and Dr. V. Dinesh (2020). Angiosperms, Histology, Anatomy and Embryology. Educational Publishers & Distributors, Aurangabad.
4. A.K. Singh and Shalini Singh (2020) Text Book of Angiosperm – Systematics Structure and Reproduction (Taxonomy, Anatomy, Embryology) Volume 1. Kalyani Publisher, India

**Reference Books :**

1. Pijush Roy (2012) Plant Anatomy New Central Book Agency (P) Ltd., Kolkata, West Bengal
2. Neeraj Tandan (2014) Introduction To Plant Anatomy, Anmol Publications Pvt Ltd, New Delhi
3. P C Sharma (2017) Text book of Plant Anatomy, Arjun Publishing House, New Delhi
4. S. N. Pandey and A. Chadha (2023) Plant Anatomy and Embryology.Vikas publishing House, New Delhi

**Course Outcomes:**

1. Knowledge on fundamental concepts of plant anatomy
2. Understanding the structure and importance of meristems in tissue organization of plant
3. Understanding the various tissue systems and wood anatomy
4. Knowledge on Primary anatomical structure and practical skills in anatomical sectioning
5. Understanding the secondary structure in plants and evaluate the ecological adaptations in plants

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | M | H | H | H | L | H | M | M |
| CO 2 | H | M | H | H | H | M | M | M | M |
| CO 3 | M | L | L | L | L | L | H | M | M |
| CO 4 | H | M | L | L | L | L | H | H | L |
| CO 5 | H | L | L | M | M | L | H | H | L |

# Taxonomy of Angiosperms and Economic Botany

**Semester – II** **Hours of instruction/week: 4**
**25MBOC09** **No. of Credits: 4**

**Course Objectives:**

- To understand the fundamental principles of plant taxonomy.
- To develop skills in plant identification and herbarium techniques.
- To gain knowledge on diagnostic characteristics and the economic importance of plant families.

**Unit-1: Introduction and Classification**

Introduction, objectives, basic components and importance, taxonomical hierarchy **(Self-study)**. History of classification, systems of classification - Linnaeus, Bentham and Hooker, Engler and Prantl, and Cronquist, Outline of Angiosperm Phylogeny Group (APG-III) plant classification. **12hrs**

**Unit-2: Nomenclature and Modern Trends**

Plant nomenclature – Principles, rules (Typification,effective and valid publication, rule of priority, Author citation), recommendation. Herbarium techniques and identification methods (taxonomic literature, taxonomic keys and computers in identification), Flora and Monograph, Botanical gardens. Modern trends in taxonomy: chemotaxonomy and numerical taxonomy and molecular taxonomy **(Self-study)** . **10hrs**

**Unit-3: Dicotyledonae**

A detailed study of following families with their economic importance. Dicot :Magnoliaceae, Capparidaceae , Leguminosae (Caesalpiniaceae, Mimosaceae, Papilionaceae), Rhamnaceae, Combretaceae, Lythraceae, Apocynaceae, Apiaceae, Meliaceae, Sapindaceae, Oxalidaceae, Passifloraceae, Bignoniaceae, Lamiaceae **(Self -study)**. Asteraceae, Rubiaceae, Asclepiadaceae **14hrs**

**Unit-4: Monoclamydae and Monocotyledonae**

Comparative and detailed study of following families with their economic importance. Monoclamydeae: Amaranthaceae, Euphorbiaceae. Monocot: Amaryllidaceae, Commelinaceae, Cannaceae, Musaceae, Cyperaceae, Gramineae **(Self -study)** **12hrs**

**Unit-5: Economic Botany**

Economic importance of plants: Food crops (Paddy, Wheat and Sorghum), Pulses (Black gram, Green gram and Soyabeans) Spices and condiments- Pepper,cardomum, clove, Beverage plants (Coffee, Tea and Cocoa)Timber (Teak and Rosewood) Fiber yielding plants (Jute and Cotton), Oil seed crops (Sunflower, Groundnut and Coconut); Medicinal plants *(Andrographis, Ocimum,. Gymnema, Catharanthus and Adhathoda)* **(Self -study).** **12hrs**

**Total Hours** **60hrs**

**Text Books :**


1. O.P. Sharma (2009). Plant taxonomy (2nd Edition). McGraw-Hill Education (India) Pvt Limited,New Delhi.
2. Singh, G. (2019). Plant Systematics: An Integrated Approach, Fourth Edition. United Kingdom: CRC Press.
3. Saxena N.B and Shamindra Saxena (2014).Plant Taxonomy, Pragati Prakashan Publishers, Meerut.
4. P. C. Sharma (2017). Text book of Plant Taxonomy. Bio Green Book Publishers, New Delhi.
5. Sambamurthy, A.V.S.S. (2019). Taxonomy of Angiosperm. Dreamtech Press
6. Gurcharan Singh (2020), Plant systematics theory and practice 4$^{th}$edition, CBS Publishers Distributors; Bangalore, Karnataka.
7. Pandey, A. K., Kasana, S. (2021). Plant Systematics. United States: Narendra Publishing House.
8. Kochhar (2009). Economic Botany In the Tropics. Macmillan Publishers India Limited.


**Reference Books:**


1. .Hutchinson, J. 1973. The Families of Flowering Plants. 3 rd ed. Oxford University Press, UK.
2. Lawrence, G.H.M. 1951. Taxonomy of Vascular Plants. Macmillan publishers, New York.
3. Rendle, A.B. 1904. Classification of Flowering plants. 2 nd ed. Vol.1. Cambridge University Press, England.
4. Stace, C.A. 1989. Plant Taxonomy and Biosystematics. 2 nd ed. Edward Arnold. London


**Course Outcomes:**

1. Knowledge on different classification systems and phylogenetic relationships within the plant kingdom
2. Understanding key methods to handle and analyse plant materials in the laboratory and the field.
3. Understanding the different taxonomical characteristics of plant families, genera, and species
4. Knowledge of the taxonomic diversity of important families and useful plants
5. Awareness on the medicinal and economic importance of plants in modern society

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | L | L | L | L | M | H | L | L |
| CO 2 | H | M | M | M | H | H | H | M | H |
| CO 3 | H | H | H | M | M | H | H | H | H |
| CO 4 | H | H | H | H | H | H | H | M | H |
| CO 5 | H | M | H | H | H | M | H | H | M |

# Anatomy of Angiosperms & Taxonomy of Angiosperms and Economic Botany-Practical -III

**Semester –II**
**25MBOC10**

**Hours of instruction/week: 4**
**No. of Credits: 2**

**Course Objectives:**

- To understand plant structures and adaptations.
- To develop taxonomic and morphological identification skills
- To apply practical techniques for identifying plant species and enhancing taxonomic research skills

**Unit 1: Tissues and Primary Structure** **10 hrs**

Cell structure apical meristem and tissues; Sectioning of dicot & monocot root – *Tridax*, *Canna*; stem- *Tridax*, *Canna*; leaf-*Nerium*, grass.

