M.Sc.BOTANY
SEMESTER-I
THEORY PAPER-1.1: BIOLOGY AND DIVERSITY OF VIRUSES, BACTERIA, ALGAE AND FUNGI

Course objectives

This course is designed to

- Understand the structure and significance of viruses.
- Explain the ultrastructure and nutritional types of bacteria.
- Expose to Actinomycetes, Mycoplasmas and cyanobacteria.
- Have an idea about distribution, classification and significance of algae and fungi.

UNIT - I
Brief account of discovery of viruses; general properties, structure, cultivation, purification and transmission of viruses; brief account of bacteriophages and plant viruses; Economic importance

Learning Outcomes
The student will have an idea about

- Basic and advanced information on viruses.
- The importance of viruses.

UNIT - II
Morphology and ultra structure of bacteria; Nutritional types (autotrophs and heterotrophs); Growth of Bacteria; Recombination in bacteria (transformation, transduction and conjugation); General characters of Actinomycetes, Archaebacteria, Mycoplasmas and Cyanobacteria; Economic importance.

Learning Outcomes
The student will have an idea about

- Ultrastructure and significance of bacteria.
- Categorization bacteria based on nutrition.
- The importance of Archaebacteria, Actinomycetes and Cyanobacteria.

UNIT - III
Distribution, thallus organization, classification and economic importance of algae; Algae as primary producers and commercial products. Algae as SCP. Algal blooms and toxins.

Learning Outcomes
The student will have an idea about

- The importance of algae.
- Categorization of algal members.

UNIT - IV

General characters; Nutrition and reproduction of fungi; classification of Fungi (Ainsworth system); Ecto and endomycorrhizal associations; Edible and poisonous mushrooms, Mushroom cultivation; Importance of Fungi in Agriculture and industry. Mycotoxins

Learning Outcomes

The student will have an idea about

- Distribution and importance of fungi.
- Distinguishing edible and poisonous mushrooms.
- Cultivation of mushrooms.

REFERENCE BOOKS

1. An Introduction to Fungi: by Webster, J. (1985). Cambridge Univ. Press.
2. Brock Biology of Microorganisms: by Madigan. Mordinko and Parker (2000). Prentice Hall.
3. Introduction to Plant Viruses: by Mandahar. C.I. (1978). Chand & Co., New Delhi.
4. Introductory Phycology by Kumar, H.D. (1988). Affiliated East-West Press. Ltd, New Delhi.
5. An Introduction to the Algae by Morris. J. (1986). Cambridge University' Press, U.K
6. Microbiology: by Prescott, L.M., Harley, J.P. and Klein, D.A. (1992), WCB Publishers.
7. Introductory Mycology: by Alexopoulos, C.J. Mims, C.W. and Blackwell, M. (1996). John Wiley & Sons.
8. The Biology of Algae by Round. F.E. (1986). Cambridge University Press. U.K.

M. Sc. BOTANY
SEMESTER-I
THEORY PAPER- 1.2: BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PLANT FOSSILS

Course Objectives
The aim of the course is to

- Increase the understanding of the students about the diversity of bryophytes, pteridophytes and gymnosperms.
- Impart knowledge about classification, general characters, structure and reproduction of these archigoniatae groups.
- Know about distribution, evolutionary trends in different stages of these groups.
- Understand the principles of palaeobotany and evolution of fossils of various extinct lower groups of plants.

UNIT - I
Classification, general characters, range of thallus organization and reproduction in Hepaticopsida, Anthocerotopsida and Bryopsida. Evolutionary trends in gametophytes and sporophytes of Bryophytes.

Learning Outcomes
On successful completion of unit, the students will be able to

- Learn about general characters, vegetative and reproductive structures of bryophytes.
- Understand the evolution of sporophytes and gametophytes of bryophytes by theoretical and practical exposures.

UNIT - II
General characteristics and classification of pteridophytes; Study of morphology, anatomy and reproduction of Psilopsida, Psilotopsida, Lycopsida, Sphenopsida and Pteropsida. Origin and phylogeny of pteridophytes. Evolution of stele in Pteridophytes. Heterospory and seed habit in pteridophytes.

Learning Outcomes
On successful completion of unit, the students will be able to

- Know the general characters, classification, vegetative and reproductive morphology of pteridophytes.
- Learn about origin and phylogeny of pteridophytes, origin of stele and seed habit in different classes of pteridophytes.

UNIT - III
Classification, distribution and economic importance of Gymnosperms. Structure and reproduction in living (modern) Cycads, Coniferopsida and Gnetopsida. Wood of gymnosperms; Male and female gametophytes of gymnosperms.

Learning Outcomes
On successful completion of unit, the students will be able to

- Understand different groups of gymnosperms and their structure and reproduction.

- Know the economic uses of gymnosperms.
- Learn evolutionary changes in wood of gymnosperms.

UNIT - IV

Principles of Paleobotany; Geological time scale; determination of age of plant fossils; process of fossilization; types of fossils; a comprehensive account of fossil algae, fossil bryophytes, fossil pteridophytes and gymnosperms (Pteridospermales, Bennettitales, Cordaitales and Pentoxylales).

Learning Outcomes

On successful completion of unit, the students will be able to

- Learn about geological time scales and the process of fossilization.
- Know various plant fossils of algae, bryophytes, and pteridophytes and gymnosperms.

REFERENCE BOOKS

1. Agashe, S.N. 1995. Palaeobotany. Oxford & IBH, New Delhi
2. Arnold, C.A. 1947. An introduction to Palaeobotany, New York
3. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd. NewDelhi.
4. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
5. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
6. Puri, P. 1980. Bryophytes. Atma Ram & Sons, New Delhi.
7. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publication. Pvt. Ltd.
8. Sporne, K.R. 1965. The Morphology of Gymnospermae. B.I. Publications, NewDelhi.

M.Sc. BOTANY

SEMESTER - I

THEORY PAPER- 1.3: PLANT SYSTEMATICS

Course Objectives

The aim of the course is to

- Impart knowledge in basic components, hierarchical structure and categories of systematics and principles governing the naming of plants.
- Know various aspects of evolution of classification systems.
- Learn various methods of identification and preservation of plants.
- Understand recent advances in systematics.

UNIT - I

Systematics: Concepts and basic components; Taxonomic structure; Taxonomic hierarchy- species to division; Evaluation of taxonomic categories; International Code of Nomenclature (ICN) of algae, fungi and plants – Principles, Rules and Recommendations, Ranks, Principle of Priority, Typification, Author citation, Effective and Valid publication.

Learning Outcomes

On successfulcompletion of unit, the students will be able to

- Explain the importance of systematics and its fundamental components.
- Learn the hierarchical taxonomic structure.
- Know the principles and rules of nomenclature for naming the plants.

UNIT - II

Armen Takhtajan system of classification, its merits and demerits; Angiosperm Phylogeny Group (APG) classification; A brief account of selective clades like Basal angiosperms, Magnoliids, Monocots (including Commelinids), Eudicots, Rosids, Asterids; Taxonomic evidence: Morphology, Anatomy, Embryology, Palynology and Cytology in relation to taxonomy.

Learning Outcomes

On successful completion of unit, the students will be able to

- Understand the recent advances in the classification plant groups.
- Learn different phylogentic clades of plants based on molecular studies.
- Determine the role of various taxonomic evidences in classification of plants.

UNIT - III

Process of Plant Identification: Construction, types and use of Taxonomic keys; Herbarium methodology: Collection of plants, processing and preservation of specimens; Important World and Indian herbaria; Major botanical gardens of the World and India; Data information systems; Botanical Survey of India (BSI) : Objectives, activities, organization and publications.

Learning Outcomes

On successful completion of unit, the students will be able to

- Identify the plants by using various methods.
- Explain the method of herbarium preparation.
- Know the important herbaria and botanical gardens of the world.
- Develop data information systems

UNIT - IV

Chemosystematics: Primary and Secondary metabolites, semantides and non-semantides etc., in plants; Phylogenetic Systematics: operational units, characters, coding and construction of cladograms; Serosystematics: Methodology and its applications in systematics; Molecular Systematics: Gene sequences, Phylogenetic analysis, Restriction site analysis, allozymes, DNA bar coding in plants and its practical implications.

