

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	I	18MBO11C	PAPER – I MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY	7

Objectives:

1. To provide the basic knowledge of microbes
2. To introduce the techniques involved in their study
3. To highlight the role of microbes in the human welfare;
4. To deal with microbial products and also introduces the students to some key aspects of virology
5. To understand the concept of plant pathology and plant diseases

Unit – I

General account of Microbes; Brief history of Microbiology; Whittaker's Five kingdom concept; Prokaryotic and Eukaryotic microbes; Ultra structure of bacteria; Classification of Bacteria (Bergey's manual of Systematic Bacteriology); General account and Economic importance of Archaeobacteria, Eubacteria, Cyanobacteria and Actinomycetes.

Methods in Microbiology: Sterilization methods, Staining, Major types of Culture Media, Pure culture and sub-culture methods. Preservation and storage of cultures; Growth and Population enumeration of microorganisms by Direct and Indirect methods; Bacterial Growth Curve in batch culture.

Unit – II

Viruses: Characteristics and Ultrastructure of Viruses: Classification of viruses, types of phages, Chemical composition, Characteristic features of host – virus interaction, replication, transmission of viruses and economic importance; Pathogenic virus: Tobacco Mosaic Virus; General account of Mycoplasma; Viroids and Prions.

Industrial application of Microorganisms: Organic acids (Acetic acid and Citric Acid); Alcohol (wine); Milk products (cheese and yogurt); Antibiotics (Penicillin and Streptomycin); Bio pesticides (*Trichoderma sp.* and *Bacillus sp.*).

Unit – III

Fungi: General characteristics of fungi; Mode of nutrition (Saprophytic, Parasitic and Symbiotic); Reproduction (Vegetative, Asexual and Sexual); Heterothallism; Heterokaryosis; Parasexuality; Types of fungal spores and mode of dispersal; Classification of Fungi (Ainsworth, 1973); Phylogeny of fungi and General account of Mastigomycotina and Zygomycotina.

Unit – IV

General account of Ascomycotina, Basidiomycotina, Deuteromycotina. Mycorrhizae, Fungi as bio control agent. General account of Lichens – Thallus structure, reproduction and Economic importance.

Unit – V

Plant Pathology: General account of plant pathogens: Diseases caused by plant pathogens and defense mechanism: Physical, physiological, biochemical and molecular mechanisms.

Plant disease epidemiology: Transmission and spread of plant pathogens; disease cycle, epidemics: Modeling and disease forecasting.

Plant Diseases: Symptoms, Causative organisms and control measures of the following diseases:

1. Blast disease of Paddy
2. Powdery mildew of Grapes
3. Cotton blight
4. Bunchy top of Banana
5. Phyllody - Sesame

PRACTICALS:

Microbiology

1. Preparation of Basic medium – solid medium and broth
2. Preparation of agar plates, agar slants and agar deep tubes.
3. Simple staining of bacteria.
4. Gram's staining of bacteria.
5. Hanging drop method
6. Isolation of Bacteria, Fungi, Actinomycetes from soil and water.
7. Isolation and Enumeration of microorganisms from the infected plant tissues.
8. Subculture, pure culture and maintenance of cultures.

Mycology:

1. Study of morphology and anatomy of available Genera as given in the syllabus:
(*Pythium*, *Mucor*, *Phyllochora*, *Polyporus*, *Trichoderma*)
2. Pathology Herbarium Submission (Any 5 Plant specimens)
3. Screening of VAM infection.

TEXT BOOKS:

1. Sambamurthy, A.V.S.S (2013). A text book of Plant Pathology, I.K. International Publishing House Pvt. Ltd, New Delhi.
2. Malhotra R.S , Ashok Agarwal (2003) Plant pathology second edition, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.
3. Dubey and Mageshwari (2003) Text Book of Microbiology. S. Chand & Co. Ltd.
4. Sharma, O.P. 1989. Text book of Fungi. Tata Mc Graw Hill Pvt Ltd., New Delhi.
5. Pelczar, M.J (Jr), Chan, E.C.S and Krieg, N. R (1986). Morphology. Tata Mc Graw Hill Publishing Company Ltd, New Delhi.
6. Gangulee, H.C. and Kar. A.K.1989. College Botany. Vol. II. New Central Book Agencies Ltd., Kolkata.
7. Pandey, B.P. 1982. Plant Pathology – Pathogen and Plant disease. S.Chand & Company Pvt. Ltd, New Delhi.

REFERENCES:

1. Alexopoulos, C.J., Mims, C. W and Blackwell, M. (1996). Introductory Mycology. John Wiley & Sons Inc.
2. George N, Agrios, (2003) Plant Pathology (5th edition), Academic Press, University of Florida, USA
3. Rajni Gupta. (2004). A Textbook of Fungi. A.P.H. Publishing Corporation, New Delhi.
4. David, H. Griffin. (1994). Fungal Physiology. Wiley-Liss, Inc., New York.
5. Ahemed, M. and S.K. Basumatary, (2006). Applied Microbiology. MJP Publishers, Chennai. Rao, A.S (1997). Introduction to Microbiology. Prentice Hall of Pvt. Ltd., New Delhi.
6. Mishra, A., A. Bohra and A. Mishra (2011). Plant Pathology-Disease and Management. AgroBios, Jodhpur.
7. Pathak, Khatri and Pathak (1996). Fundamentals of Plant Pathology. AgroBios, Jodhpur.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	I	18MBO12C	PAPER – II PLANT DIVERSITY - I (PHYCOLOGY AND BRYOLOGY)	7

Objectives:

1. To define and characterize diversity
2. To understand the range of diversity and diversification
3. To understand the morphology, life cycle and phylogeny of algae
4. To understand the cultivation and applications of algae
5. To acquire knowledge and understand the general and reproductive characters of Bryophytes

Unit – I

The classification of Algae – Fritch (1945) & Prescott (1969); Comparative study of the range of thallus structure, morphology, reproduction, life cycle, phylogeny of the Cyanophyceae and Chlorophyceae.

Unit - II

Comparative study of the range of structure, morphology, reproduction, life cycle, phylogeny of the Bacillariophyceae, Phaeophyceae and Rhodophyceae.

Unit-III

Methods of cultivation of fresh water and marine Algae: Indian contribution to Algalogy; Economic importance of fresh water and marine algae. Biological importance of Phytoplankton; Role of algae in Agriculture; Fossil algae.

Unit – IV

Classification, General characters and Distribution of Bryophytes; Reproductive characters and Comparative study of gametophytes and sporophytes of the following major classes: Hepaticopsida, Anthocerotopsida, Bryopsida. Economic importance of Bryophytes.

Unit – V

General characters, Distribution, Morphology, Reproduction and Life history of the following orders: Sphagnales, Funariales and Polytrichales; Origin of Bryophytes; Evolution of sporophytes and gametophytes in Bryophytes, Ecological aspects and economic importance; Fossil Bryophytes.

PRACTICALS

PHYCOLOGY

Study of the morphology of Algae with particular reference to the following Genera: *Chlorella*, *Pithophora*, *Bulbochaeta*, *Fritschiella*, *Codium*, *Nitella*, *Diatoms*, *Padina*, *Turbinaria*, *Sargassum*, *Batrachospermum*, *Gelidium*, *Gloeocapsa*, *Lyngbya* ; Algal culture.

Visit to CMFRI, Mandabam

BRYOPHYTES:

Morphological and Anatomical study of Bryophytes with reference to the following Genera: *Targionia*, *Lunularia*, *Reboulia*, *Dumortiera* and *Sphagnum*.