**Unit 2:Secondary structure and Ecological adaptations** **10 hrs**

Secondary growth in dicot – *Cucurbita* Anomalous Secondary growth in dicot- *Bignonia, Bougainvillea, Mirabilis* and monocot stem – *Dracaena* Ecological adaptations - Hydrophytes, Mesophytes and Xerophytes

**Unit 3:Taxonomy of Angiosperms** **15 hrs**

Study of the morphological and floral characteristics of following dicot families : Magnoliaceae, Capparidaceae, Leguminosae -Caesalpineaceae, Mimosaceae, Papilionaceae, Rhamnaceae, Combretaceae, Lythraceae and ApocynaceaeApiaceae, Meliaceae, Sapindaceae, Oxalidaceae, Passifloraceae, Bignoniaceae, Lamiaceae Asteraceae, Rubiaceae, and Asclepideaceae

**Unit 4:Taxonomy of Angiosperms and Economic Botany** **15 hrs**

Study the morphological and floral characteristics of Monoclamydae and Monocot families: Amaranthaceae, Euphorbiaceae. Amaryllidaceae,Commelinaceae, Cannaceae, Musaceae, Cyperaceaeand Gramineae. Economic importance of the plants studied in the syllabus

**Unit 5: Key Preparation and Herbarium** **10 hrs**

Identification of local plants up to species level with the help of modern flora keys using Gambles flora. Submission of not less than 50 herbarium sheets and field report

**Total Hours** **60 hrs**

**Text Books :**


1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
2. Sinha, R. K. (2013). Practical Taxonomy of Angiosperms. India: I.K. International Publishing House Pvt. Limited.
3. Bebbington, A. (2014). Understanding the Flowering Plants: A Practical Guide for Botanical Illustrators. United Kingdom: Crowood Press.
4. BP Pandey (2019) – Modern Practical Botany VOl. II., S. Chand Publicating House , New delhi
5. Kalidoss Rajendran (2023), Anatomy of Angiosperms, Academic Guru Publishing House,
6. Pandey, B.P.(1999) Economic Botany, S.Chand & Company, New Delhi.


**Reference book**


1. Jonathan Fowler · 2014- Practical Botany, Kendall Hunt Publishing Company
2. Peterson, R. L., Peterson, C. A., Melville, L. H. (2008). Teaching Plant Anatomy Through Creative Laboratory Exercises. Canada: NRC Press.


**Course Outcomes:**

1. Knowledge about the origin, development, and dissection of anatomical structures.
2. Capable to classify plants based on taxonomic principles.
3. Understandng diagnostic characteristics of plant families, genera, and species.
4. Learning fundamental methods and gain a foundational understanding of taxonomic diversity.
5. Awareness on the economic significance of plants in contemporary society.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | L | M | L | L | H | H | L |
| CO 2 | H | H | H | L | M | M | H | H | M |
| CO 3 | H | H | H | M | L | L | H | H | M |
| CO 4 | H | H | H | H | M | L | H | H | M |
| CO 5 | H | L | M | H | M | H | H | M | H |

# Embryology of Angiosperms

**Semester –II**
**25MBOC11**

**Hours of instruction/week: 4**
**No. of Credits: 4**

**Objectives:**

- To understand the development of gametophytic phase of angiosperms
- To understand the development of reproductive phase.
- To gain knowledge on types of embryo and endosperm.

**Unit 1: Microsporangium and Male gametophyte**

Development of anther wall, endothecium, middle layers, tapetum, nuclear behaviour in tapetal cells, microsporogenesis. Formation of vegetative and generative cells, pollen wall development **(Self-study).** **12hrs**

**Unit 2: Megasporangium and Female gametophyte**

Ovule – structure, types, special structures, endothelium, obturator, hypostase, and epistates, nucellus, megasporogenesis (monosporic, bisporic, tetrasporic). Organization of female gametophyte. (egg, synergids, antipodals and central cell) **(Self-Study)** **12hrs**

**Unit 3: Fertilisation**

Germination of Pollen tube- course of Pollen tube- rate of growth of pollen tube entry of pollen tube into embryo sac- Double fertilization- gametic fusion- persistence and possible haustorial function of pollen tube- X-bodies **(Self-study).** **12hrs**

**Unit 4: Embryo**

Development of dicot embryos (Crucifer, Asterad, Solanad, Caryophyllad and Chenopodiad types) and monocot embryo (Najaslacerata). **12hrs**

**Unit 5: Endosperm**

Endosperm – Structure and development of Nuclear, Cellular, Helobial and Ruminate endosperm **(Self-study).** Haustorial structures of Nuclear and Helobial endosperms **12hrs**

**Total Hours** **60hrs**

**Text Books**


1. S.N Pandey. (1996) Plant Anatomy and Embryology, Vikas publishing House, New Delhi
2. B.P. Pandey, (2004). Text book of Botany: Taxonomy, Anatomy, Embryology and Economic Botany. S.Chand , New Delhi.
3. S.S Bhojwani, S.P. Bhatnagar and P. K. Dantu (2015). The Embryology and Angiosperms. 6th Edition Vikas Publishing House Pvt. Ltd, New Delhi.

**Reference Books**


1. Batygina, T. B. (2005) Embryology of Flowering Plants: Terminology and Concepts. Vol. 2: The Seed (Vol. 2). CRC Press, US
2. Bhojwani S. S. and Woong- young S. (2001). Current Trends in the Embryology of Angiosperms, Springer Publications, New Delhi.
3. Shivana K. R. and Rejesh, T. (2014). Reproductive Ecology of Flowering Plants ; A. manual Springer Publications , New Delhi.
4. Bhatnagar, S.P., Danter, P.K. and Bhojwani, S. S.(2016). The Embryology of Angiosperms.Vikas Publication house, New Delhi.