Learning Outcomes

On successful completion of unit, the students will be able to

- Understand the importance of metabolites and sementides in systematic.
- Construct cladograms by using cladistic methods.
- Explain serological and molecular techniques in establishing phylogenetic relations.

REFERENCES BOOKS

1. **International Code of Nomenclature for algae, fungi, and plants** (Schenzhen Code), 2018.(online version) adopted by the *Nineteenth International Botanical Congress*, Chenzehen, China
2. **Angiosperm Phylogeny group**, 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnaean Society* 181: 1-20.
3. **Judd,W.S. Campbell, C.S.,Kellogg, E.A.,Stevens, P.A. and Donoghue**, M.J.2016. *Plant Systematics: A Phylogetic Approach.* Sinauer Associates, Inc.,Massachusetts.
4. **Simpson, M. G.** 2006. *Plant Systematics*. Elsevier Academic Press, Canada.
5. **Sambamurthy, A. V. S. S.** 2005. *Taxonomy of Angiosperms*. I.K. International Pvt. Ltd, New Delhi.
6. **Crawford, D.J**.2003. Plant Molecular Systematics. Cambridge University Press, Cambridge , UK.

7. **Gurcharan Singh**.1999. *Plant Systematics - Theory and Practice*. Oxford & IBH Publishing company Pvt. Ltd., New Delhi.
8. **Radford, A. E**. 1986. *Fundamentals of Plant Systematics*. Harper & Row Publisher, New York.
9. **Davis, P. H.** and **Heywood**, **V. M.**1973. Principles of Angiosperm Taxonomy. Robert E.Kereiger Publishers, New York.
10. **Gamble, J. S.** and **Fisher, C. E. C**. 1915-35. *Flora of Presidency of Madras*. 3 Volumes. BSMS, Dehradun.

M.Sc. BOTANY
SEMESTER 1
THEORY PAPER –1.4: ETHNOBOTANY AND ETHNOMEDICINE

Course Objectives

- Ethnobotany and Ethnomedicine course could address the contemporary issues related to human health and problems faced by indigenous communities, such as Biopiracy, Intellectual Property Rights etc.
- To understand the interactions between the cultural practices, ecosystems and modern science.
- To know the major areas of human interactions with plants and environment.
- Ethnomedicinal uses of plants to treat human diseases.
- To know methods followed by Ethnobotany researchers.

UNIT - I

Definition, concept, history, scope and importance; Plants used in various systems of medicine – Ayurveda, Unani and Homeopathic system; allopathic system. Indigenous knowledge and traditional practices of indigenous communities of Eastern Ghats of Andhra Pradesh. Sacred groves of Andhra Pradesh and biodiversity conservation; Scope for the development of plant resources. Developing the questionnaire for the usage of plants by local communities for various purposes.

Learning Outcomes

- Student can learn the techniques to develop the questionnaire for collecting the data related to the usage of plants by local communities for various purposes.
- How many communities are living in Eastern Ghats of Andhra Pradesh, what are their socio-economic conditions, traditional practices, customs and religious belief?
- Concept of sacred groves and their role in biodiversity conservation.

UNIT - II

Macro and micro propagation and multiplication of medicinal plants such as *Rauwolfia serpentina*, *Withania somnifera, Aegle marmelos* and *Vanilla planifolia;* commercial production of bio-active molecules through tissue culture technology. Methods of collection, processing, storage, market potential and trade of plant medicine; IPR & IPP, Biopiracy,adoption of GATT, TRIPS for plant medicine.

Learning Outcomes

- How the native people are cultivating the medicinal plants traditionally.
- Various micropropagation methods through tissue culture.
- Commercial production of bio-active compounds' through tissue culture technology.
- Market potential and trade of plant medicine by adhering to various international agreements such as GATT, TRIPS etc.

UNIT - III

Role of Ethnobotany in drug discovery. Identification of locally available medicinal plants. Ayurvedic drug preparation and adulteration of drugs; pharmacognostical studies to check adulteration. Approaches to drug discovery from the ethnobotanical knowledge.

Learning Outcomes

- How does ethno botanical knowledge helpful in drug discovery?
- Identification and systematic position of locally available medicinal plants.
- How the drug adulteration is rampantly going on and how to detect it.
- What are different approaches of drug discovery from the ethnobotanical knowledge?

UNIT - IV

Secondary metabolites (natural products) from plants and their importance, systematics and characterization. Alkaloids, flavonoids, glycosides, steroids and tannins from plant kingdom. Functions of secondary metabolites in plant defense and also curing various human diseases. Biological active principle of established herbal medicine. Herbal cosmetics and Neutraceuticals.

Learning Outcomes

- What are the secondary metabolites present in plant system and their importance and characterization?
- Functional aspects of secondary metabolites in plants and this information is useful in evaluating the medicinal property of natural products.
- Bioactive principle of established herbal medicine.
- Usage of herbal cosmetics and Neutraceuticals.

REFERENCE BOOKS

1. Jain, S.K. 1981. *Glimpses of Indian Ethnobotany*, Oxford and IBH Publishing Co., New Delhi.
2. Rao, P.S. Venkaiah, K. & Padmaja, R. 1999. *Field guide on Medicinal Plants*. A. P. Forest Department.
3. Trivedi, P.C. 2002. *Ethnobotany*. Avishkar Publishers, Jaipur, India.
4. Arber, A. 2008. *Herbal Plants & Drugs*. Agro Science Book Centre, New Delhi.
5. Cutler. S.J. & Cutler. H.G. 1999. *Biologically Active Natural Products – Pharmaceuticals*. Agro Science Book Centre, New Delhi.
6. Harborne, J.B. 1948. *Phytochemical Methods*. Chapman and Hall, London.
7. Kokate, C.K. Purohit, A.P. Gauchely, S.B. 1990. *Pharmacognosy*, Nirali Prakashan, Pune.
8. Khare, C.P. 2000. *Indian Herbal Therapies*. Delhi Book Co., New Delhi.
9. Nadkarni, K. M.2004. *Indian Plants & Drugs with their Medicinal Properties*. Agro Sci. Publ. Centre, New Delhi.
10. Panda, H. 2003. *Medicinal Herbs & Their Uses with Formulations*. Daya Publishing House, New Delhi.
11. Trease, G.E. and Evans, W.C. 1983. *Pharmacognosy.* (12th Ed.), Bailine, London.

12. Wallis, T.E. 1999. *Text Book of Pharmacognosy*, (5th Ed.) CBS Publishers & Distributions, New Delhi.
13. Paroda, R.S. & Arora, P.K. 1991. *Plant Resources conservation and management concepts and approaches,* New Delhi.
14. Martin, G.J. 1995. *Ethnobotany: Principles and Applications*. John Wiley and Sons, Chichester.
15. Yamin, F. 1995. *The Biodiversity Conservation and Intellectual Property Rights*, Switzerland.
16. Kaushik, P. 2009. *Indigenous Medicinal Plants including Microbes and Fungi*. Today &Tomorrow's Printers and Publisher, New Delhi.
17. Das, A.P. & Pandey, A.K. 2007. *Advances in Ethnobotany*. Bishen Singh and Mahendra Pal Singh, Dehra Dun.

M.Sc. BOTANY
SEMESTER-II
THEORY PAPER – 2.1: CELL BIOLOGY AND CYTOLOGY OF PLANTS

Course objectives
This paper is designed to have a thorough knowledge on structure and function of cells, biomolecules and chromosomes

- Impart knowledge on different organelles of eukaryotic cell.
- Importance of cell cycle and role of cyclins.

UNIT - I
Prokaryotic and Eukaryotic Cells: Ultra structure of Prokaryotic and Eukaryotic cells. Organelles of eukaryotic cell; Nucleus, Chloroplast, Mitochondria, Ribosome, Endoplasmic reticulum, Microtubules, Peroxisomes, Golgi apparatus, Lysosomes and plant vacuoles and cytoskeleton.

Learning Outcomes

- Differentiate prokaryotic and eukaryotic cell.
- Understand structure, organization and function of cell organelles.

UNIT - II
Cell cycle – Phases of Cell cycle:- G1,S,G2 and M phases, check points in cell cycle - Role of cyclins; Cyclin dependent kinases; Apoptosis –mechanism and significance , oncogene and tumour suppressor genes. Genomes of mitochondria and chloroplasts. Endosymbiotic theory.