TEXT BOOKS:

1. Sharma.O.P (2011). Algae. Tata Mc Graw Hill Education Pvt. Ltd., New Delhi.
2. Sharma.O.P (1986). Text book of Algae. Tata Mc Graw Hill Company Pvt. Ltd., New Delhi.
3. Sambamurthy, A.V.S.S, (2005). Text book of Algae. IK International Publications, New Delhi.
4. Gangulee, H.C. and Kar. A.K (1989). College Botany. Vol. II. New Central Book Agencies Ltd., Kolkata.
5. Vishista. S (1986) Bryophytes: Chand Co., Pvt. Ltd
6. Sharma O.P, (2014). Bryophytes: Tata McGraw Hill Publication.

REFERENCES

1. Singh Pandey and Jain (2010) A Text Book of Botany 4th Edition Rastogi Publications.
2. Pandey B.P. (2013) College Botany 5th Edition S. Chand Co., Pvt. Ltd.
3. Gangulee and Kar (2007). College Botany Vol II. New Central Book Agency Pvt. Ltd.
4. Sharma O.P (1986). Text Book of Algae: Tata McGraw Hill Publication.
5. Round F.E (1981), The Ecology of Algae: Cambridge University Press.
6. Vashista B.S (1983), Algae Chand Co., Pvt. Ltd.
7. Gupta J.S (1981). Text Book of Algae: Oxford and IBH Publishing Co.,
8. Gangulee, H.C. and Kar. A.K.(1989). College Botany. Vol. II. New Central Book Agencies Ltd., Kolkata.
9. Chopra.R.N. (1998). Biology of Bryophytes. New Age International Pvt. Ltd., New Delhi.
10. Tuba, Z. Nancy.G. Slack. And Lioyd,R. Stark. (2011). Cambridge University Press. New York.
- 11.Reddy, S.M. (1996). University Botany.I: Algae, Bryophyta and Pteridophyta. New Age International Publishers, New Delhi.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	I	18MBO13C	PAPER – III CELL BIOLOGY	6

Objectives:

1. To understand the concept of cell theory
2. To understand the structural organization and function of different cell organelles.
3. To understand the chromosome architecture and types
4. To obtain the knowledge of cell cycle and cell division

Unit – I

The Cell: cell theory; ultrastructure of a typical plant cell. Cell wall: Origin, ultra structure, chemical constituents and functions of cell wall. Cell membrane organization with reference to fluid mosaic model; role of various membrane proteins, lipids and carbohydrates; role of ion channels and pumps in cellular transport and signaling.

Unit – II

Structure and function of sub - cellular structures: Golgi complex; endoplasmic reticulum (RER and SER); lysosomes; Micro bodies – peroxisomes, glyoxysomes and sphaerosomes. Ribosome: structure; prokaryotic, eukaryotic and organelle ribosomes and their functional significance. Cytoskeleton – microtubules, microfilaments and intermediary filaments – structure and function.

Unit – III

Mitochondria – origin, distribution and structure – mit DNA – organization and function. Chloroplast - origin, distribution, types and structure – chl DNA – organization and function. Nucleus: Ultrastructure; nuclear envelope, nuclear pore complex, nuclear matrix, nucleoplasm and nucleolus.

Unit – IV

Chemical structure of DNA- Watson and Crick model - Types of DNA; RNA structure and types. Chromosome architecture: Packaging of DNA: Nucleosome – organization of histone octamer – 300 A⁰ Chromatin fiber – DNA scaffolds – solenoid model – Euchromatin and Heterochromatin, DNA metylation. Chromosome banding techniques (G banding), karyotype and Idiogram. Specialized chromosomes – polytene – lampbrush and B chromosome

Unit – V

Cell cycle – four phases – biochemical and cellular activities. Cell division types - amitosis, endomitosis, polyteny, Mitosis and Meiosis. Kinetochore, Role of centromere and spindle fibers- Spindle apparatus – Cytokinesis. Apoptosis and its significance.

PRACTICALS:

1. Observation of ultrastructure of cell organelles (electron micrographs).
2. Observation and study of different stages of mitosis by onion root tip squash.
3. Observation and study of different stages of meiosis by Rheo flower bud squash.
4. Isolation of cell organelle chloroplast and mitochondria (only schematic representation).

TEXT BOOKS:

1. Derobertis E.D. and De Robertis E.M.F. (2002). Cell and Molecular Biology 8th Edition. Lee and Fab International edition, Philadelphia.
2. Gupta P.K(2013). Genetics and Cytogenetics. 7th Edition. Rastogi Publications.
3. Verma P.S and Agarwal V.K (2011) . Cytology. S.Chand and Co. Ltd.
4. Sundararajan S (1998), Introduction to Cell Biology: Vikas Publishing House Pvt. Ltd.
5. Power., C.B (1984), Cell Biology. Himalaya Publishing House.

REFERENCES:

1. Lodish et al. (2000), Molecular cell Biology: W.H. Freeman & Co, NY, USA
2. David Friefelder (1987). Molecular Biology: Nansa Publishing House, New Delhi.
3. Cooper G. (1996). The cell – A molecular approach: ASM Press, Washington
4. Sheeler P and Binachi D (2004). Cell and Moecular Biology: Third edition, Wiley New York, USA.
5. Khush, G.S (1973). Cytogenetics of Aneuploids. Academic: Press, New York, London.
6. Karp, G. (1999). Cell and Molecular Biology : Concept and Experiments. John Wiley and Sons, Inc., USA.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	I	18MBO14E	ELECTIVE PAPER – I BIOINSTRUMENTATION	4

Objectives:

1. To understand the operating principle and applications of microscope and other techniques and instruments
2. To apply the knowledge to handle the instruments
3. To understand the molecular biology tools and techniques

Unit - I

General Laboratory practices

Microscopy: Principles of Light and Electron Microscopy; Phase contrast and Fluorescent microscopy; confocal microscopy; Micrometry, TEM and SEM. Microtome: Types and their uses.

Unit - II

Separation Techniques: Principle and applications of centrifuge, lyophilizer and sonicator; Chromatographic Techniques: Principle, types and application of TLC, HPLC and GC.

Unit- III

Spectroscopy: Principle, types and applications of Visible, UV, FTIR, NMR and Mass Spectrophotometers.

Unit - IV

Electrophoretic techniques: Principle, types and applications of SDS- Polyacrylamide Gel Electrophoresis (PAGE) and Agarose Gel Electrophoresis (AGE), 2D gel electrophoresis, isoelectrofocussing.

Unit - V

Working principle of PCR, RAPD, RFLP, FISH, DNA sequencing and DNA hybridization techniques, DNA microarray, SAGE.

PRACTICALS

1. Separation of DNA fragments through Agarose Gel Electrophoresis
2. Demonstration of DNA sequencing
3. Demonstration of PCR
4. Demonstration of Cryopreservation
5. Visit to Biotechnological Laboratories

TEXT BOOKS:

1. Jeyaraman, J. (1981). Laboratory Manual in Biochemistry: Wiley Eastern Ltd. Mumbai
2. Nagarajan, P. and Senthilkumar, N. (2001). Molecular biology principles and methods a practical approach: Sree Narmatha Printers, Coimbatore.
3. Plummer, D.T (2003). An Introduction to practical biochemistry. Tata MC Graw Hill Co. New York.
4. Sharma, R.K. and S.P.S. Sangha. (2009). Basic Techniques in Biochemistry and Molecular Biology. I.K. International Pvt. Ltd, New Delhi.