**Course Outcomes:**

1. Knowledge on the reproductive phases of plant system.
2. Knowledge on origin and development of embryological structures.
3. Understanding the fertilization process
4. Knowledge on the process of embryo development
5. Understanding the development and role of endosperms.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | M | L | M | L | M | H | H | H |
| CO 2 | H | M | L | M | L | M | H | H | H |
| CO 3 | H | M | L | L | M | M | H | H | H |
| CO 4 | H | M | L | M | L | M | H | H | H |
| CO 5 | H | L | M | M | L | M | H | H | H |

# Plant Physiology

**Semester – II** **Hours of instruction/week: 4**

**25MBOC12** **No. of Credits: 4**

**Objectives:**

- To understand the plant physiological processes.
- To know the role of plant hormones and environmental factors in plant growth and development
- To gain knowledge on plant responses to stress and mechanism of resistance

**Unit 1: Transpiration and Translocation of Organic Solutes**

Introduction, kinds of transpiration–cuticular, lenticular and stomata, Mechanism of transpiration, Mechanism of stomatal movement (starch-sugar hypothesis and proton concept), Significance and Antitranspirants. Path of translocation, mechanism of translocation through phloem **(Self-study)**- Munch's Hypothesis, Protoplasmic streaming theory, Interfacial flow hypothesis, Activated diffusion hypothesis, Electron-Osmotic theory. **15hrs**

**Unit 2: Photosynthesis and Respiration**

Photosynthesis- Structure of Chroloplast, Mechanism of photosynthesis- Light reaction and dark reaction ($C_3$cycle), $C_4$ dicarboxylic acid pathway *(Hatch-Slack pathway)* **(Self-study)** and CAM pathway. Respiration- Mechanism- Fermentation, Glycolysis, Kreb's cycle, Electron transport system and Oxidative phosphorylation, Pentose phosphate pathway and *photorespiration (glycolate cycle)* **(Self-study)**. **15hrs**

**Unit 3: Growth Hormones and Flowering Physiology**

Growth regulators- Chemical nature and Physiological effects of auxin (IAA, IBA, NAA), cytokininin, gibberllin (GA3), Abscisic acid and ethylene **(Self-study)**. Physiology of flowering (Photoperiodism and Vernalization **10 hrs**

**Unit 4: Seed Dormancy and Germination**

Seed dormancy- types, factors causing seed dormancy, methods of breaking seed dormancy, Advantages of seed dormancy. Germination- Requirements of seed germination, factors for seed germination and seed viability **(Self -study)**. Seed treatments –Benefits and Methods- Mechanical, Physical, Chemical and Special seed treatments (coating, pelleting, drilling, encapsulation, biological) **10hrs**

**Unit 5: Stress Physiology**

Physiological responses of plants to biotic (insects and pathogens) and abiotic stresses (water, temperature, salt and heavy metals). Mechanism of resistance to biotic and abiotic stress **10hrs**

**Total Hours 60 hrs**

**Text Books:**


1. S.K.Verma and Mohit Verma (2021). A Textbook of Plant Physiology, New Edition, Biochemistry , and Biotechnology S.Chand and Company LTD., Ram nagar, New Delhi.
2. Pandey B P. (2022). College Botany Volume III, Daya S.Chand and Company LTD., Ram nagar, New Delhi
3. S. L. Kochhar (2016). Plant Physiology, Cambridge University Press India Private Limited, New Delhi
4. Pandey, N. S. and Pandey, P. (2016). Textbook of Plant Physiology. Daya Publishing House,New Delhi.
5. Bandana Bose, Jyoti Chauhan, Rajesh Kumar Singhal (2018). A quick approach to Plant Physiology, Biochemistry and Biotechnology. Jain Brothers Publishers
6. V. K. Jain (2022). Fundamentals of Plant Physiology.18th edition , S.Chand and Company LTD., Ram nagar, New Delhi


**Reference Books**


1. S.L. Kochhar and Gujral, S. K (2021) Plant Physiology: Theory and Applications, 2nd Edition, Cambridge University Press
2. Gonita A. S (2016). A Textbook of Plant Physiology, Sathish Serial Publishing House
3. P.S.Gill. (2010). Plant physiology, S.Chand and Company LTD., Ram nagar, New Delhi.
4. Sinha, R.K.(2015) Modern Plant Physiology. New Delhi: Narosa.
5. Taiz,L and E.Zeiger (2018). Plant Physiology and Development. New Delhi: Panima.


**Course Outcomes:**

1. Knowledge on the mechanisms of transpiration and translocation.
2. Knowledge on the mechanisms of Photosynthesis and Respiration.
3. Understanding the role of plant growth regulators and environmental factors in regulating flowering and plant development
4. Understanding the principles of seed physiology and its technical aspects.
5. Knowledge on the physiological responses of plants to biotic and abiotic stresses.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | M | H | H | H | H | H | H | H | H |
| CO 2 | H | M | H | L | H | H | H | H | M | H |
| CO 3 | H | M | H | L | H | H | H | H | M | H |
| CO 4 | H | M | H | H | H | H | H | H | M | H |
| CO 5 | H | M | H | H | H | H | H | H | M | H |

# Embryology of Angiosperms & Plant Physiology - Practical - IV

**Semester II** **Hours of instruction/week: 4**

**25MBOC13** **No. of Credits: 2**

**Objectives:**

- To understand the development and structure of anthers and ovules, and process of embryogenesis.
- To measure and analyse various physiological processes in plants
- To develop hands-on- skills in plant embryology and physiology experiments

**Unit1: Embryology** **10 hrs**

T.S. of anther (young and mature) at various stages of Development, L.S. of ovule, Types of ovules – orthotropous and Anatropous

**Unit 2: Embryology** **10 hrs**

Embryogenesis, Embryo Dissection - Dissection of embryo / endosperm from developing seeds

**Unit 3:Plant Physiology** **15 hrs**

Determination of osmotic pressure (OP) of cell sap of given specimen (Rheo leaf), Determination of diffusion pressure deficit (DPD) with potato tubers, Potato Osmoscope

**Unit 4:Plant Physiology** **15hrs**

Measurement of Stomatal Index, Determination of absorption and transpiration ratio in plants, Effect of light intensity on transpiration using Farmers photometer, Determination of photosynthetic rate in water plants under different CO2 concentrations, Measurement of oxygen evolution using Wilmott's bubbler.