Learning Outcomes

- Overview of the cell cycle and the check points.
- Significance of oncogenes and tumour suppressor genes.
- Understand genomics of chloroplast and mitochondria.

UNIT - III
Ultrastructure of prokaryotic and eukaryotic chromosome; chromosome banding; Chromosomes structure and organization of DNA; Euchromatin and heterochromatin. Special types of Chromosomes: Polytene, Lamp-brush, B-chromosomes, and Sex- chromosomes, Cell division; significance of meiosis; Karyo-type study in relation to taxonomy.

Learning Outcomes

- Distinguish between prokaryotic and eukaryotic cells and chromosomes.
- Significance of meiosis.
- Understand the relationship of karyotyping and taxonomy.

UNIT - IV
Structural alteration in chromosomes - Origin, meiosis and breeding behaviour of duplication deficiency, inversion and translocation heterozygotes.
Numerical alteration in chromosomes: Origin, occurrence and induction of haploids, polyploids and aneuploids.

Learning Outcomes

- Emphasize structural alterations in chromosomes.
- Diagnose numerical alterations in chromosomes.

REFERENCE BOOKS

1. Brown and Berke: **Text Book of Cytology**, Blackstains Sons & Co.
2. Brachet and Mirsky (ed.): **The Cell**, Academic Press, Vols. 1-6.
3. Darlington, C.D :**Recent Advances in Cytology**, Blarkstains Sons & Co.
4. Lewin, B. 2000. **Genes VII,** Oxford University Press, USA.
5. De Robertis, E.D.P. and De Robertis, E.M.F. 2001. **Cell and Molecular Biology**, Lippinectt Williams & Wilkins, Bombay.
6. Sharma, A.K. and Sharma, A. 1980. Chromosome Techniques. Theory and Practice. Butterworth.
7. Stebbins, J.L. **Chromosomal Evolution in Higher Plants**, Edward Arnold Publ., London.
8. Roy, S.C. and Kumar, K.D.C. 1977. **Cell Biology,** New Central Book Agency, Calcutta.
9. Wolfe, S.L. 1993. **Molecular and Cellular Biology**. Wordsworth Publ. Co., California. USA.

M. Sc. BOTANY
SEMESTER – II
THEORY PAPER – 2.2: PLANT STRUCTURE AND DEVELOPMENT

Course Objectives

- Study the shoot apex organization in Angiosperms, Gymnosperms and Pteridophytes.
- Study the variations in Root apical organization of plants.
- Study the development and anatomical differences of leaves.
- Study the structure and abnormal activity of cambium.
- Study the seed dormancy, germination and seedling growth.
- Study the mechanism and significance of leaf senescence and programmed cell death.

UNIT - I

Plant Embryo development - Stages of embryo development, cell division and pattern formation in embryo**,** cell polarity in embryo, genetic and hormonal regulation of embryo development; Meristems - types and functions of Meristems; Determinate and indeterminate Meristems, organization of Shoot Apical Meristems (SAM), regulation of SAM, floral Meristems; Microscopy-Working principle and applications of Light (Bright field, Dark field, Phase contrast, Differential Interference Contrast Microscopy and Flourescence Microscopy) and Electron (SEM, TEM, STEM) Microscopy.

Learning Outcomes

- Students will understand the SAM organization in different groups of plants.
- Students will acquaint with the principles and uses of light and electron microscopy.

UNIT - II

Vascular Cambium- origin, structure and types of cambium, cambium activity, factors influencing the cambial activity; Wood - Heart wood and sap wood, porous and nonporous wood, reaction wood; Secondary growth - in Dicots and Monocots; Anomalous secondary growth in Dicots and Monocots, structure and functions of xylem and phloem; Tissues - Parenchyma, Collenchyma and Sclerenchyma.

Learning Outcomes

- Students will understand the nature and functions of different types of cambia.
- Students will learn about anomalous secondary growth and functions of different tissues.
- Students will understand the differences among different types of wood.

UNIT - III

Leaf – basic structure and development of leaf; Stomata - structure, development and classification; Nodal anatomy - nodal types (Unilocunar, Trilocunar, Multilocunar) and evolution; Kranz anatomy and CAM anatomical features; Seed - seed germination and seedling growth, factors influencing the germination and development of seedling, metabolism of seed reserved food material during germination.

Learning Outcomes

- Students will gain knowledge on morphology, histology and development of leaf.
- Students learn about factors influencing the seed germination and stages associated with seedling growth.

UNIT - IV

Seed Dormancy- types, factors causing seed dormancy, mechanism of breaking seed dormancy and its significance; Programmed Cell Death (PCD) and its significance; Senescence - types, biochemical changes associated with leaf senescence, applications of anatomy in systematic and pharmacognosy.

Learning Outcomes

- Students able to understand the factors inducing and breaking the dormancy.
- Students will understand the process of PCD, senescence and their significance in development of plants.

REFERENCE BOOKS

1. Atwell, B.J. Kriederusann, P.E. and Jumbull, C.G.N. (Eds.), 1999. **Plant in action**: **Adaptation in nature, Performance in cultivation**, MacMillan Education. Sydney.
2. Bewley, J. D. and Black, M. 1994. **Seeds: Physiology of Development and Germination**, Plenum Press, New York.
3. Burgess, J. 1985. **An Introduction to Plant Cell Development**, Cambridge University Press, Oxford.
4. Fahn, A. 1982. **Plant Anatomy** (3Td Ed.), Pergamon Press, Oxford.
5. Fosket, D.E. 1994. **Plant Growth and Development** - A Molecular approach, Academic Press, Oxford.
6. Lyndon, R.F. 1990. **Plant Development-The Cellular basis**, Unnin Hyman, London.
7. Raghavan, V. 1999. **Developmental Biology of Flowering Plants**, Springer-Verlag, New York.
8. Steeve, T.A. and Sussex, I.M. Patterns in Plant Development (2r Ed.), Cambridge University Press, Cambridge.
9. Singh, V., Pande, P.C and D.K.Jain (2ed.). Anatomy of Seed Plants. Rastogi Publications, Meerut, India.

M.Sc. BOTANY

SEMESTER – II

THEORY PAPER – 2.3: PLANT ECOLOGY AND BIODIVERSITY

Course Objectives

The aim of the course is to

- Impart knowledge of concepts and principles of population, community, ecosystem etc., and bioenergetics of ecosystem and its controls.
- Understand different aspects of nutrient cycling and phytogeography.
- Learn current concepts, levels and hot spots of biodiversity.
- Develop strategies of biodiversity conservation and application of these concepts to solve environmental problems.

UNIT - I

Levels of Ecological Organization; Population characteristics and dynamics; Communities characteristics and their analysis; Structure and function of ecosystem; Energy flow in ecosystem; Homeostasis of ecosystem; Biomes and their types.

Learning Outcomes

On successful completion of unit, the students will be able to

- Understand the characteristics of population, community, ecosystem and biome.
- Know the bioenergetics and equilibrium of ecosystem.

UNIT - II

Soils: Soil properties and types of soils; Global biogeochemical cycles of Carbon and Sulfur; Dynamic Phytogeography: Basic principles, Age and area theory; Centre of origin; Endemism, Migration and Continental drift; Air pollution and climate change; Sustainable development.

Learning Outcomes

On successful completion of unit, the students will be able to

- Analyze and identify different types of soils
- Learn gaseous and sedimentary nutrient cycling in ecosystems
- Explain principles and theories pertaining to geographical distribution of plants.

UNIT - III

Biodiversity: Current concepts, Levels of Biodiversity like Species, Ecosystem and Genetic diversities, IUCN categories of threat; Causes of biodiversity loss; Keystone species; Biodiversity

hot spots of India and world; Organizations involved in biodiversity conservation: IUCN, WWF,UNEP and UNESCO; Phytoremediation.

Learning Outcomes

On successful completion of unit, the students will be able to

- Identify different levels of biodiversity and causes for its loss.
- Understand hot spot regions rich in threatened plants of the world and their conservation.
- Know the role of various international organizations in biodiversity conservation.

UNIT - IV

Strategies for *in situ* conservation: Protected areas: Sanctuaries, National Parks, Biosphere Reserves and Mangroves; Strategies for *ex situ* conservation: Botanical Gardens, Seed Banks, Field Banks, Gene Banks, *in vitro* preservation; Application of Remote sensing and Geographical Information System (GIS) in biodiversity studies.