REFERENCES:

1. Glick and Thompson, (1993). Methods in plant Molecular Biology & Biotechnology: CRC Press, BR, Florida, USA
2. Rastogi S.C (2010). Biochemistry: Third edition. Tata McGraw Hill Education private limited New Delhi.
3. Terrance G Cooper, (1942). The tools of Biochemistry: A Wiley Interscience publication
4. Keith Wilson and John Walker (1995). Practical biochemistry: Univ. of Cambridge., New York.
5. Chawla, H.S. (2000). Introduction to biotechnology: Oxford and IBH publishing Co., New Delhi.
6. Johansen, D.A. (1940). Plant Microtechnique: MC Graw Hill Co., New York.
7. Keith Wilson and John Walker (2010). Principles and Techniques of Biochemistry and Molecular biology: Cambridge University Press, New York.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	II	18MBO21C	PAPER – IV PLANT DIVERSITY - II (PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY	6

Objectives:

1. To define and characterize diversity of Pteridophytes and Gymnosperms
2. To understand the dynamics of diversity
3. To realize the significance of diversity
4. To acquire knowledge and understand the concept of Paleo botany

Unit- I

Pteridophytes: General characters; Reimer's Classification (1954); Theories of Origin of Sporophyte; Telome concept; Sporangium development: Eusporangiate type and Leptosporangiate type; Range of structure; Reproduction and Evolution of the Gametophytes: Sex organs; Life cycle Patterns; Apogamy and Apospory; Detailed account of Stelar and Soral evolution; Heterospory and Seed habit.

Unit – II

Comparative study of Morphology, Anatomy, Reproduction and Phylogeny of the following classes: Psilophytopsida, Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Economic importance of pteridophytes.

Unit- III

Gymnosperms: Introduction; Classification of Gymnosperms (Sporne, 1965); Characteristic features and Life cycle of Gymnosperms; Comparative study of Morphology, Anatomy, Reproduction and Phylogeny of the following Orders: Pteridospermales, Bennettitales, Pentoxylales, Cycadales and Cordaitales.

Unit- IV

Comparative study of Morphology, Anatomy, Reproduction and Phylogeny of the following orders: Coniferales, Taxales, Ginkgoales and Gnetales; Economic importance of Gymnosperms.

Unit- V

Paleobotany: Geological time scale; Fossils and Fossilization: Kinds of Fossils: Petrification, mold, cast, impression and compression; Nomenclature of Fossil plants; Indian contribution towards fossil resources; Half-life period; Radiocarbon dating. Contribution of Prof. Birbal Sahni.

PRACTICALS:

Study of morphology, anatomy and reproductive structures of the following genera:

Pteridophytes

Psilotum, Lycopodium, Selaginella, Equisetum, Alsophila, Acrostichum, and Marsilea.

Gymnosperms

Zamia, Cupressus, Podocarpus, Gnetum.

Paleo Botany

Pteridophytes- *Rhynia, Lepidodendron, Calamites.*

Gymnosperms- *Lyginopteris, Williamsonia, Lagenostoma, Cordites.*

TEXT BOOKS:

1. Sporne K.R. (1996). Morphology of Pteridophytes: Hutchinson; 3rd edition.
2. Arnold C.A. (1972). An introduction to Paleobotany: New York, McGraw-Hill Publishers.
3. Vashishta B.R. (2001). Botany for degree students – Pteridophytes: S Chand & Co Ltd; 5th edition.
4. Parihar N.S. (1959). An introduction of Peridophytes: Central Book Depot. Publishers.
5. P.C. Vashista, A.S. Sinha and Anil Kumar, (2010) Pteridophyta (Vascular Cryptogams): S. Chand & Company, New Delhi.
6. Govil C.M. (2011). Gymnosperm: Krishna Prakashan Media.
7. Bhatnagar, S. P. and Moira, A. 1996. Gymnosperms. New age international Pvt. Ltd., New Delhi.
8. Sambamurthy, A.V.S.S. (2005). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and paleobotany: I.K. International Publishing House. New Delhi.
9. Lily Bora (2010). Principles of Paleobotany: International Scientific Publishing Company, New Delhi.

REFERENCES:

1. Parihar , N.S (1977) An introduction to Embryophyta Vol. II Pteridophytes: Central Book Dept.
2. Trivedi P.C. (2002). Advances in Pteridology: Pointer Publishers.
3. Rashid A (1978). An introduction of Peridophytes: Vikas publishers.
4. Vashista P. C.- Gymnosperms
5. Sporne, K. R. - Morphology of gymnosperms, 1965. Hutchinson univ. Asia Publishing House.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	II	18MBO22C	PAPER – V- ANATOMY AND EMBRYOLOGY	7

Objectives:

1. To understand the basic principle of differentiation of cell types
2. Application of various micro techniques
3. To trace the development of male and female gametophyte
4. To highlight the physiological role of endosperm in the morphogenesis of embryo
5. To assess the process of seed development

Unit - I

Cell Wall: Morphological and physico-chemical changes; Plasmodesmata- types of pits – growth of cell wall – formation of intercellular spaces; **Meristems:** Classifications: Theories of shoot and root apices, Cytological zonation in shoot apex.

Vascular Cambium: Composition and organization – multiplicative and additive divisions.

Xylem: Primary and secondary xylem – tracheary elements and vessels – vesselless dicots – xylem rays and axial parenchyma of angiosperm wood; **Dendrochronology** – grain, texture and figure in wood; reaction wood; ring porous and diffuse porous wood. **Phloem:** Ultra structure and ontogeny of sieve tube elements and companion cell. Evolution of tracheary elements.

Unit - II

Periderm: Structure, organization and activity of phellogen. Polyderm and Rhytiderm – wound periderm. Normal secondary thickening in Dicots; Anomalous secondary growth in Dicots (Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and arborescent Monocots. Primary thickening in palms; Ontogeny of leaf, Structure and types of Stomata; Leaf abscission; Major nodal types; Kranz anatomy and its significance.

Microtechnique: Principle of killing and fixation, dehydration and rehydration of botanical specimens. Stains: Principle of double staining (fast-green and light green) of free hand sections; Protocol for serial sectioning of paraffin wax impregnated specimens; Mounting and mounting media.

Unit – III

Microsporangium and Male gametophyte: Structure and development of Anther; Ultrastructure and physiology of anther tapetum; Male gametophyte; **Palynology:** Morphology and ultrastructure of pollen wall, pollen kitt, pollen analysis, pollen storage, pollen sterility and pollen physiology.

Unit - IV

Megasporangium and Female gametophyte: Structure and development of Megasporangium; Types of ovules, Endothelium, obturator and nucellus. Megasporogenesis:

Female gametophyte: Structure, types, haustorial behavior and Nutrition of embryo sacs.

Fertilization: Double fertilization and triple fusion; **Endosperm:** Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminant endosperm. **Embryogeny:** Development of monocot (Grass) and dicot (Crucifer) embryos.

Unit - V

Polyembryony: Causes of Polyembryony, classification, induction and practical application. Apomixis and its significance. Seed and Fruit development and role of growth substances. Parthenocarpy and its importance.

PRACTICALS:

ANATOMY

1. Study of shoot apex of *Hydrilla*
2. Observation of cambial types.
3. Sectioning and observation of nodal types.
4. Study of anomalous secondary growth of the following:

STEM- Nyctanthus, Bouerhavia, Aristolochia, Bignonia, Piper petal and Mirabilis.

ROOT: Acyranthus

5. Observation of stomatal types by epidermal peeling.
6. Maceration of wood and observation of the components of xylem.
7. Double staining technique to study the stem anomaly.
8. Preparation and submission of 5 permanent slides.

EMBRYOLOGY:

1. Observation of T.S. of anther.
2. Observation of ovule types.
3. Observation of mature embryo sacs.
4. Dissection and observation of embryos (globular and cordate embryos).
5. Study of pollen morphology
6. Study of *in vitro* pollen germination.
7. Observation of endosperm types.