**Unit 5: Plant Physiology** **10 hrs**

Measurement of respiration rate using germinating seeds and flower buds with simple respiroscope, Determination of respiratory quotient using Ganong's respirometer,Aerobic and anaerobic respiration, Kuhne's fermentation tube. Determination of peroxidase and catalase activity

**Total hours** **60 hrs**

**Text Books:**

1. Anupama Verma, Ravindra Sachan (2025), Practical manual on Plant Physiology, S.K. Kataria & Sons.
2. Asok kumar Bera, Bandana Bose and Rajesh Kumar (2023), PG Practical Manual Experimental Plant Physiology and Biochemistry Manual, Jain Brothers, Science Technology
3. N.K. Gupta & M.K. Sangha Manju Bala, Sunita Gupta (2016), Practicals and Plant Physiology, Scientific Publishers

**Reference Books**

1. Runjhun Gogoi Rajkumari and Kalyan Das (2022), Plant Physiology with Practical, Mahaveer Publications
2. A.Bhattachariya and Vijay Lakshmi. (2015). Methods and techniques in Plant Physiology, Nipa Publishers

**Course Outcomes:**

1. Identification of different parts of an anther and ovule
2. Understanding the process of embryogenesis
3. Apply the concept of osmotic pressure, diffusion pressure deficit (DPD), and plasmolysis.
4. Knowledge on the effects of light intensity on transpiration rates and measure stomatal index.
5. Understanding the results of respiration rate measurements using simple respiroscope, Ganong's respirometer, and Kuhne's fermentation.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | H | M | H | H | H | H | L |
| CO 2 | H | H | H | H | H | H | H | H | L |
| CO 3 | H | H | H | H | M | H | H | H | M |
| CO 4 | H | H | H | H | M | H | H | H | M |
| CO 5 | H | H | H | H | H | H | H | H | L |

# Biochemistry

**Semester – III**
**25MBOC14**

**Hours of instruction/week: 3**
**No. of Credits: 3**

**Objectives:**

- To know about the components of living cell.
- To know about the primary and secondary metabolites present in plants
- To understand the vitamins, enzymes and pigments of plants

**Unit 1: Cell, biophysical chemistry and bonding**

Structure and Functions of Plant Cell, Elemental components of living matter, macromolecules in cell, organization of cell – prokaryotes and eukaryotes. Principles of biophysical chemistry - pH, buffer; acids and bases (**Self study**); chemical bonding – electrovalent, covalent and hydrogen bonds. **9 hrs**

**Unit 2: Carbohydrates and lipids**

Carbohydarte - Classification - monosaccharides, oligosaccharides and polysaccharides (**Self study**). Functions of carbohydrates. Metabolism – Glycolysis, Gluconeogenesis, Glycogenolysis, Glycogenesis, Pentose Phosphate Pathway, Fructose metabolism, Galactose metabolism. Lipids – classification and function. Metabolism – Fatty acid oxidation, fatty acid synthesis, Metabolism of glycerophospholipids, sphingolipids and cholesterol. Digestion, absorption and transport of lipids. **9 hrs**

**Unit 3: Aminoacids and proteins**

Amino acids – structure, classification of standard amino acids, *rare amino acids* (**Selfstudy**) andnon protein amino acids. Chemical and Biosynthesis of Amino acids. Proteins – classification, functions, synthesis of protein in prokaryotes and eukaryotes **9 hrs**

**Unit 4: Vitamins and Nucleic acids**

Vitamins – water soluble vitamins and fat soluble vitamins (**Self study**) - general characters, classification, structure and function. Nomenclature and properties of enzymes. Apo-enzymes, co-enzymes and co-factors. Mechanism of enzyme action and Enzyme inhibition; Michaelis- Menten equation and Line waver – burk plot of enzyme activity. **9 hrs**

**Unit 5: Plant Secondary metabolites**

Classification, Structure, function and biosynthesis of alkaloids, flavonoids, *terpenoids* (**Self study**). Plant Pigments - Structure, Classification and functions of chlorophyll, carotenoids, xanthophylls and anthocyanins **9 hrs**

**Total Hours 45 hrs**

**Text Books:**


1. S.P. Singh. Textbook of Biochemistry (2021). CBS Publishers & Distributors 7thEdition
2. Prof. Bandana Bose, Jyoti Chauhan, Rajesh Kumar Singhal (2018). A quick approach to Plant Physiology, Biochemistry and Biotechnology. Jain Brothers Publishers
3. Nagaraj, G. (2020). Plant Biochemistry. New India Publishing Agency
4. U. Satyanarayana and U. Chakrapani (2021). Essentials of Biochemistry. 3rd Edition Elsevier Publisher
5. Caroline, B. and Alyson, T. (2021). Plant Biochemistry, 2nd Edition. CRC press
6. Dr. L. K. Attriand V. C. Chandel (2022). Fundamentals of Plant Biochemistry. New Delhi Publisher


**Reference Books**


1. C.W. Pratt and K. Cornely (2020). Essential of Biochemistry 5th Edition. Wiley PLUS Publishers
2. David L. Nelson and Michael M. Cox (2021). Lehninger Principles of Biochemistry. 8th Edition Macmillan Learning
3. Hans-Walter Heldt, Brigit Piechulla (2023). Plant Biochemistry 5th Edition. Academic Press, Elsevier pp.628


**Course Outcomes:**

1. Knowledge on the components of a cell and chemical bonding
2. Knowledge on the importance of primary metabolites of the plant
3. Understand the biochemistry of plant growth and development
4. Understanding on vitamins and minerals present in plants and their effects in living systems
5. Knowledge on the secondary metabolites and its significance

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | L | M | M | H | L | L | H | M | L |
| CO 2 | H | M | M | H | L | L | H | H | L |
| CO 3 | H | M | M | H | L | M | H | H | L |
| CO 4 | H | M | H | H | M | L | H | H | L |
| CO 5 | H | M | L | H | M | L | H | H | L |

# Plant Biotechnology

**Semester –III**
**25MBOC15**

**Hours of instruction/week: 4**
**No. of Credits: 4**

**Objectives:**

- To acquire knowledge on recombinant DNA Technology.
- To know about the application of rDNA technology in crop improvement.
- To gain knowledge about CRISPR/Cas9 technology

**Unit 1: History, Scope and branches of Biotechnology**

History and Scope of Biotechnology, Microbial biotechnology, Environmental biotechnology, Marine biotechnology, Agricultural biotechnology and food biotechnology. **12 hrs**