Learning Outcomes

On successful completion of unit, the students will be able to

- Develop strategies for biodiversity conservation.
- Gain knowledge about protected areas like biosphere reserves, gene banks etc. useful for conservation.
- Understand the role of Remote sensing and GIS in biodiversity management.

REFERENCE BOOKS

1. **Marchese**,**C**, 2014. *Biodiversity hot spots : A shortcut for more complicated concept.Global Ecology and conservation*. http://dx.doi.org/10.10.16/j.gecco.2014.12.008
2. **Odum, E.P**. and **Gary W. Barrett**, 2011. *Fundamentals of Ecology* (5th Edition), Saunders ISBN
3. **Russel, P.J**., **Wolfe,S.L.,Hertz, P. E., Starr, C.** and **Mc Million B.**, 2008. *Ecology*, Cengage Learning India Pvt Ltd.,New Delhi.
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5. **Chapman, J.L.** and **Reiss, M.J.,** 2003. *Ecology: Principles and Applications*, (2nd Edition) Cambridge University Press, UK.
6. **Ambasht, R.S.** and **Ambasht, N.K**., 1999. *A Text Book of Ecology*, CBS Publishers and Distributers, New Delhi.
7. ***IUCN** Red List of threatened species* Version 2019.1.
8. **Chauhan, S.S.** 2014. *Status of Biodiversity in India: Issues and Challenges.* Indian Journal of Plant Sciences 3(1) : 35-42.
9. **Wood,A.,Pamela,S.E.** and **Johanna,M**. 2000. *The root causes of biodiversity loss*. United Kingdom: Early-Scan Publications.
10. **Richard B. Primack**, 1993. *Essentials of Conservation Biology* (6th Edition) Oxford University Press.

11. **Heywood, V.M.** and **Watson,** R.T. 1985. Global Biodiversity Assessment, Cambridge University Press, Cambridge
12. **Swaminathan M.N. &Jam R.S.**, 1982. *Biodiversity: Implications for Global Security*, Macmillan.

M.Sc. BOTANY

SEMESTER-II

THEORY PAPER – 2.4: PLANT PHYSIOLOGY

Course Objectives

- Structural and functional stoichiometry of membranes in transport of water, solutes and mineral nutrients and their transport mechanism
- Photobiology of plants and its role in flowering and photo morphogenesis.
- Role of growth regulators and proteins in growth and development of plants
- Stress physiology of plants with special reference to abiotic (water, salt and temperature) and biotic stress.

UNIT - I

Membrane transport and translocation of water and solutes**:** The structure and properties of water; water transport processes (diffusion, bulk flow, osmosis, water potential, components of water potential); Mechanism of water transport through xylem; Water loss by transpiration; Mechanism of stomatal movements, antitranspirants; Essential nutrients, deficiencies and plant disorders; Solute transport by passive and active mechanisms and membrane transport proteins.

Learning Outcomes

- Complete understanding of transport and translocation of water, solutes and minerals help to design field conditions in plantation research.
- Basic principles on stomatal physiology and ionic transport facilitate the student to understand gas exchange reactions of plant and environment which help to identify the sensitivity of plant and vice-versa.

UNIT - II

Sensory Photobiology: History of discovery of phytochromes, structure and function of phytochrome, photochemical and biochemical properties of phytochrome, phytochrome induced plant responses, molecular mechanism of action of phytochrome in gene expression, Cryptochrome and its role in photomorphogenesis.

The flowering process: Photoperiodism and its significance, initiation of flower primordia, flowering stimulus, vernalization, endogenous clock and its regulation.

Learning Outcome

- Complete understanding of sensory photobiology help to acquire skill in floriculture.
- Understand photoperiodism, vernalization help to develop technology of mass cultivation of diurnal and seasonal crops of agriculture and horticulture importance.

UNIT - III

Plant growth regulators: Physiological effects and mode of action of auxins, gibberellins, cytokininas, ethylene, abscisic acid, brassinosteroids, jasmonic acid and salicylic acid.

Signal transduction: Over view, receptors and G proteins, second messengers, two component sensor regulator system in bacteria and plants, signal transduction and gene expression.

Learning Outcomes

- Understand different types of growth regulators and acquire the skill of application in agriculture.
- Gain the knowledge of different types of signal transduction processes.
- Acquire the skill of application of analytical techniques studied in separation, recovery and purification of signal proteins.

UNIT - IV

Stress Physiology: Water stress, salt stress, temperature stress (HSP), biotic stress (HR and SAR), heavy metal stress; Stress avoidance and tolerance mechanisms; Structural, physiological, biochemical and molecular responses of plants to environmental stress; Reclamation of saline and heavy metal contaminated soils.

Learning Outcomes

- Acquire the knowledge in physiological adaptations and mechanism of plants under biotic and abiotic stress conditions.
- Gain the knowledge of different types of environmental conservation, benefits of reclamation of saline and heavy metal contaminated soils.

REFERENCE BOOKS

1. Devline and Witham, 1986. Plant Physiology. CBS Pubis. and Distributors. New Delhi.
2. Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons. Inc., New York, USA.
3. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. Springer Verlag, New York, USA.
4. Singhal *et al*. 1999. Concepts in Photobiology. Photosynthesis and Photo-morphogenesis, Narosa Pub. House. New Delhi.
5. Taiz and Zeiger, 1998. Plant Physiology. Sinauer Associates Inc., Publishers, Sunderland.
6. Salisbury F.B & C. W. Ross, 1992. Plant Physiology, 4th Edition. Wadsworth Publishing Co., Belmount, California.

M.Sc. BOTANY

SEMESTER - III

THEORY PAPER- 3.1: PLANT PATHOLOGY

Course Objectives

- To gain knowledge about symptoms caused by various plant pathogens.
- To understand the different strategies of the pathogen to invade the host tissues.
- To understand the role of plant pathogens in yield losses of important crop plants.
- To know about control measures for plant diseases.
- To create an awareness about importance of Integrated Pest Management (IPM).

UNIT - I

Concept of disease in plants; Definitions of plant disease; Historical development of Plant Pathology.

Methods of studying Plant disease; collection, preservation, isolation of pathogens and proving Koch postulates.

Symptoms caused by plant pathogenic fungi, bacteria and viruses.

Classification of plant diseases.

Learning Outcomes

- Differentiate symptoms caused by Fungi, Bacteria and Viruses.
- Know the essential steps in identification of organism as pathogen.

UNIT - II

Entry of pathogens into the host

Role of enzymes, toxins and phytoalexins in plant pathogenesis

Physiological changes in diseased plants

Plant disease forecasting

Genetics of disease resistance

Learning Outcomes

- Understand the effector mechanisms adopted by pathogens to invade the plant tissue.
- Understand the role of a pathologist in disease forecasting and development of disease resistance.

UNIT - III

Details study of symptoms, etiology, epidemiology and control of the following fungal diseases of plants; late blight of potato, *Taphrina* leaf spot of turmeric, powdery mildew of cucurbits, black stem rust of wheat, blast of rice, tikka disease of groundnut, red rot of sugarcane.

Learning Outcomes

- Differentiate the pathogenicity of pathogens belongs to four classes of fungi namely Mastigomycotina/Ascomycotina/Basidiomycotina and Dueteromycotina.

UNIT - IV

Detailed study of the following bacterial and viral diseases: bacterial leaf blight of rice, angular leaf spot and black arm of cotton, citrus canker, tobacco mosaic disease.

Principles of plant disease control: Plant quarantine, seed treatment, cultural practices chemical control, development of disease resistant varieties. Biological control of plant diseases.

Integrated Pest Management - concept, system, benefits and limitations.

Learning Outcomes

- Utilise the information about plant quarantine centre in controlling the diseases.
- Came to know that application of biological methods is the best pest control measure.

REFERENCE BOOKS

1. Agrios, G.N. 1997. Plant Pathology, Academic Press, London.
2. Tar, S.A.J. 1972. Principles of Plant Pathology.
3. Singh, R.S. 1991. Plant diseases, 6th Edn., Oxford & IBH Co., New Delhi.
4. Singh, R.S. 1988. Principles of Plant Pathology, 3rd Edn., Oxford & IBH Co., New Delhi.
5. Mehrotra, R.S. 1980. Plant Pathology, Tata-McGraw Hill Publishing Company, New Delhi.
6. Rangaswami, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India, 4th Edition, Printice Hall of India Publications.