TEXT BOOKS:

1. B.P Pandey (2011). College Botany Vol II: S. Chand and CO., Ltd New Delhi.
2. B.P. Pandey (2009). Plant Anatomy: S. Chand and Co., Ltd., New Delhi.
3. Katherine Esau (1965). Anatomy of seed plants: 2nd Edition Wiley NewYork.
4. Fahn, A. (1990). Plant Anatomy: Pergamon Press, New York.
5. S.S. Bhojwani and Bhatnagar, S, P (2009), Embryology of Angiosperms: Vikas Publishing House (P) Ltd.
6. P. Maheswari (1963). An Introduction to embryology of Angiosperm: Mc Craw-Hill., New York
7. Pullaiah, T., Lakshminarayanan, K. and Hanumantha Rao, B. (2001). Text book of embryology of angiosperms, Regency Publications, New Delhi.

REFERENCES:

1. R. F Suan E. Eichhorn (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissue of the Plant Body, 3rd Edition, Pergamon Press NewYork.
2. Fahn. A (1985). Plant Anatomy:.. 3rd Edition. Pergamon Press NewYork.
3. Carlquest, S (2001).Comparative Wood Anatomy: Springer Science. Publication.
4. V. Singh P.C. Pande and D.K. Jain (1998). Anatomy of Seed Plant: Rastogi Publications,Meerut.
5. Charles B. Beck. (2010). An Introduction to plant structure and development: Cambridge University Press. New York.
6. Pandey, S.N. and Chadha, A. (1996). Plant anatomy and Embryology: Vikas Publications, New Delhi.
7. Katherine Esau. (1960). Anatomy of Seed plants: Wiley India Pvt. Ltd. New Delhi.
8. Bhojwani, S.S. and Soh, W.Y. (2001). Current Trends in the embryology of angiosperms: Kluwer Academic Publishers. The Netherlands.
9. Bhojwani, S.S. and Bhatnagar, S.P. (1974). The embryology of Angiosperms: Vikas Publishing House Pvt. Ltd. New Delhi
10. Lersten, N.R. (2004). Flowering Plant Embryology: Blackwell Publishing, Australia.
11. Pandey, S.N. and Chadha, A. (1996). Plant anatomy and Embryology: Vikas Publications, New Delhi.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	II	18MBO23C	PAPER –VI- PHYTOCHEMISTRY	7

Objectives:

1. To understand the concept of bioenergetics
2. To understand the structure and function of various biomolecules in plant cells
3. To elucidate the interrelationships of the cellular components
4. To acquire knowledge of their chemical composition
5. To create a basic understanding of the importance of enzymes as cellular catalysts
6. To provide details about the importance of the biomolecules present in our system and the regulation of secondary metabolic pathways

Unit – I

pH and its significance; pH scale; Derivation of Henderson-Hasselbalch equation; isoelectric point, buffers and their importance; Energy flow, enthalpy and entropy, Laws of thermodynamics; concept of free energy; energy transfer and redox potential.

Unit – II

Enzymology - Classification and nomenclature of enzymes; physico-chemical properties of enzymes; cofactors and coenzymes; isozymes; kinetics of enzyme action; significance of K_m ; Mechanism of enzyme action (Lock and key hypothesis and Induced fit model) factors affecting enzyme activity, Allosteric modification and feedback regulation.

Vitamins: Classification and Structure – Water soluble (B complex and Ascorbic acid) and fat soluble (A, D, E and K), Deficiency symptoms and Sources of vitamin.

Unit – III

Amino acid metabolism: Structure, properties and classification of amino acids; protein and non-protein amino acids, peptide bond and polypeptide chain; Classification, properties and structure (primary, secondary, tertiary and quaternary) of proteins. Protein denaturation.

Unit - IV

Carbohydrate metabolism: Classification, structure and properties of representative examples of monosaccharides, disaccharides and polysaccharides.

Lipid metabolism: Saturated and unsaturated fatty acids; fatty acid biosynthesis; oxidation of fatty acids; storage, mobilization and functions of fatty acids and lipids.

Unit – V

Plant Secondary metabolites: Brief outline of shikimate, acetate and mevalonate pathway of secondary metabolites; Structure, classification and biological significance of alkaloids, terpenoids and polyphenolic compounds; Extraction, isolation and identification of alkaloids and terpenoids.

PRACTICALS

1. Preparation of buffers (citrate and phosphate)
2. Qualitative tests for sugars
3. Qualitative tests for aminoacids
4. Qualitative tests for proteins
5. Qualitative tests for alkaloids, terpenoids, flavanoids, and steroids
6. Quantitative determination of aminoacids by Ninhydrin method
7. Quantitative determination of carbohydrates by Anthrone method
8. Quantitative determination of protein by Lowry's method
9. Enzyme assay- Peroxidase
10. TLC separation of alkaloids and terpenoids

TEXT BOOKS:

1. Conn, E. and Stump, P.K., (1979). Outline of Biochemistry: Niley Easdtern Ltd., New Delhi.
2. Stryer, L. (1995). Biochemistry, Fourth edition: W.H. Free Man & Company New York.
3. Lehninger, A.L. (2005). Biochemistry Vth edition: Kalyani Publishers, Ludhiana.
4. Jain,J.L., (1999). Fundamentals of Biochemistry: S.Chand & Co. Ltd., New Delhi.
5. Voet, D and Voet, J.H. (1995). Biochemistry: John Wiley and Sons, New York
6. G.S Kumar and Dr. K.N. Jayaveera (2014). A text Book of Pharmacognosy and Phytochemistry: S. Chand. New Delhi.

REFERENCES

1. Devlin TM. (2006). Text book of Biochemistry: 6th Ed. A John Wiley & Sons, Inc. Publication, New York.
2. Marry.K.Campbell. Shawn O. Fawell. (2007). Biochemistry: 6th Ed. Thompson. Brooks / cole .USA
3. Reginald. H. Garrett, Charles M. Grisham. (2010). Biochemistry: Mary Fimch Puhlisher. Boston. USA.
4. Henrich. (2012). Fundamentals of Pharmacognosy and Photochemistry: Elsevier Health Science.
5. Fundamentals of Pharmacognosy & Phytochemistry (2012). Henrich Elsevier Health Science
6. Shah.B. and Seth.A. (2010). Text book of Pharmacognosy and Phytochemistry: Elsevier India Pvt. Ltd. New Delhi.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	II	18MBO24E	ELECTIVE PAPER – II- BIOSTATISTICS AND SEED TECHNOLOGY	4

Objectives:

1. To equip students with the knowledge of scientific Data collection, analysis and presentation
2. To understand the concept of seed technology

Unit - I

Biostatistics: Definition, scope, functions of biostatistics; **Data:** Primary and secondary Data; Methods of collection of Data; Sampling techniques; Frequency distribution table.

Unit – II

Presentation of Data: Tabulation - general rules for Tabulation, Parts of Tables and types of Tables; **Diagrammatic presentation:** Line, bar and pie; **Graphic representation:** Histogram, frequency polygon, frequency curve and Cumulative frequency curve.

Unit - III

Analysis of Data: Measures of central tendency: Mean, Median and Mode; Measures of Dispersion: Range, Standard deviation and Standard error; Correlation and Regression analysis.

Unit – IV

Test of significance: Analysis of variance (ANOVA): one way and two way methods; Chi-square test: Definition and applications; Role of statistical tools in biology.