**Unit 2: Plant Tissue Culture**

Designing of plant tissue culture laboratory. Sterilization techniques- Fumigation, wet and dry sterilization, glassware sterilization, ultraviolet sterilization and surface sterilization. Preparation of media. Media composition – Macronutrients, Micronutrients and growth regulators. Concept of totipotency, Differentiation and Redifferentiation. In vitro callus formation. Micropropagation and industrial application. Suspension Culture, Protoplast Culture and Transgenic plants (Self -study). **10 hrs**

**Unit 3: Genomic Library and DNA sequencing.**

Enzymes – restriction endonucleases, ligases, alkaline phosphatase, and polymerases. Cloning vectors – plasmids, bacteriophages, cosmids, phagemids, Definition –Construction of genomic DNA library and cDNA library. DNA probes: Definition, types, Maxam and Gilbert's method of DNA sequencingmethod, Sanger's Dideoxynucleotide DNA sequencingmethod. DNA amplification through PCR procedure and applications (Self-study). **12 hrs**

**Unit 4: Recombinant DNA technology**

Introduction of foreign DNA -Agrobacterium mediated gene transfer, artificial gene transfer - electroporation and micro injection technique, shot gun technique, identification and confirmation of foreign gene by southern blotting technique. Electrophoresis - Agarose gel electrophoresis and SDS PAGE (Self-study). **12hrs**

**Unit 5: Gene therapy**

Gene silencing –definition, causes of gene silencing and strategies for avoiding gene silencing. CRISPR/Cas9 technology and its application. Antisense therapy: definition, production of antisense on mRNA (*in vitro*), inhibition of gene expression by antisense RNA, Applications of antisense therapy (Self-study). **14 hrs**

**Total Hours 60 hrs**

**Text Books:**


1. Renneberg, Reinhard. *Biotechnology for beginners*. Academic Press, 2023.
2. Dubey, R. C. *A textbook of Biotechnology*. S. Chand Publishing, 2022.
3. Jeyanthi, G. P. (2019). *Molecular biology*. MJP Publisher.
4. Stewart Jr, C. N. (Ed.). (2016). *Plant biotechnology and genetics: principles, techniques, and applications*. John Wiley & Sons.
5. Dubey, R.C. 2014. A Textbook of Biotechnology. 5th ed., S. Chand & Co. P Ltd, New Delhi, p. 602. ISBN 81-219-2608-4


**Reference Books**


1. Gresshoff, Peter M. *Plant biotechnology and development*. CRC Press, 2024.
2. Chen, S., Li, Z., Zhang, S., Zhou, Y., Xiao, X., Cui, P., ... & Dai, Y. (2022). Emerging biotechnology applications in natural product and synthetic pharmaceutical analyses. *Acta Pharmaceutica Sinica B*, *12*(11), 4075-4097.
3. Zhu, H., Li, C., & Gao, C. (2020). Applications of CRISPR–Cas in agriculture and plant biotechnology. *Nature Reviews Molecular Cell Biology*, *21*(11), 661-677.
4. Khan, F. A. (2020). *Biotechnology fundamentals Third Edition*. CRC Press.
5. Bishun Deo Prasad Sangita Sahni, Prasant Kumar and Mohammed Wasim Siddiqui (2017).
6. Bhatia, S., Sharma, K., Dahiya, R., & Bera, T. (2015). *Modern applications of plant biotechnology in pharmaceutical sciences*. Academic press.


**Course Outcomes:**

1. Knowledge on history, Scope and branches of Biotechnology
2. Knowledge on Plant tissue culture and its application.
3. Knowledge on DNA sequencing and electrophoretic techniques.
4. Knowledge on rDNA technology.
5. Learning the application of gene silencing and CRISPR technology in crop improvement.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | M | H | M | M | M | H | H |
| CO 2 | H | H | M | H | H | H | H | M | H |
| CO 3 | H | H | M | H | M | M | H | M | H |
| CO 4 | H | H | M | H | M | M | H | M | H |
| CO 5 | H | H | H | M | H | H | H | M | H |

# Biochemistry & Plant Biotechnology - Practical – V

**Semester –III**
**25MBOC16**

**Hours of instruction/week: 4**
**No. of Credits: 2**

**Objectives:**

- To know the procedure for preparation of buffers
- To learn various Biochemical techniques
- To learn the standard procedures in electrophoresis

**Unit 1:Plant Biochemistry** **10 hrs**

Preparation of Phosphate buffers and Citrate buffers, Qualitative analysis of secondary metabolites

**Unit 2: Plant Biochemistry** **15 hrs**

Estimation of Fats, Total free Aminoacids (Ninhydrin reagent method), Total soluble Carbohydrates. (Anthrone reagent method).

**Unit 3:Plant Biochemistry** **15 hrs**

Estimation of Protein (Lowry's method), Tannins, Phenols, Alkaloidsand Flavonoids

**Unit 4: Plant Biochemistry** **10 hrs**

Determination of Vitamin C (Ascorbic acid) and Vitamin E (Tocopherol)

**Unit 5:Plant Biotechnology** **10 hrs**

Preparation of Agarose gel electrophoresis, Separation of proteins by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and Plasmid DNA isolation

**Total Hours** **60 hrs**

**Text Books:**


1. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York
2. Ruzin, S. E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.
3. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
4. Plumber, D. T. (2006). An introduction to practical biochemistry TATA-McGraw- Hill
5. Publication, New Delhi
6. S.P. Singh. Practical Manual of Biochemistry (2017). CBS Publishers & Distributors 8th Edition

**Reference Books**


1. Shah, B.N. (2005). Text book of Pharmacognosy and phytochemistry. CBS Publishers &Distributors-New Delhi
2. Egbuna, C., Chinenye, J. Stanley I. and Udedi, C. (2018). Phytochemistry: Fundamental, modern techniques and applications. Apple Academic Press. CRC press


**Course Outcomes:**

1. Knowledge on preparation of buffers and secondary metabolite analysis
2. Practical knowledge on qualitative analysis of primary plant metabolites
3. Practical knowledge on estimation of protein and phytoconstituents present in plants
4. Knowledge on determination of vitamins
5. Knowledge on preparation of Agarose gel electrophoresis and isolation of Plasmid DNA

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | H | H | M | L | H | H | H |
| CO 2 | H | H | H | H | M | L | H | H | H |
| CO 3 | H | H | H | H | H | L | H | H | H |
| CO 4 | H | H | H | H | H | L | H | H | H |
| CO 5 | H | H | M | H | M | L | H | H | H |

# Cell and Molecular Biology

**Semester III**
**25MBOC17**

**Hours of instruction/week:4**
**No. of Credits: 4**

**Objectives:**

- To know the structure and inclusions of living cells, uncovering their complexities and significance.
- To gain knowledge on DNA, RNA, and emerging biotechnological advancements.
- To aware recent breakthroughs and advancements in Molecular Biology.