M. Sc. BOTANY
SEMESTER-III
THEORY PAPER – 3.2: MOLECULAR BIOLOGY OF PLANTS

Course Objectives

- To train students about classical and modern concepts of genetic material, mapping technologies, physical and chemical structure of DNA.
- To expose students to various functions of DNA like replication, transcription, translation, genetic code, protein synthesis and sorting.
- To enlighten students about regulation of DNA function at different levels of organization.
- To train the students about mechanisms and working principles of DNA/ RNA sequencing, microscopy, centrifugation, electrophoresis and spectroscopy.

UNIT - I

Mendelian principles, gene interactions, multiple alleles, quantitative inheritance, linkage and recombination, construction of linkage and restriction maps, gene mapping in diploids by three point crossover data, gene mapping in haploids by tetrad analysis in *Neurospora*.

Learning Outcome

- Students will learn about classic Mendelian concepts related to genetic material, interaction and recombination of genetic material and mapping of genes in chromosomes.

UNIT - II

Evidence for DNA as genetic material, Physical and chemical structure of DNA, mechanism of DNA replication, DNA damage and DNA repair mechanisms. Gene fine structure and evolution of gene concept. C value and C value paradox. Cot curves. Transcription in prokaryotes and Eukaryotes, mRNA processing and other RNA processing events, mechanism of Translation, RNA splicing, genetic code, protein biosynthesis. Protein sorting and targeting of proteins to the organelles.

Learning Outcome

- Students will be able to know experimental evidences for DNA as genetic material, structure and replication of DNA, transcription, translation and protein sorting by theoretical and practical classes.

UNIT - III

Principles of gene regulation, gene regulation in prokaryotes (lactose and tryptophan operons), Role of chromatin remodeling and histone code in gene expression. DNA methylation in gene regulation and imprinting. Transposons, mechanism of transposition and genetic consequences of transposition. Cis-acting and trans-acting – factors in eukaryotic gene regulation. Small RNA (Micro RNAs) mediated transcriptional and translational regulation (RNAi). TALENS, ZFNs and CRISPR-CAS9 based genome editing technologies.

Learning Outcome

- Students will have information on gene regulation by genetic and epigenetic means, transposons, micro-RNAs and nucleases.

UNIT - IV

Maxim & Gilbert, Sanger and Next generation DNA sequencing methods. RNA sequencing; Microscopy of living cells - Scanning and Transmission Electron microscopy, specimen preparation and Image processing methods for SEM and TEM. Molecular separation techniques.
Centrifugation: Sedimentation - RCF, Differential and Density Gradient centrifugation.
Chromatography: Basic Principles and types of Chromatography.
Electrophoresis: Principles and types of electrophoretic techniques.
Spectroscopy: UV/ visible and Mass spectrometry, LC-MS; Labeled tracers.

Learning Outcome

- Students will learn about principle and working mechanisms of various biophysical and biochemical techniques.

REFERENCE BOOKS

1. Alberts, B., Bray, D., Lewis, I Rail, M., Roberts, K. and Watson. J.D, Molecular biology of the cell, Garland Publishing Inc., New York.
2. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. arid D1iei1, J 2000. Molecular Cell Biology. W.H. Freeman and Co., New York, USA.
3. Richard, M., Twyman and Wisden, W. 1999. Advanced Molecular Biology, Viva Books Pvt. Ltd.
4. Turner, P.C., Mclenann, A.G., Bates, A.D. and White, M.R.H. 2001 Instant notes on molecular biology. 5. Snustad Peter, D. Michael J. Simmons. Principles of Genetics, John Wiley Sons.
5. Robert H. Tamarin. Principles of Genetics, Tata McGraw Hill Company.
6. Benjamin Lewin. Genes VIII, Prentice Hall. 8. West head, D.R. J.H. Parish & R.M. Twyman. Bioinformatics. Viva Books.
7. Adams, R. L. P., Knowler, J. T. and Leader, D. P. 1994.The Biochemistry of the Nucleic acids.Chapman& Hall.
8. Brown, T. A. 1999. Genomes 3. John Wiley & Sons, New York, USA.
9. Watson JD, Baker TA, Bell SP, Gann A, Levine M, Losick R. 2004 Molecular biology of the Gene (5^{th} Ed.) Benjamin Cummings.
10. Robert F. Weaver.2008. Molecular Biology. Mc Graw Hill Higher Education.
11. Buchanan, B. B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. Am. Society of Plant Physiologists, Maryland, USA.
12. Upadyaya, A., Upadyaya, K., and Nath, N. Biophysical Chemistry-Principle and Techniques, Himalaya Publishing House, New Delhi
13. Keith Wilson and John Walker (Editors) 2005.Principles and Techniques of Biochemistry and Molecular Biology (6th Ed.) Cambridge University Press, New York.

M.Sc. Botany
SEMESTER-III
THEORY PAPER – 3.3: REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Course Objectives

- This course is meant to answer how the innate biology influenced by variety of developmental and ecological constraints.
- To impart an insight into the reproduction of the most evolved and advanced group of plants - Angiosperms.
- To understand the morphology and development of reproductive parts.
- To study the seed and fruit development.
- To understand the various life cycle patterns of flowering plants.

UNIT - I

Historical account of Plant Reproduction.
Floral differentiation: Inflorescence and floral meristem, mutations affecting floral differentiation.
Male Gametophyte:Structure of anther, microsporogenesis, role of tapetum; pollen development; formation of vegetative and generative cells; pollen sterility; abnormal features of pollen.
Female gametophyte: Types of ovule, megasporogenesis, special features. Types of female gametophytes, ultra structure of mature embryo sac; haustorial behaviour of embryo sac, nutrition of embryo sac.

Learning Outcomes

- Historical account deals about the out-standing contributions of world renowned reproductive biologists, how they discovered a particular phenomenon; all that contributes for the advancement of science that in turn to students to think in that lines.
- This unit explains how floral differentiation takes place and what genes are responsible for it.
- What are the incidents taken place leading to pollen sterility: this phenomenon could be exploited for crop improvement.
- What are different types of concealment of ovules and female gametophytes?

UNIT - II

Pollination: Pollen transfer, pollination mechanisms and vectors. Structure of style and stigma; pollen-pistil interaction.
Fertilization: Pollen germination and pollen-tube growth, path of pollen-tube, pollen tube discharge; double fertilization.
Endosperm: Types of endosperm,cytology and functions of endosperm.

Learning Outcomes

- What are dynamics of plant-pollinator interaction and pollen-pistil interaction as well?
- How does double fertilization take place which is a common phenomenon in flowering plants?
- Various types of endosperms and how they develop.

UNIT - III

Embryogenesis: Gene expression during embryogenesis. Embryogeny in dicots and monocots. Underdeveloped and reduced embryos, Nutrition of embryo. Seed and fruit development.
Polyembryony: Causes of polyembryony, experimental induction of polyembryony, classification of polyembryony, practical value of polyembryony.
Apomixis: Vegetative reproduction, apospory, causes of apomixis, significanceof apomixis.

Learning Outcomes

- What is the molecular mechanism and gene expression in embryogenesis?
- What are different stages leading to formation of dicot and monocot embryos?
- What are causes responsible for polyembryony and its practical applications?
- Similarly practical applications of apomixis.

UNIT - IV

Embryology in relation to Taxonomy: Importance of embryological characters in taxonomic considerations, families with special embryological features. Role of palynology in Taxonomy; Experimental Embryology: Embryo rescue and its culture;Somatic embryogenesis and synthetic seeds.

Learning Outcomes

- Student could learn some of embryological characters that are useful in solving the problems of systematic position of various disputed Taxa of angiosperms.
- Before losing its viability embryo is isolated and rescued by various nutritive media, where by developing various interspecific and intergeneric hybrids is possible.
- What are different pathways for somatic embryogenesis? Student could learn the techniques to develop synthetic seeds of various crops.