Unit - V

Seed Technology: Structure of seed and seed coats. Mechanism of seed germination and types; Mechanisms of seed dispersal: Zoochory, Anemochory, Hydrochory and Autochory. Seed processing and storage; Seed vigour and seed viability (Tetrazolium test); Seed Dormancy: Hormonal regulation of dormancy and germination; Seed certification.

PRACTICALS:

1. Organization of a Table
2. Diagrammatic presentation of given Data : line, bar and pie diagram.
3. Graphic presentation of given Data: Histogram, frequency polygon, frequency curve and Cumulative frequency curve.
4. Determination of Mean, Median and Mode of the Data obtained from plant sources.
5. Determination of Standard deviation and Standard error of the Data obtained from plant sources.
6. Test of significance by Chi-square test.
7. Seed viability test (TZ test)
8. Mode of Seed dispersal
9. Seed certification (model certificate).

TEXT BOOKS:

1. S.Prasad (2011). Elements of Biostatistics: Rastogi Publications, Meerut.
2. Arumugam N and R.P. Meyyan (2000). Evolution and Biostatistics: Saras Publication, Nagarcovil.
3. Archana Sharma (2014), Seed Technology and Seed Pathology: Pointer Publishers.

REFERENCES:

1. Dipak kumar Kar and Soma Halder (1997), Plant Breeding and Biometry: New Central Book Agency (P) Ltd ., Kolkata
2. Sanjeev Kumar (2014), Principles of Seed Technology: Sonali Publications.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	III	18MBO31C	PAPER VII PLANT SYSTEMATICS, RESOURCES AND ETHNOBOTANY	7

Objectives:

1. To acquire the fundamental values of plant systematics
2. To know about the basic concepts and principles of plant systematics
3. To establish a suitable method for correct identification and adequate characterization of plants
4. To aware of the importance of taxonomic relationships in plant systematic studies
5. To understand the utility of different plant species
6. To have a first- hand knowledge on Economic Botany and Ethnobotany

Unit – I

History of classification; Systems of classification: Bentham and Hooker and Cronquist; Angiosperm Phylogeny Group 2011; International Code for Botanical Nomenclature; Typification, Valid publication, Citation, Retention choice and Rejection of names; Priority.

Unit –II

Plant molecular systematics; Chemotaxonomy and Numerical taxonomy; Taxonomic evidences from Morphology, Anatomy, Embryology, Palynology and Cytology; Concepts of Taxa and Taxonomic hierarchy; Construction and uses of different types of key for plant identification (indented and bracket keys); Basic concepts of Flora, Revisions, Monographs, Herbaria and Data information system; Botanical Gardens.

Unit – III

Comparative and detailed study of the following families: Nymphaeaceae, Capparidaceae Polygalaceae, Portulacaceae, Zygophyllaceae, Rhamnaceae, Sapindaceae, Combretaceae, Passiflorae, Ebenaceae, Ficodeae, Rubiaceae, Oleaceae and Boraginaceae.

Unit – IV

Comparative and detailed study of the following families: Bignoniaceae, Verbenaceae. Nyctaginaceae, Aristolochiaceae, Santalaceae, Scitamineae, Orchidaceae, Commelinaceae, Palmae, Aroideae and Cyperaceae.

Unit – V

Plant Resources: Binomials, Families, Morphology of useful parts and uses of the following: **Food crops** – Cereals - Wheat and Millets (*Pennisetum*); **Pulses** - Black gram; **Nuts** - Cashew nut; **Sugar yielding plant** – Sugarcane; **Oil yielding plant** – Sunflower; **Spices** – Cardamom; **Beverage plant** – Cocoa; **Timber and pulp yielding plants**- Red sandal and *Eucalyptus*; **Fiber yielding plant** – *Corchorus*; **Fodder plant** - Fodder grass (*Panicum*);

Medicinal plant – *Catharanthus*; **Horticultural plants** – Jack fruit, Hedge plant (*Duranta*), Garden plant (*Gerbera*); **Plant for soil conservation** – Lemongrass.

Ethnobotany: Definition, History, Modern Ethnobotany and Ethnomedicine; An insight into the ethnobotanical practices of Indian sub-continent; A listing of the medicinal practices of two tribes of Tamil Nadu (Kurumbas and Irulas).

PRACTICALS

- **Diversity of Angiosperms:** Morphology of Angiospermic plants.
- **Taxonomy:** Taxonomic study of plants belonging to the families as per the syllabus (only Dicot families given for identification in practical examination).
- **Field visits:** Botanical study tour for 3 or 4 days to be undertaken for covering various natural habitats and one or two single day collection trips.
- **Submission of herbarium:** Submission of 50 herbarium sheets along with tour/trip report and field note book.
- **Economic Botany:** Study of the morphology and structure of useful parts of the plants mentioned in the syllabus and collection of plant samples and submission of herbarium sheets.
- **Ethnobotany:** Listing of medicinal plants and medicinal practices of Kurumbas and Irulas Tribes .

TEXT BOOKS:

1. O.P. Sharma. (2007). Plant Taxonomy: Data McGraw-Hill Publishing Company New Delhi.
2. B.K. Verma (2011). Introduction to Taxonomy of Angiosperms: PHI Learning Pvt. Ltd New Delhi.
3. V. Singh, Dr. V. Singh & Dr. D.K. Jain. (2010). Taxonomy of Angiosperms: Second Edition. Rastogi Publications Meerut India.
4. Pandey S.N. and Mishra. S.P. (2009). Taxonomy of Angiosperms: Ane Books Pvt. Ltd. New Delhi.
5. Pandey, B.P. (2012). Taxonomy of Angiosperms: S.Chand and Company Ltd., New Delhi.
6. B.P. Pandey. (2011). College Botany Vol. I: S. Chand and Co., Ltd. New Delhi.
7. Pandey, B.P. and Anita, (2009). Economic Botany: S. Chand and Co., Ltd. New Delhi.
8. Pandey, B.P. (2010). Ethnobotany: S. Chand and Co., Ltd. New Delhi.

REFERENCES:

1. Singh (2004). Plant Systematics: Oxford & IBH Publishing Co., Pvt., Ltd. New Delhi.
2. A.K. Mondal (2009). Advanced plant Taxonomy: New Central Agency Pvt. Ltd., New Delhi.
3. Bharathi Bhattacharyya (2009). Systematic Botany: Narosa Publishing House. India.

4. N.S. Subrahmanyam, (2007). Modern Plant Taxonomy: Vikas Publishing House Pvt. Ltd New Delhi
5. Lawrence, G.H.M. (1961), Taxonomy of Vascular Plants: MacMillan and Co., New Delhi.
6. Pullaiah, T. (2007). Plant Taxonomy: Regency Publications, New Delhi.
7. Singh, G (1999). Plant Systematics – Theory and Practice: Oxford and IBH Publishing Co. Pvt Ltd., New Delhi. 35pp.
8. Kochar, S.L. (2000). Economic Botany of the Tropics: Macmillan India Pvt. Ltd.
9. Sharma, (1996). Economic Botany: Tata McGraw Hill Co., Ltd.
10. The useful Plants of India – CSIR Publications (1986) and Information Directorate, New Delhi.
11. Verma, (1998). Ethnobotany: Rastogi Publications Meerut India.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	III	18MBO32C	PAPER-VIII PLANT PHYSIOLOGY	7

Objectives:

1. To understand the concepts involved in the function of plants
2. To study the recent aspects of various physiological processes in plants
3. To understand the physiological roles of plant hormones
4. To acquire the knowledge of plant growth and stress

Unit – I

Water movement in plants: Mechanism of Absorption of water: Apoplast and Symplast, Ascent of sap: Soil- Plant- Atmosphere Continuum (SPAC) concept; Transpiration: Stomatal physiology and mechanism and guttation; Mechanism of Absorption of mineral salts; Mechanism of transport of organic solutes: Pressure flow mechanism, phloem loading and unloading.