**Unit 1: Cell wall and Cell Membrane** **12 hrs**

Structure, chemical composition and functions of primary and secondary cell wall and middle lamella. Plasma membrane - structure as per fluid mosaic model, chemical composition, enzymatic composition and *functions of plasma membrane* (**Self-study**).

**Unit2: Cell organelles** **12 hrs**

Structure, chemical composition and functions of mitochondria, plastids (leucoplast, chloroplast and chromoplast), ribosomes, endoplasmic reticulum, golgi bodies, vacuoles, *peroxisomes* (**Self -study**) and nucleus.

**Unit3: Chromosomes and genes** **12 hrs**

Structure, chemical composition of chromatin and chromosomes - heterochromatin and euchromatin. gene families, giant chromosomes (lampbrush, polytene), Interrupted genes Transposable elements. Cell division – amitosis, mitosis and meiosis-*significance of cell division* (**Self -study**).

**Unit 4: DNA and RNA.** **12 hrs**

Structure and chemical composition of Nucleic acids – DNA & RNA; Types of RNA; functions of DNA & RNA. Models of replication – conservative, semiconservative and dispersive. Unit of replication, enzymes involved, replication origin, replication fork. *DNA replication in E. coli* (**Self- study**) and Protein Synthesis in *E. coli*-Mechanism-transcription of mRNA from DNA and steps involved (initiation, elongation and termination)

**Unit 5: RNA processing, slicing and editing** **12 hrs**

Translation- steps involved (initiation, elongation and termination). Regulation of protein synthesis- Operon Concept. RNA processing – definition and mechanism, RNA splicing – definition, splicing of hnRNA of higher eukaryotes through spliceosomes, splicing of major class of GU – AG introns- spliceosome assembly and splicing of group entrons. RNA editing – definition. Pan editing, insertional editing and polyadenylation editing. Levels of regulation - Regulation at translational level – activator repressor proteins and *ribozyme* (**Self-study**).

**Total Hours 60 hrs**

**Text Books :**


1. Joshi, P., Kasar. C.R., Awate, P.J. and V. Sreedevi. 2024. Fundamentals of Cell Biology, Genetics, Molecular Biology, Evolution, and Ecology. Academic Guru Publishing House
2. Verma, P.S. and V.K. Agarwal. 2022. Cell Biology (Cytology, Biomolecules and Molecular Biology). S CHAND & Company Limited.
3. Verma, S., Gupta, V., and N.V. Harney. 2024. Foundations of Life: Cell Biology, Genetics, Molecular Biology, Evolution, and Ecology 2024. Academic Guru Publishing House
4. Prajith, P.K. 2024. Cell Biology, Ecology, Evolution, Genetics and Molecular Biology. Academic Guru Publishing House.
5. James, J.W., Sohal, J. K., Gupta, A., and A. Rani. 2023. Cell and Molecular Biology. Academic Guru Publishing House


**Reference Books:**


1. Darnell, J.E and H. Lodish. 2023. Molecular Cell Biology. KD Publication
2. Alberts B., Heald, R., Johnson, A., Morgan, D. and M. Raff. 2022. Molecular Biology of the cell. W W Norton & Co Inc


**Course Outcomes:**

1. Clear understanding of cell structures and their functions.
2. Knowledge of the structures and functions of various cellular organelles.
3. Comprehend the molecular organization of chromosomes and the process of cell division.
4. Knowledge on the structure, composition, and roles of nucleic acids, including replication and transcription.
5. Understanding the molecular mechanisms governing cellular processes.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | M | L | L | H | M | L |
| CO2 | H | H | M | M | L | L | H | H | M |
| CO3 | M | H | H | M | H | M | M | H | H |
| CO4 | M | M | H | L | H | M | H | H | H |
| CO5 | L | M | H | H | H | H | M | H | H |

# Ecology, Evolution and Phytogeography

**Semester –III**

**25MBOC18** **Hours of instruction/week: 3**

**Objectives:** **No. of Credits: 3**

- To learn and understand the importance of the environment.
- To know the various principles and relationships between the plants and environment.
- To know about the effects of pollution and their control measures.

**Unit 1: Ecology**

History, scope and basic concepts. Ecological factors: Climatic, Topographic, Edaphic and Biotic. Population and Community Ecology: Characteristics of populations - size and density, dispersion, age structure, natality and mortality, population growth, fluctuation, dispersal, population structure. Community ecology- composition, development and *classification* **(self study)**, method of study of plant communities - quantitative, qualitative and synthetic characteristics of plant communities **9 hrs**

**Unit 2: Ecosystem and Ecological succession**

Ecosystem- structure, function of ecosystem types of ecosystem- Terrestrial ecosystems, Freshwater ecosystem, Marine ecosystem, energy flow- trophic level, food chains, food webs, ecological pyramids, and biogeochemical cycles(water and nitrogen).Ecological succession – Seral and Climax communities – Hydrosere, *Xerosere* **(self study)**. **9 hrs**

**Unit 3: Evolution**

Origin and Evolution of life, Theories of Evolution. Theories, critical analysis, significance and examples of Lamarckism and Neo-Lamarckism, Darwinism and Neo Darwinism. Mutation Theory – Experiments and its significance. **9 hrs**

**Unit 4: Environmental pollution and Disaster management**

Environmental pollution - Air, Water, Soil, Thermal, Radiation, Noise, Cumulative effect of Pollution on global environment; Global warming, climate change and its consequences; Environmental Impact Assessment (EIA). Land movement disasters- earthquakes, landslides and soil erosion. Water disasters- floods, tsunamis, Weather disasters-drought, cyclonic storms, tornadoes. Disaster awareness and safety programme for the public. Pollution and mineral indicators, *Bioremediation* **(self study).** **9 hrs**