REFERENCE BOOKS

1. Maheswari, P. A. 1950. *Introduction to Embryology of Angiosperms*. McGraw Hill Book company
2. Shivanna, K.R. and John, B.M. 1989.*The Angiosperm Pollen structure and Function*, WileyEastern Ltd., New Delhi.
3. Johri, B.M., Ambegaokar, K.B. and Srivastava, P.S. *Comparative Embryology of*
4. *Angiosperms*, Vol. I & II, Springer Verlag.
5. Bhojwani, S.S. and Bhatnagar, S.P. 2000. *Embryology of Angiosperms* (revised edition), Vikas publishing House, New Delhi.
6. Fosket, D.E. 1994. *Plant Growth and Development: A Molecular Approach*. Academic Press, New York.
7. Raghavan, V. 1997. Molecular Embryology of Flowering plants. Cambridge University Press, Cambridge.
8. Khasim, S. M. 2002. *Botanical Microtechnique: Principles and Practice*. Capital publishing company, New Delhi.

M.Sc. BOTANY

SEMESTER – III

THEORY PAPER – 3.4: PLANT METABOLISM

Course Objectives

- Principles of thermodynamics in energy dessimination and biochemical reactions of plant.
- Photochemistry of plants and its role in carbon assimilation.
- Role of Respiration and Biological oxidation in energy metabolism of plants.
- Importance of nitrogen, sulfur and lipids in plant metabolism.

UNIT - I

Energy and Enzymes: Energy flow through living systems, principles of the thermodynamics, free energy and chemical potential, free energy of oxidation–reduction reactions, redox potential, types of phosphorylations, structure and functions of ATP.

Enzymes: General aspects, nomenclature and classification of enzymes, mode of enzyme action, Michaelis – Mention equation and its significance, regulation of enzymes, enzymes inhibition and isoenzymes.

Learning Outcomes

- Basic knowledge on concept of thermodynamics and energy kinetics to understand the physiological specificity of plants.
- Understand physiological variations in phosphorylation reactions and transport of solutes.
- Complete understanding of structural and functional stoichiometry of Enzymes.

UNIT - II

Photochemistry and Photosynthesis: General concepts of photosynthesis, photosynthetic pigments, structure of photosynthetic apparatus, photosynthetic electron transport (Non-cyclic, cyclic), proton transport and ATP synthesis.

Carbon assimilation: The carbon cycle, photorespiration and its significance, C_4 and CAM pathways and their physiological and ecological significance. Biosynthesis of starch and sucrose, translocation by phloem, phloem loading and unloading.

Learning Outcomes

- Complete understanding of photochemistry in photosynthesis and energy transduction mechanism.
- Understand the photosynthetic pigments and their role in energy transduction mechanism of ATP synthesis.
- Basic knowledge on different types of carbon reduction mechanisms of plants and sink source relation in sugar translocation.

UNIT - III

Respiration: Over view of plant respiration, glycolysis, pentose phosphate pathway, TCA cycle, electron transport, chemiosmotic hypothesis of ATP synthesis, alternative oxidase system, Alcohol and Lactic acid fermentations.

Learning Outcomes

- Complete understanding of biological oxidation of carbohydrates and energy productions.
- Understand glycolysis, decarboxylation pathways and Electron transport system.
- Basic knowledge on different types of fermentation reactions and their biological significance.

UNIT - IV

Nitrogen metabolism: Sources of nitrogen to plants, biological nitrogen fixation, nodule formation and nod-factors, mechanism of nitrate uptake and reduction, ammonium assimilation (reductive amination, transamination and GS-GOGAT).

Sulfate metabolism: Uptake, transport and assimilation.

Lipid metabolism: Structure and function of lipids, classification of lipids, fatty acids and their biosynthesis. Synthesis of phospholipids and storage lipids; catabolism of lipids; glyoxylate cycle.

Learning Outcomes

- Acquire knowledge in nitrogen mechanisms and ecological significance of transformations of nitrogenous compounds.
- Gain knowledge of lipid metabolism.

REFERENCE BOOKS

1. Dennis et al., 1997. **Plant Metabolism** (2nd ed.), Longman, Essex, England.
2. Hopkins, W.G. 1995. **Introduction to Plant Physiology,** John Wiley & Sons, Inc., New York, USA.
3. Nobel, P.S. 1999. **Physiochemical and Environmental Plant Physiology,** Academic Press, San Diego, USA.
4. Taiz and Zeiger, 1998. **Plant Physiology**(2nd ed.)
5. Voet and Voet, 1992. **Biochemistry,** John Wiley & Sons, Inc., New York, USA.
6. Raghavendra, S. 1988 Photosynthesis, A comprehensive Treatise, Cambridge University press, Cambridge, UK.

M. Sc. BOTANY
SEMESTER - IV
THEORY PAPER – 4.1: PLANT CELL, TISSUE AND ORGAN CULTURE

Course Objectives

- To train the students on practical and theoretical aspects of plant tissue culture.
- To expose the students to basic concept of regeneration and about the role of plant growth regulators governing *in vitro* response of cultures.
- To enlighten students about micropropagation, somatic embryogenesis, artificial seeds, somaclonal variations, somatic hybrids, cybrids, embryo and anther culture.
- To make students to learn about secondary metabolite production through tissue culture, cryopreservation and gene banks.

UNIT - I

Tissue culture media: Composition and preparation of different types of media. Laboratory requirement and sterilization techniques.

Basic concept of regeneration: Concept of Cellular Totipotency and Differentiation. Fundamental aspects of Morphogenesis. Organogenesis-direct & indirect. Role of plant growth regulators and factors governing *in vitro* behavior of cultures.

Learning Outcome

- Students will learn about preparation and sterilization of various plant tissue culture media, basic concepts of totipotency, differentiation and morphogenesis.

UNIT - II

Propagation and variation: Stages and application of Micropropagation. Photoautotrophic micropropagation and acclimatization of tissue culture plants. Production of Pathogen free plants and their application. Somatic embryogenesis, role of physical and chemical factors in the induction; synthetic seed-production and uses. Origin, molecular basis and applications of Somaclonal variation.

Learning Outcome

- Students will learn about working principles and applications of micropropagation, somatic embryogenesis, synthetic seeds, and somaclonal variations in terms of theory and practical experience.

UNIT - III

Somatic hybridization: Protoplast isolation, fusion and culture, selection and characterization of hybrids. Symmetric, asymmetric hybrids and cybrids, significant achievements and limitations of Protoplast research, production of test tube plants. Callus and embryo culture, production of seedless fruits.

Learning Outcome

- Students will gain hands on experience on production of somatic hybrids, cybrids, callus and embryo culture.

UNIT - IV

Applications of Plant Tissue culture: Production of Haploids and its significance in Crop improvement. Secondary metabolite production through Cell and Organ culture-Hairy roots. Shikonin production. Cryopreservation methods and *in vitro* conservation of Germplasm. Gene Banks.

Learning Outcome

- Students will be in a position to produce haploids by anther and microspore culture, secondary metabolite by cell cultures, cryopreservation and gene banks.

REFERENCE BOOKS

1. Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice (a revised edition). Elsevier Science Publishers, New York, USA.
2. Bojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations, Elsevier Science Publisher, New York, USA.
3. Vasil, I.K. and Thorp e, T.A. 1994. Plant Cell and Tissue Culture, Kluwer Academic Press, The Netherlands.
4. Razdan, M.K. 1994. An Introduction to Plant Tissue Culture: Oxford & IBH Publishing Company Private Limited, New Delhi.
5. Chawla, H.S. 2003. Introduction to Plant Biotechnology. Oxford & IBH, New Delhi.
6. George, E.F., Vol-I (1986) and Vol II (1993) Plant propagation by Tissue culture.
7. Kartha, K.K. 1985. Cryopreservation of plant cells and organs. CRC Press, Boac Raton, Florida, USA.
8. Reinert, J. Bajaj, YPS (Eds.). 1977. Applied and fundamental aspects of plant cell, tissue, and organ culture. Springer-Verlag, New York.

M. Sc. BOTANY
SEMESTER – IV
THEORY PAPER – 4.2: GENETIC ENGINEERING, GENOMICS, PROTEOMICS AND BIOINFORMATICS

Course Objectives

- To make the students to learn about tools and techniques needed for application of genetic engineering technologies, screening procedures, Genomic DNA/ c-DNA library generation and PCR by theoretical and practical classes.
- To expose the students to various plant transformation technologies and their applications.
- To enlighten the students about biosafety, bioethical and IPR issues, functional identification of genes by TILLING, RNAi, genome editing technologies and microarrays.
- To train the students on basic working concepts, and principles belonging to bioinformatics related databases, search engines and sequence analysis.