Unit - II

Mineral nutrition: Criteria of essentiality of elements; Macro and Micro- nutrients; Role of essential elements; Mineral deficiency symptoms; Mineral salt absorption: Nutrient uptake and transport mechanism: Role of cell membrane, Ion pump carrier.

Unit –III

Photosynthesis: Organization of photosynthetic apparatus and light absorbing antenna systems; Absorption and transformation of radiant energy; Photosynthetic Electron transport and Photophosphorylation; Photooxidation of water; C₃, C₄ and CAM pathways and their efficiencies; Photorespiration and its regulation; Inorganic carbon concentrating mechanisms; RUBISCO and PEPC.

Unit - IV

Respiration: Glycolysis, TCA cycle and its regulation ; aerobic and anaerobic respiration; electron transport in Mitochondria, Redox potential, Oxidative phosphorylation, Mechanism of ATP Synthesis; ATP - biological energy currency, Pentose Phosphate Pathway.

Plant Hormones: Skoog and Miller's theory (1957); Structure, physiological role and mode of action of Auxins, Gibberellins, Cytokinins, Ethylene and Abscissic acid (brief out line only); Synergistic action of Auxins and Cytokinins.

Unit - V

Growth: Growth retardants - polyamines and morphactins. Flowering, photoperiodism its significance- short day, long day and day-neutral plants, regulations of flowering and vernalization. **Biological rhythm-** Endogenous clock mechanism- circadian rhythm. **Ageing and senescence-** Types of physiological changes. **Stress physiology** – Classification of stress – biotic and abiotic; Response of plants to stress; Mechanism of stress resistance.

PRACTICALS:

1. Determination of osmotic pressure
2. Determination of water potential of Potato tuber.
3. Extraction and estimation of chlorophyll.
4. Determination of stomatal frequency and stomatal index.
5. Effect of light intensity on the rate of photosynthesis.
6. Effect of quality of light on the rate of photosynthesis.
7. Effect of varying concentrations of CO₂ on the rate of photosynthesis.
8. Separation of chlorophyll pigments using paper chromatography.
9. Measurement of respiration by simple respiroscope.
10. Determination of relative transpiration using potometer.
11. Effect of temperature on the permeability of cell membrane (demonstration).
12. Effect of auxins on etiolated stem.
13. Hill reaction by isolated chloroplasts (demonstration).
14. Manometric determination of R.Q (demonstration).

TEXT BOOKS:

1. Salisbury, F.B and Ross, C.W. (1992). Plant Physiology (4th Edition): Wadsworth Publishing Co. California, USA.
2. Devlin and Witham, F.H. (1999). Plant Physiology. 4th Edition: CBS Publishers and Distributors, New Delhi.
3. Noggle, G.R. and Fritz, G.J. (2010). Introductory Plant Physiology: 2nd Prentice Hall of India, New Delhi.
4. Kochhar, P.L., and Krishnamurthy, H.N. (1989). Plant Physiology: Atmaram & Sons, New Delhi.
5. Jain, V.K. (1995). Fundamentals of Plant Physiology: S. Chand & Co. New Delhi.
6. Verma, S.K. (1995). A Textbook of Plant Physiology and Biochemistry: S. Chand & Company Ltd, New Delhi.

REFERENCES:

1. Sinha, R.K. (2007), Mordern Plant Physiology: Narosa Publishing House, New Delhi.
2. Mukjerjee S. and Ghosh A.K. (2009). Plant Physiology: New Central Book Agency; 3rd Revised edition edition.
3. Jain, A. K. (2003), “Textbook of Physiology”: Arichal Publishing Company. New Delhi.
4. Hopkins W.G. (1995). Introduction to plant physiology: John Wiley and Sons, new York, USA.
5. Moore T.C. (1989). Biochemistry and physiology of plant hormones: Springer Verlag. New York, USA.
6. Taiz L. And Zieger E. (1998). Plant physiology: Sinauer Associates Inc. and publishers, USA.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	III	18MBO33E	ELECTIVE PAPER III- MOLECULAR BIOLOGY AND BIOINFORMATICS	7

Objectives:

1. To know the central dogma of molecular biology
2. To understand the molecular mechanism of gene regulation
3. To make the learners understand the functional aspects of the cell at molecular level.
4. To detail the various web based resources for biological information
5. To provide a platform for molecular understanding of the structure- function relations in DNA/RNA/Proteins

UNIT – I

Central Dogma of Molecular Biology - Modern concept of gene – cistron, recon and muton - One gene one polypeptide hypothesis - Bacterial DNA replication - Rolling circle model - Replication of Eukaryotic DNA – Semiconservative model. Transcription: RNA polymerase; signals; chemistry and process. Translation: mechanism of initiation; elongation and termination of protein synthesis.

UNIT –II

Regulation of gene expression in Prokaryotes: Induction and repression in prokaryotes; The operon model: ‘lac’- an inducible operon, Positive control of the ‘lac’ operon by CAP and cyclic AMP; ‘trp’ – a repressible operon, control of ‘trp’ operon by attenuation, Regulation of ‘ara’ operon; Allosteric enzymes and feedback regulation.

UNIT -III

Regulation of Gene expression in Eukaryotes: Transcriptional regulation, Cis and trans factors; Co-operative and on / off regulation, repressors and inducers; transcriptional regulation by sigma factors; Post transcriptional regulation (mRNA capping, pre-mRNA splicing and poly ‘A’ tail); Translational and post translational Control; Protein targeting; Epigenetic mechanism of gene control; Principles of RNA interference and gene silencing.

UNIT IV

Bioinformatics: Definition and Scope. Biological information portal: NCBI, Biological databases – EMBL. Gen Bank, DDBJ – Sequence and molecular file formats. Genomics: Definition – BLAST- An overview of BLAST tools available with NCBI. Gene prediction methods (Homology, *ab initio*, and comparative method). scoring matrices (PAM AND BLOSUM). Pair wise and Multiple sequence alignment, Molecular phylogeny (Cladistics and phenetic methods) CLUSTAL and PHYLIP.

UNIT V

Proteomics: Definition, Levels of protein structure, Protein secondary structure prediction (SOPMA and JPRED). Molecular visualization tool- Rasmol and Swiss PDB Viewer. Protein modeling methods-Comparative and *De novo* methods. Model refinement and evaluation of model. Over view of SWISS PROT. Outline of computer aided drug designing. Systems biology – concept and applications.

PRACTICALS:

- Observation and analysis of web sites of NCBI, EMB Net, PDB, SWISS PROT, SCOP.
- Visualization of protein structure with Rasmol and Swiss PDB Viewer
- Multiple sequence analysis and phylogenetic tree construction using CLUSTAL X and PHYLIP
- Comparative modeling of protein using SWISS MODEL/MODELLER
- Docking analysis of metabolic inhibitors

TEXT BOOK(S):

1. Freifelder, D. (1993). Essentials of Molecular Biology: Jones & Bartlett, Boston.
2. De Robertis and De Robertis. (1990). Cell and Molecular Biology: Saunders College, Philadelphia, USA.
3. Lodish (2004), Molecular cell biology: COH freeman & Co. New York.
4. Watson J.D. (2004), Molecular biology of the gene: Pearson education, Singapore.
5. Karp, G. (1999). Cell and Molecular Biology : Concept and Experiments. John Wiley and Sons, Inc., USA.
6. Balagurusamy, E., (1985), Programming in BASIC. Tata McGraw Hill Publication Co. Ltd., New Delhi.
7. Smith, D.W., (1994), Biocomputing – informatics and Genome Project: Academic press, Inc., New York.