**Unit 5: Phytogeography**

Principles and importance of plant geography- *Phytogeographic regions of India* **(self study)**. Patterns of distribution, Introduction to IUCN criteria – Red Data, Rare, Endangered Species. Factors involved in distribution –Endemism, Age and Area hypothesis; Dispersal and Migration and their aims and methods Theories of present day distribution of plants- Continental drift hypothesis. Hot spots. Remote sensing – Introduction and its principles **9 hrs**

**Total Hours** **45 hrs**

**Text Books**


1. Odum, E.P. (2005). Fundamentals of Ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation.Anamaya Publications, New Delhi, India.
3. Kumaresan V. and N. Arumugam (2016) Plant Ecology and Phytogeography. Saras Publication.
4. Garg, B. (2019). Handbook of Environmental Science. India: Amiga Press Incorporated.
5. Brusseau, M. L., Pepper, I., Gerba, C. (2019). Environmental and Pollution Science. Netherlands: Academic Press
6. Denis Walsh, R. Paul Thompson (2017). Evolutionary Biology: Conceptual, Ethical, and Religious United Kingdom: Cambridge University Press.
7. Max K. Hecht , Bruce Wallace , Ghillean T. Prance (2012). Evolutionary Biology, Springer publication.
8. P.D. Sharma (2019). Plant ecology and Phytogeography. Rastogi Publications Reprint
9. Swapnil Yadav (2021), Ecology and Phytogeography, Mahaveer Publications,


**Reference Books**


1. Sharma, P.D. (2010). Ecology and Environment.Rastogi Publications, Meerut, India.8th edition.
2. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Mahua Basu and Xavier Savarimuthu SJ (2017).Fundamentals of Environmental Studies. Cambridge University Press.


**Course Outcomes:**

1. Fundamental knowledge of ecological concepts and influencing factors.
2. Understanding the structure, functions, and types of ecosystems, along with ecological succession.
3. Knowledge on plant forms concerning evolutionary processes.
4. Awareness of global environmental issues, including pollution and disaster management.
5. Enhance understanding of phytogeography and its significance.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | M | M | M | L | H | H | H |
| CO 2 | H | H | H | M | H | H | H | H | H |
| CO 3 | H | M | L | L | M | M | H | M | L |
| CO 4 | H | H | H | H | H | M | H | H | H |
| CO 5 | H | M | H | H | H | L | L | H | M |

## Cell and Molecular Biology & Ecology, Evolution and Phytogeography-Practical -VI

**Semester III**
**25MBOC19**

**Hours of instruction/week: 4**
**No. of Credits: 2**

**Objectives:**

- To develop practical skills in cell counting, viability testing, and plant DNA isolation.
- To know ecological sampling methods and assess water quality parameters.
- To understand the principles of evolution through practical demonstrations..

**Unit1: Cell Biology**
Cell structure and Organelles, cell number count – haemocytometer, cell viability test **15 hrs**

**Unit 2: Molecular Biology**
Different stages of Mitosis and Meiosis, Isolation of Plant DNA. **10 hrs**

**Unit 3: Ecology**
Vegetation sampling methods – Different types of quadrate, line and belt transects. **15 hrs**

**Unit 4: Ecology**
Estimation of dissolved oxygen, CO2 estimation in the water sample. Determination of acidity/alkalinity **10 hrs**

**Unit 5: Evolution**
Demonstration of Evolutionary theories discussed in the syllabus. **10 hrs**

**Total Hours 60 hrs**

**Text Books:**


1. Amit Gupta and Bipin Kumar Sati. 2019. Practical Laboratory Manual-Cell Biology. Lambert Academic Publishing.
2. Dr. Tripurari Mishra and Dr. Diwakar Mishra. 2024. Cell Biology with practical. Mahaveer Publications.
3. Pranab Paul and Dr. Bhaskar Sarma. 2022. Molecular Biology with practical. Mahaveer Publications.
4. P.D. Sharma (2019). Plant ecology and Phytogeography. Rastogi Publications Reprint


**Reference Books:**


1. Douglas Futuyma (Author), Mark Kirkpatrick (Author) (2017). Evolution, Sinauer publishers (4$^{th}$Edn)

**Course Outcomes:**

1. Hands on knowledge on cell counting using a hemocytometer and assess cell viability.
2. Identification of different stages of mitosis and meiosis and isolate plant DNA.
3. Knowledge on vegetation sampling techniques, including quadrat, line, and belt transects.
4. Practical experience on water quality by estimating dissolved oxygen, $CO_2$ levels, and acidity/alkalinity.
5. Understanding of evolutionary theories through practical applications..

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | M | L | M | L | H | M | L |
| CO 2 | H | M | H | M | L | M | H | H | M |
| CO 3 | H | H | M | L | H | M | M | H | H |
| CO 4 | M | H | H | H | H | M | H | H | H |
| CO 5 | L | M | H | H | H | H | M | H | H |

# Ethnobotany

## (Self-Study Course)

**Semester –III**
**25MBOC21**

**Hours of instruction/ week: 2**
**No. of Credits: 2**

**Objectives:**

- To understand the concept of ethnobotany and the lifestyle and traditional practices of plants by Indian tribals.
- To gain knowledge of medicinal plants used to cure common ailments.
- To apply methods to transform ethnobotanical knowledge into value-added products.

**Unit 1:Ethnobotany** **7 hrs**

Introduction, concept, scope and objectives. Major tribes in India and Tamil Nadu. The relevance of ethnobotany in the present context. Methodology of ethnobotanical studies. a) Field work b) Herbarium c) Ancient Literature d) Temples and sacred places

**Unit 2: Ethnic medicine** **7 hrs**

Introduction of Tribal, Folk and Traditional medicines. Significance of the following plants in ethno botanical practices -Rhizome & roots- Mango ginger, Sweet flag (*Acorus*), Sarsaparilla (*Hemidesmus*). Bark and wood-Cinnamon, Cinchona, Sandalwood, Spanish Cherry(*Mimusopselengi*). Leaves- *Eucalyptus*, Oma Valli (*Coleus*), Betel. Flowers and Fruits. And seeds-Saffron, Clove, Coriander, Bael, Cumin, Fennel, Pepper,

**Unit 3: Medicinal Plants** **7 hrs**

Plants for Diabetes (*Eugenia jambolana, Trigonella foenum-graecum, Aegle marmelos, Murrayakoenigii*), Respiratory ailments *Adhatodavasica, Solanumtrilobatum*), Rheumatism (*Cissus quadrangularis, Vitex negundo, Pergulariadaemia*) Lactation (*Euphorbia hirta*)

**Unit 4: Medicinal Plants** **5 hrs**

Plants for jaundice (*Phyllanthus amarus, Ricinus communis, Tribulus terrestris*), fever (*Tinospora cordifolia, Andrographis paniculata*), dandruff (*Lippianodiflora, Aloe vera*) skin diseases (*Acalypha indica, Azadirachta indica*).