UNIT - I

Recombinant DNA technology: Tools in DNA technology; Characteristics of different types of vectors – plasmids (pBR322, phagemid, cosmids), Yeast artificial chromosomes and Ti plasmid derivatives. Enzymes: restriction endonucleases, DNA and RNA polymerases, DNA ligases, S1nuclease, polynucleotide kinase, alkaline phosphatases; Olilgonucleotides – linkers, adaptors and homopolymer tails. Methods involved in generating r-DNA molecules, gene cloning-techniques, identification of clones by screening procedures, construction of genomic / c-DNA libraries, PCR and its applications, Blotting techniques.

Learning Outcome

- Students will be in a position to know about various tools and techniques employed in the application of genetic engineering technology.

UNIT - II

Genetic Engineering of plants: Plant transformation with Ti-plasmid of *Agrobacterium tumefaciens,* physical methods of transferring genes to plants, reporter genes and use of different promoters. Chloroplast transformation. Production and application of transgenic plants (Drought, disease and stress tolerant plants). Regulations and concerns for the release of genetically modified crops; Intellectual Property Rights (IPRs).

Learning Outcome

- Students will gain information on various plant transformation technologies and their applications in production of disease, drought, and stress tolerant plants. Biosafety, bioethical and IPR related issues.

UNIT - III

Functional Genomics: Experimental techniques for functional identification of genes: Insertional mutagenesis, Targeting Induced Local Lesions in Genomes (TILLING), RNA interference (RNAi) and gene knockout. Genome editing technologies. Transcript profiling – DNA Micro array, Serial Analysis of Gene Expression (SAGE) and Massively Parallel Signature Sequencing (MPSS).

Proteomics: Protein sample preparation and separation techniques – 2D - Gel Electrophoresis analysis, Liquid Chromatography and Mass spectrometry (LC-MS), protein sequencing, protein micro arrays. Analysis of protein interactions and protein complexes.

Learning Outcome

- Students will come to know about various techniques employed for functional identification of genes, basic principles of proteomics like 2- dimensional electrophoresis, chromatography, mass-spectroscopy, protein sequencing and protein-protein interactions.

UNIT - IV

Bioinformatics: definition, introduction, scope and applications. Databases – CBI GenBank, PDB, OMIM, EMBL. Literature Data banks – Pub Med, Med line. Plant Biology Specific search Engines. Sequence Alignment based on Matrices (BLOSUM and PAM), Algorithm (Needleman Wunsch & Smith Waterman). Tools for sequence alignment – BLAST, FASTA. Pair wise and Multiple sequence alignment and phylogenetic analysis. The biological databases and types; Sequence databases; Structural databases; Prediction of genes and gene function. Translation of gene into protein; Protein secondary structure prediction; Prediction of domains, motifs and profiles of proteins.

Learning Outcome

- Students will be informed about basic and working principles of bioinformatics, databases, search engines and sequence analysis.

REFERENCE BOOKS

1. Lewin, B. 2006. Gene VIII, Oxford University Press, New York, USA.
2. Purohit, S.S. 2000. Biotechnology; Fundamentals and Applications, Agrobios, New Delhi.
3. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Waston, J.D. 1989. Molecular Biology of the Cell, Garland Publishing Inc., New York.
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5. Gupta, R.K. Molecular Biology & Generic Engineering, Rastogi Publication.
6. Adrian Slater, Nigel Scott, and Mark Fowler (2006). Plant Biotechnology
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8. Primrose, S.B. & Twyman, R. M. 2003.Principles of Genomic Analysis and Genomics. (7th Ed.). Blackwell Science
9. Brown, T.A.2001.Gene cloning and DNA Analysis- An introduction (5th Ed.), Blackwell Scientific Publications, Oxford, U.K.
10. Christopher A. Cullis. 2004. Plant Genomics and Proteomics. John Wiley & Sons, New Jersey.
11. Gustafson, J. P. 2000. Genomes, Kluwer Academic plenum publishers, New York, USA.
12. Jolls, O. and Jornvall, H. (eds.) 2000. Proteomics in Functional Genomics. Birkhauser

Verlag, Basel, Switzerland.
13. Arthur M. Lesk. 2002. Introduction to Bioinformatics. Oxford University Press, USA
14. Henry, R. J. 1997. Practical application of Plant Molecular Biology. Chapman & Hall, London. U.K.
16. Mount, D., 2004. Bioinformatics: Sequence and Genome Analysis. (2nd Ed.) Cold Spring Harbor Laboratory Press.
17. Bioinformatics. A practical guide to analysis of genes and proteins. 1998. Baxevanis and Quellette.
18. Bioinformatics: A biologist's guide to biocomputing and the internet. 2000. Stuart M. Brown.
19.Bioinformatics: Sequence and genome analysis. 2001. David W. Mount.

M. Sc. BOTANY
SEMESTER – IV
THEORY PAPER – 4.3: CYTOGENETICS AND PLANT BREEDING

Course Objectives

- The main objective of plant breeding is to develop improved varieties of crop plants that will be commercially successful.
- To know the accomplishments of plant breeders

UNIT - I

Principles of plant breeding- Objectives and achievements; Breeding methods in clonally propagated, self pollinated and cross pollinated crops; Adaptive breeding; Selection - types of selection and significance; Hybridization-types, techniques, significance; Hardy-Weinberg Law.

Learning Outcomes

- Students will be able to identify the breeding methods of self and cross pollinated species.
- Student will understand the role of selection in crop improvement.

UNIT - II

Heterosis - theories and importance; Hybrids - production and significance; Synthetic composite varieties-production and significance; Male sterility (**MS**) - classification (GM, CMS, CGMS and chemically induced MS) and its importance in breeding; Polyploidy-types, polyploidy induction, polyploidy effects, polyploidy breeding and its significance.

Mutation breeding-mutation types, mutagens, procedure for mutation breeding, significance of induced mutations in plant breeding, achievements of mutation breeding; Breeding methods for resistance- to biotic (Fungi, Viruses, Insect and Pests) and abiotic (Drought and Salt) stresses.

Learning Outcomes

- Students will be able to identify the sources of genetic variation to perform breeding programme intended to concerned crops.
- Students will be able to understand the process associated with development of both biotic and abiotic stress resistant plants.

UNIT - III

Plant Introduction; Plant genetic resources - centers of origin, conservation and utilization; Molecular Markers - types (RFLP, RAPD) and their applications in plant breeding; Marker assisted selection (MAS); Molecular maps - Genetic and physical maps, QTL maps and linkage maps. National and International plant organizations associated with crop improvement programmes. Intellectual Property Rights.

Learning Outcomes

- Students identify the importance of plant genetic resources as a source of variability in plant breeding programmes, and know the appropriate processes for their collection, conservation evaluation.

- Students obtain the knowledge on preparation of genetic and physical maps and their utility in plant breeding.

UNIT - IV

Molecular Cytogenetics **-** FISH, GISH, FIBER-FISH, Flow karyotyping, Flow cytometry and applications of molecular Cytogenetics; Microdissection and Microcloning techniques. Introduction to statistical constants - Mean, Mode, Median, Variance, Standard Deviation and Standard Error, Normal distribution curve, Correlation path analysis, ANOVA, Students **t**-test and **F**-test.

Learning Outcomes

- Students will calculate and interpret some basic statistic parameters commonly used in plant breeding.