REFERENCES:

1. Elliott WH and Elliott, DC. (2005). Biochemistry and Molecular Biology: 3rd Ed. Oxford University, Oxford.
2. Primrose, S.B. and Twyman R.M., (2003). Principles of Genome analysis and Genomics. Oxford University, Oxford.
3. Andreas D. Baxevanis and B. F. Francis Ouellette. (2005). Bioinformatics - A Practical guide to the analysis of Genes and Proteins (Ed: 3): John Wiley & Sons, Inc., Publications, US.
4. David W Mount. (2004). Bioinformatics: sequence and Genome analysis(Ed: 2): Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
5. Primrose S.B. and Twyman R.M. (2004). Principles of Genomics and Proteomics (Ed: 3): Blackwell Science Ltd. Oxford, UK.

6. Cullis C.A. (2004). Plant Genomics and Proteomics: John Wiley & Sons, Inc., Hoboken, New Jersey.
7. Gupta P.K (2013). Genetics and Cytogenetics: 7th Edition. Rastogi Publications.
8. Ahluwalia K.B (2005). Genetics: New Age International Private Ltd. Publishers, New Delhi.
9. Pawar C.B (2003). Genetics Vol. I and II: Himalaya Publishing House, Mumbai
10. Sheeler P and Binachi D (2004). Cell and Molecular Biology: Third edition, Wiley New York, USA.

Website(s)

- <http://www.ncbi.nlm.nih.gov/genbank>
- www.phylogeny.fr/
- [www.bioinformatics.oxfordjournals.org/egi/content/full/ btp228](http://www.bioinformatics.oxfordjournals.org/egi/content/full/btp228)
- www.bioinformatics.org/
- www.ebi.ac.uk/

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	IV	18MBO41C	PAPER-IX GENETICS, CYTOGENETICS AND PLANT BREEDING	7

Objectives:

1. To acquire a knowledge on various Mendel's experiments and laws
2. To understand the molecular mechanism of linkage and crossing over
3. To study the mutation types and DNA repair mechanisms
4. To acquire a knowledge on various breeding methods involved in the improvement of crop plants
5. To study the application of induced mutations, induced polyploidy and wide hybridization for crop improvement

Unit-I

Mendel's experiments and Principles of inheritance: Back cross and Test cross; Gene interactions: Allelic Interaction (Incomplete dominance, Co-dominance, Lethal genes); Non-allelic Interaction (Complementary gene, Supplementary gene, Duplicate gene and Dominant epistasis); Multiple alleles in Corn and Tobacco; Quantitative Genetics: Quantitative traits - Multiple factor hypothesis.

Unit -II

Linkage and Crossing over: Coupling and repulsion phases; Interference and Coefficient of Coincidence, Molecular Mechanism of Crossing Over, Holliday model of recombination; Mutation (Spontaneous and Induced mutation); Physical and chemical mutagens; Molecular basis of mutation; Transposable elements in Prokaryotes and Eukaryotes.

Unit -III

DNA damage and DNA repair mechanisms (Dark repair, Photo reactivation, Excision repair, Post-replication recombination repair and SOS repair); Proto-oncogenes and oncogenes; Sex determination: Sex determining mechanisms; Extra chromosomal inheritance: Cytoplasmic Male Sterility (eg. Maize), Plastid inheritance (eg. *Mirabilis*).

Unit -IV

Variation in chromosome structure (Duplication, Deletion, Inversion and Translocation); Variation in chromosome number: Euploidy- Autopolyploidy and Allopolyploidy, Aneuploidy- Trisomics (Primary Trisomics, Secondary Trisomics, Tertiary Trisomics, Tetra-trisomics and Acrotrisomics), Monosomics and Nullisomics. Polyploidy in Plants, Role of Polyploidy in Evolution (eg. Wheat); Population Genetics: Gene frequency, Hardy-Weinberg Law, Factors influencing Hardy-Weinberg equilibrium (Natural selection, Genetic Drift and Mutation).

Unit -V

Plant breeding: Methods of Plant Improvement-Introduction and Acclimatization, Selection - Mass selection - Pure line selection - Clonal selection. Hybridization: Methods of Hybridization (Pedigree method, Bulk method, Backcross method, Multiple cross method), Heterosis. Heritability, General Combining Ability (GCA), Specific Combining Ability (SCA). Mutation breeding: Breeding for disease resistance; Breeding of Wheat, Potato, Paddy and Cotton. Polyploidy breeding, Role of Biotechnology in Plant Breeding.

PRACTICALS:

1. Genetics problems related to Monohybrid cross, dihybrid cross, test cross, back cross, incomplete dominance, co-dominance and dominant epistasis
2. Chromosomal mapping
3. Calculation of gene and gene frequency using Hardy – Weinberg's equilibrium.
4. Hybridization techniques using potted plants
5. Schematic flowchart of bulk and pedigree methods

TEXT BOOKS:

1. Gardner, Simmons and Snustad (1991), Principles of Genetics: Eighth edition - John Wiley & Sons, Inc., New York.
2. R.S. Shukla and P.S.Chandel (1988), Cytogenetics, Evolution and Plant Breeding: S. Chand & Company (Pvt) Ltd, New Delhi.
3. P.K. Gupta (1979), A Textbook of Cytology, Genetics and Evolution-Third edition : Rastogi Publications, Meerut, India.
4. P.K. Gupta, (2007). Genetics: Classical to Modern-First Edition: Rastogi Publications, Meerut, India.
5. J R Sharma (1994). Principles and Practice of Plant Breeding: Tata McGraw Hill Publishing Company Limited, New Delhi.
6. R.A Shukla and P. S Chandel (2009). Cytogenetics, Evolution, Biostatistics and Plant Breeding - First Edition: S. Chand & Company Ltd, New Delhi.

REFERENCES:

1. Mahabal Ram (2010). Fundamentals of Cytogenetics and Genetics: PHI Learning Private Limited, New Delhi.
2. S.B. Basu M. Hossain (2006), Principles of Genetics: Books & Allied (P) Ltd, Kolkata.
3. David Freifelder (1998). Molecular Biology: Second Edition - Narosa Publishing House, New Delhi.
4. Peter J Russell (1987). Essential Genetics: Second Edition- Blackwell Scientific Publications, London.
5. Gupta P.K (2013) Genetics and Cytogenetics. 7th Edition. Rastogi Publications.

6. Ahluwalia K.B (2005) (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
7. Sariu C (2004) (Sixth Edition) Genetics. TATA McGraw-Hill Publishing Company Ltd., New Delhi.
8. Pawar C.B (2003) (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai
9. Lewin, B. (2000). Gene VII. Oxford University Press, New York, USA.
10. Gupta P. K. (1999). Cytogenetics. Rastogi Publication Meerut.
11. Prasad G. (1998). Introduction to Cytogenetics. Kalyani Publishers, New Delhi.
12. Sinha U. and Sinha S. (1998). Cytogenetics, Plant Breeding and Evolution. Vikas Publishing house Pvt. Ltd. New Delhi

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	IV	18MBO42C	PAPER – X PLANT ECOLOGY, CONSERVATION AND PHYTOGEOGRAPHY	7

Objectives:

1. To understand the basic and applied aspects of environmental botany; the levels of organization and the basic divisions of biology.
2. To make to understand the concepts of Ecosystem, Autecology and Synecology
3. To plan and co-ordinate conservation efforts
4. To sustainability use biodiversity within management systems
5. To protect and restore ecosystems, species and genetic diversity using a variety of *in situ* and *ex situ* methods
6. To make to understand the importance of forests and plant geography

Unit –I

Factors of Environment: Interpretation of effects of climatic, edaphic, topographic and biotic factors; Principle of limiting factors: trigger factors and holistic environment; Population ecology: growth curve, biotic potential and age structure. Community ecology; Climate change and Global Warming.