**Unit 5: Applications in Ethnobotany** **4 hrs**

Role of ethnic groups in conservation of plant genetic resources. Participatory forest management. Recent trends and application in Ethnobotany. Study on Nilgiri, Coimbatore and Erode tribes.

**Total Hours** **30 hrs**

**Text Books**


1. Barbara M. Schmidt, Diana M. Klaser Cheng.(2017). Ethnobotany: A Phytochemical Perspective.John Wiley & Sons, United States.
2. T. Pullaiah, K. V. Krishnamurthy, Bir Bahadur (2017). Ethnobotany of India, Volume 3: CRC Press. Florida.
3. Amner Muñoz-Acevedo, José L. Martinez, Mahendra Rai(2018). Ethnobotany: Application of Medicinal Plants. United States: CRC Press.
4. Kumar, N. (2018). A Textbook of Pharmacognosy. Aitbs Publishers, India.
5. T. Pullaiah, K. V. Krishnamurthy, Bir Bahadur(2021), Ethnobotany of India, Volume 5, 1st edition,Apple Academic Press, New York,
6. Jayanta Kumar Patra, Gitishree Das, Sanjeet Kumar, Hrudayanath Thatoi (2021), Ethno-pharmacology and Biodiversity of Medicinal Plants 1st edition, Apple Academic Press,


**Reference Books**


1. Singh, V. 2009. Ethnobotany and Medicinal Plants of India and Nepal (Vol. 3). Scientific Publishers. New Delhi.
2. Albuquerque, U. P., Ramos, M. A., Júnior, W. S. F., and De Medeiros, P. M. (2017). Ethnobotany for beginners. Springer International Publishing, US
3. Qadry, J.S. (2014). A textbook of Pharmacognosy Theory and Practicals. 17th ed. CBS Publishers & Distributors, New Delhi.


**Course Outcomes:**

1. Awareness on the lifestyle and traditional plant practices of Indian tribal communities.
2. Awareness of ethical principles and values in ethnobotanical studies.
3. Knowledge of the medicinal properties of plants.
4. Understanding the significance of ethnobotanical studies in community development, sustainable land management, and overall progress.
5. Knowledge in recent trends and applications in the field of Ethnobotany

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | H | H | M | H | L | L | M | H |
| CO 2 | H | L | H | M | H | M | M | M | H |
| CO 3 | H | H | H | H | M | H | H | H | H |
| CO 4 | H | M | H | H | H | M | H | H | M |
| CO 5 | H | H | H | H | H | M | H | M | M |

## SUSTAINABILITY COURSE
## Intellectual Property Rights

**Semester–III**
**25MBOSC1**

**Hours of instruction/week: 3**
**No. of Credits: Non-credit course**

**Objectives:**

- To understand the public perception and concerns regarding genetically modified crops and gene containment strategies.
- To gain knowledge of copyrights, trademarks, patents, and intellectual property rights related to biological materials.
- To analyze case studies on patents and their implications in biotechnology and agriculture.

**Unit 1: Public acceptance of genetically modified crops:**

Introduction, public concern, the current state of transgenic crops, antibiotic resistance genes, herbicide resistant weeds - super weeds - gene containment. **8 hrs**

**Unit 2: Copyright and Trademarks:** **7 hrs**

Copyright – definition, protection, Related Rights, Distinction between related rights and copyrights. Trade mark – definition, rights, kind of signs, types of trademarks, protection and registration.

**Unit 3: Patents:**

Macro-economic impact of the Patent system. Patenting of Biological materials - microorganism patents, plant patents and gene patents. Patenting of transgenic organisms. Searching, Drafting and Filling of a Patent. Different layers of the International patent system (National, Regional and International options). **9 hrs**

**Unit 4: IPR for plant breeders**

Plant variety protection and International union for the protection of new varieties of plants UPOV, functions of (UPOV), comparison of Plant Patent Act (PPA), Plant varieties protection Act (PVPA) (1970&1994) and utility plant patent (1995). Plant variety protection in developing countries and India, Farmer's rights. **9 hrs**

**Unit 5: Case studies on plant patents:**

Patenting of Basmati Rice in USA, case study of Glyphosate tolerance, resistance of Bt maize to the European corn borer, Glycine betaine production and revocation of Neem and Turmeric patents. Important Databases for Patent Search **12 hrs**

**Total Hours 45 hrs**

**Text Books**

1. Khushdeep Dharni. 2014. Intellectual Property Rights. PHI Learning.
2. Dr. Jyoti Rattan. 2024. Intellectual Property Rights. Bharat Law House Pvt. Lts.
3. Chawla. H.S. 2020. Introduction to Intellectual Property Rights. Oxford & IBH Publishing.

**References**


1. Ruchi Vipin Chandra Tiwari. 2023. Empowering Farmers: Understanding Intellectual Property Rights and Seed Laws in India.
2. R. Radhakrishnan and S.Balasubramanian. (2008). Intellectual Property Rights: Text and Cases. Excel books
3. B.L. Wadehra (2016) Law relating to Intellectual Property, 2011. Universal Law Publishing – An imprint of LexisNexis, 5th Edition
4. P.Narayanan (2010).Law of Copyright and Industrial Designs; Eastern law House, Delhi,
5. T.M. Murray and M.J. Mehlman, (2000).Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons.


**Course Outcomes:**

1. Awareness on public concerns, the status of transgenic crops, and strategies for gene containment.
2. Understanding copyright, trademarks, and intellectual property protection mechanisms.
3. Knowledge on the patenting process for biological materials, including transgenic organisms.
4. Understanding plant variety protection laws and international agreements such as UPOV, PPA, and PVPA.
5. Knowledge on real-world case studies of plant patents, including Basmati rice, Bt maize, and Neem patents.

| CO / PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|
| CO 1 | H | M | H | M | L | M | H | H | M |
| CO 2 | M | H | M | L | H | M | H | M | L |
| CO 3 | H | H | H | H | M | M | M | H | H |
| CO 4 | M | H | M | H | H | M | H | H | H |
| CO 5 | H | H | M | H | H | H | M | H | H |

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