Unit – II

Methods of studying vegetation: Floristic, Physiognomic and Phyto sociological methods; Concepts of vegetation structure – Units of vegetation; Succession: Concepts, kinds and impact of human interference on succession; Conservation: *in situ* and *ex situ*, Gene bank, Arboretum, Bambusetum, Botanical garden, Biosphere reserves, Sacred garden, Sacred grooves.

Unit – III

Ecosystem: Concept and types ; Trophic structure, Ecological pyramids, Food chain and Food web; Energy flow, Ecological energetics, Production ecology and Biogeochemical cycles. Human impact on ecosystem: Pollution, types (air, water, soil, noise and radioactive pollution); Bioremediation; E- Waste : Concept and management.

Unit – IV

Forestry: Indian forest types and forest products of India; Deforestation, soil erosion and soil conservation; Forest genetic resources management: Scope and Objectives, Afforestation, Social forestry and Clonal forestry (selection and vegetative propagation); Mapping: Conservative method and Satellite Mapping. Exobiology; Remote sensing : Principle and GIS – application; Vegetation types: Rain forest, Deciduous forest, Mangroves and Scrub jungle.

Unit – V

Plant geography: Plant distribution – concept, Age and Area hypothesis; Theory of Continental drift; Theory of endemism; Patterns: Cosmopolitan, pan tropical, continuous, discontinuous, endemic distribution; Plant indicators; Phytogeographical domains of World and India.

PRCTICALS:

1. Study of community structure by quadrats and transects (line, belt).
2. Determination of density, abundance and frequency of species.
3. Raunkiaer's biological spectrum and Raunkier's leaf size, plant maps.
4. A knowledge of equipment's used to measure various climatic factors.
5. Determination of soil moisture, pH, EC and humus content.
6. Mapping the distribution of forest types in India and Tamilnadu.
7. Mapping the phytogeographical regions in India.
8. Continental drift.
9. Forest based produces.
10. Vegetative propagation methods.

SCIENTIFIC VISITS

1. Visit to biosphere reserve, museum, national park or a sanctuary / mangrove vegetation.
2. Visit to Botanical Survey of India / Forest research institute.
3. Visit to industries to study the pollution and its impact.

TEXT BOOKS:

1. R.S.Shukla and P.S. Chandel. (2007), A text book of Plant Ecology: 11th Edition. C. Chand and Company Ltd. New Delhi.
2. P.D. Sharma, (1994). Environmental Biology: Rastogi and Company, Meerut.
3. H.D. Kumar, (2007). Modern concepts of Ecology: 8th Edition, UBS Publisher's & Distributors Pvt. Ltd. New Delhi.
4. A.K. Agarwal and P.P. Deo, (2006). Plant Ecology: Agrobios (India), New Delhi.
5. P.D. Sharma, (2009). Ecology and Environment: 10th Edition, Rastogi Publications, New Delhi.

REFERENCES:

1. G. Tyler Miller, J.R. (2010). Environmental Science: Cengage Learning India Pvt. Ltd. New Delhi.
2. Clifford B. Knight, (1971). Basic Concepts of Ecology: The Macmillan Company Collier – Macmillan Ltd. London.
3. R.S. Ambasht and N. K. Ambasht, (2011). A text book of Plant Ecology: CBS Publishers and Distributers Pvt. Ltd., New Delhi.
4. R.S. Verma and V.K. Agarwal, (1998). Concepts of Ecology: C. Chand and Company Ltd. New Delhi.
5. C. Surendran, K.T.Parthiban, K. Vanangamudi and S. Balaji, (2000). Vegetative Propagation of Trees (Principles and Practices), TNAU, Coimbatore.

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2018 -2019 onwards	IV	18MBO43E	ELECTIVE PAPER – VI BIOTECHNOLOGY	7

Objectives:

1. To provide the detailed information about the plant tissue culture practices for micro-propagation and other applied aspects
2. To provide information about the gene manipulation techniques, and introduces the students to the concepts and advancements in molecular cloning
3. To understand the diversity of vectors used for cloning purposes
4. To acquire fundamental knowledge on the application of various molecular tools and techniques for improvement of higher plants
5. To cover information about the biotechnology to agriculture, in raising transgenic plants with specific traits

Unit –I

Plant Tissue culture: Introductory history, Laboratory Organization, Culture Media, Aseptic techniques, Somoclonal variation, Micropropagation: (Techniques; multiplication through callus culture, nodal culture, meristem culture and root culture). Somatic embryogenesis and Artificial seed production.

Unit –II

Haploid production (Anther, pollen and ovary culture); Embryo culture; Single cell culture; Protoplast isolation, Somatic hybridization, Cybridization; Production of Secondary metabolites; Cryopreservation and Germplasm conservation.

Unit – III

Recombinant DNA technology: Aim and scope of rDNA technology, Basic steps in Genetic Engineering; Enzymology of genetic engineering, Restriction enzymes; cloning vectors (Plasmid, Phage, Cosmid, Yeast); Specialized vectors (Fusion and expression vectors); Selection of recombinant clones.

Unit – IV

Agrobacterium and crown gall tumors; Mechanism of T-DNA transfer; Disarmed Ti Plasmid vectors (Co-integrate and Binary vectors); plant viral vectors; Direct gene transformation methods (Particle gun bombardment, Electroporation, CaCl₂, PEG and Liposome mediated transformation); Selectable markers and promoters used in plant genetic engineering; transgenic plants (Herbicide resistance and pest resistance).

Unit – V

Genetic engineering of plants for virus resistance, Pathogen resistance, salt and drought tolerance, Cytoplasmic male sterility, antisense RNA technology; Edible vaccines, Golden rice, Plastic potato; High lysine corn. Bt cotton, Intellectual property right; Patenting of biological material; Biosafety and Bioethics.

PRACTICALS:

1. Sterilization techniques (Fumigation, Flame sterilization, Dry heat, Wet heat Filter sterilization)
2. MS media preparation
3. Isolation of protoplasts
4. Callus culture
5. Nodal culture
6. Artificial seed production
7. Isolation of Genomic DNA
8. Isolation of Plasmid DNA
9. Co- cultivation Techniques (Protocol only)
10. Visit to Biotechnology Laboratories

TEXT BOOKS:

1. Narayanasamy, S.(2000). Plant Cell and Tissue Culture: Tata Mc- Graw- Hill Publishing & Co Ltd.
2. Sathyanarayana, U (2005). Biotechnology- Books and Allied (P) Ltd.,New Delhi.
3. Dubey. R .C (1993). Text Book of Biotechnology: S. Chand &Co New Delhi..
4. Glick, B.R and Patten C.L (2017) , Molecular Biotechnology IVth edition: ASM Press.
5. Primrose, S, R. Twynman and P.Old. (2005). Principles of gene manipulation: Blackwell Science Ltd., New Delhi.
6. Balasubramanian (2002). Concept of Biotechnology: University Press.
7. Dubey, R.C. (2008). A Textbook of Biotechnology. S.Chand Company Pvt. Ltd. New Delhi.

REFERENCES:

1. Verma P.S. and Agarwal V.K. (2009). Genetic Engineering: S.Chand & Company New Delhi.
2. Renert J. and Bajaj Y.P.S (1989). Plant Cell, Tissue and Organ Culture: Narosa Publishing House New Delhi.
3. Gupta P.K, (2004). Elements of Biotechnology: Rastogi Publication
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