REFERENCE BOOKS

1. Russel, P.J. 1998. **Genetics.** The Benjamin/Cunnings Publishing Co., Inc., USA.
2. Khush, G.S. 1973. **Cytogenetics of Aneuploids,** Academic Press, London.
3. Gupta, P.K. 2005. **Molecular Biology and Genetics Engineering**
4. Snustad, D.P. and Simmons, M.J. 2000. **Principles of Genetics.**
5. Chahal, G.S. and Gosal, S.S. **Principles and Procedures of Plant Breeding – Biotechnological and Conventional Approaches,** Narosa Publishing House, New Delhi.
6. Darbeshwar Roy, 2000. **Plant Breeding: Analysis and Exploitation of variation,** Narosa Publishing House, New Delhi.
7. Singh, P. 2001. **Essentials of Plant Breeding,** Kalyani Publishers, Hyderabad.
8. Primrose, S.B. 1994. **Molecular Biotechnology** (2nd ed) Blackwell Sci. Publ. Oxford.
9. Balasubramanian, D. 2005. **Concepts of Biotechnology**
10. Old, A. and Primrose, S.B. 2002. **Principles of gene manipulation**. Blackwell Publ. Oxford.
11. Singh, R.J.(2014). **Plant Cytogenetics**, CRC Press.

M.SC. BOTANY

SEMESTER – IV

ELECTIVE THEORY PAPER – 4.4 b: HORTICULTURE AND LANDSCAPING

Course objectives

- Impart knowledge about nurseries, propagation methods
- Nutritive aspects and cultivation and production of flower, fruit, vegetable and other ornamental crops.
- Understand principles of landscape designs, and types and styles of landscape gardening.
- Learn site suitability, elements of landscape design and different plants used in landscape gardening

UNIT - I

Importance of horticulture; Nursery and types of nursery beds; Orchard plan and systems of planting; Propagation of plants by asexual methods (cutting, layering, grafting and budding); Commercial floriculture: Propagation and production of flower crops like Roses, *Chrysanthemum* and *Jasminum*.

Learning Outcomes

On successful completion of unit, the students will be able to

- Develop different types of nurseries and propagation methods.
- Produce important flower crops.

UNIT - II

Pomology: Nutritive value of fruits, Cultivation practices and production of fruit crops like Mango, Banana and Guava; Olericulture: Importance of vegetables in human nutrition, Types of vegetable gardens, A brief study of inter-cultivation practices of major vegetable crops of regional Importance.

Learning Outcomes

On successful completion of unit, the students will be able to

- Understand the nutritional aspects of different fruits and vegetables.
- Produce fruit and vegetable crops.

UNIT - III

Importance and scope of landscape gardening; Principles of landscape design; Garden adornments; Garden features: Wall, Fencing, Steps, Garden, Garden drives and Paths, Hedges,

Arches, Pergola, Lawn, Carpet bedding, Flower beds, Shrubbery, Borders, Rockery, Water gardens, Bonsai, Topiary; Garden types: Indoor garden, Outdoor garden; Garden styles: Formal gardens, Informal gardens and Free style gardens.

Learning Outcomes

On successful completion of unit, the students will be able to

- Understand the importance of gardening in aesthetics.
- Gain knowledge on types and styles of gardens.

UNIT - IV

Site analysis; Elements in landscape design: Land form, Water garden furniture, Lights, Paving etc; Study of different trees, shrubs, herbs, ground cover, indoor plants etc., suitable for landscaping and their identification; Landscaping of historical monuments and places of Tourist importance.

Learning Outcomes

On successful completion of unit, the students will be able to

- Analyze the site for gardening.
- Identify different ornamental plants for landscaping.
- Develop landscape gardening designs.

REFERENCE BOOKS

1. **Gardner V R, Bradford F C** and **Hooker Jr. H D,** 1952. *The Fundamentals of Fruit Production* , Mac Graw Hill Book Co., New York.
2. **Hartman H T, Kester D E, Davies,**Jr**,FT** and **Geneve R L** 1976. *Plant Propagation : Principles and Practices* (8th Edition) . Prentice Hall, USA.
3. **Sadhu M K** ,1996. *Plant Propagation*, New Age International Publishers, New Delhi.
4. **Mukherjee S K** and **Majumder P K,** 1973. *Propagation of Fruit Crops.* ICAR, New Delhi.
5. **Bose T K** and **Yadav L P** 1989. *Commercial Flowers,* Nayaprakash, Calcutta.
6. **Mitra S.K. Rathore D S and Bose T K,** 1992. *Temperate Fruits*, Horticulture and Allied Publishers, Calcutta.
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M.Sc. BOTANY
SEMESTER – IV
ELECTIVE THEORY PAPER – 4.4a: ORGANIC FARMING AND VERMI COMPOSTING

Course Objectives

- To minimize the use of chemical fertilizer by organic farming.
- Understand the scope, concept, advantages and disadvantages of organic farming.

UNIT - I

Soil & Soil Conditioners - Soil and its physical characters, Soil types- alluvial, laterite, clay, loam. Physical testing and assessment of soil types.
Soil conditioners – Lime, dolomite, gypsum, organic use of soil conditioners for better management of soil.

Learning outcome

- Distinguish different soils.

UNIT - II

Concept of Organic farming – Practical, positive and negative aspects of chemical fertilizer applications. Need for organic farming. Organic farming – Vision , concept, principles and benefits of organic farming; Conventional farming verses organic farming.

Learning Outcome

- Significance of organic farming.

UNIT - III

Organic manures and biofertilizers: Types of compost - green manure, farmyard manure. Nutritive value of compost. Methods of compost preparation. Biofertilizers – Types, production, processing and methods of application of biofertilizers.

Learning Outcomes

- Applications of biofertilizers.
- Understand compost preparation.

UNIT - IV

Vermi Composting: An overview of vermin composting - Introduction to vermin composting, definition, meaning, their role in biotransformation of residues, maintenance of soil structure and economic importance. Local and useful species of earthworm, choosing the right worm.

Learning Outcome

- Significance of vermin compost.

REFERENCE BOOKS

1. Hand book of organic farming and biofertilizers-M.K.GUPTA
2. Biofertilizers technology – R.SHANKARA REDDY

3. Biofertilizers technology- KHANNAIYAN. S
4. Practical handbook of agriculture science – HANSON

M.Sc. Botany I year I Semester

Title of the Papers:

1.1 – Biology and Diversity of Viruses, Bacteria, Algae and Fungi
1.2 – Bryophytes, Pteridophytes, Gymnosperms and Plant Fossils
1.3 – Plant Systematics
1.4 – Ethanobotany and Ethnomedicine

Course Outcome

After completion of First semester the students will be able to

- Understand the General characters and the importance of Viruses, Bacteria, Algae and Fungi
- Have a general understanding on structure, reproduction and importance of various groups in Bryophytes, Pteridophytes and Gymnosperms
- Get knowledge about plant fossils and their importance
- Get acquainted with different classification systems of Angiosperms and plant identification
- Gain knowledge on importance of Molecular systematics and Chemosystematics
- Understand the diversity of medicinal plants in Eastern Ghats and their micropropagation techniques.
- Get knowledge on the bioactive principles in plants and their use in drug development

M.Sc. Botany I year II Semester

Title of the Papers:

2.1 – Cell Biology and Cytology of Plants
2.2 – Plant Structure and Development
2.3 – Plant Ecology and Biodiversity
2.4 – Plant Physiology

Course Outcome

After completion of Second semester the students will be able to

- Get knowledge about structure and functions of cell organelles of prokaryotes and eukaryotes
- Gain knowledge of special types of chromosomes and their functions
- Understand the different theories involved in organization of root apex and shoot apex
- Learn about anomalous secondary growth in monocots and dicots
- Get knowledge about the functions of organizations involved in biodiversity conservation
- Know about the protected areas and Botanical gardens in India and abroad
- Get the knowledge on properties of phytochromes and significance of photoperidiosm
- Get acquainted with the knowledge of survival mechanisms in plants under stress conditions

M.Sc. Botany II year III Semester

Title of the Papers:

3.1 – Plant pathology
3.2 – Molecular Biology of Plants
3.3 – Reproductive Biology of Angiosperms
3.4 – Plant Metabolism

Course Outcome

After completion of Third semester the students will be able to

- Learn about the principles of pathogen entry and establishment in the host
- Get knowledge about different diseases on economically important crop plants and their control
- Know the significance of genetic material and regulation of genes in prokaryotes and eukaryotes
- Understand the mechanisms of various biophysical and biochemical techniques in molecular biology
- Gain the knowledge on different stages involved in reproduction of angiosperms
- Know the importance of embryological studies in relation to Plant taxonomy
- Get acquainted with different carbon assimilation mechanisms in plants
- Understand the mechanism of respiration and metabolism of different substrates in plants

M.Sc. Botany II year IV Semester

Title of the Papers:

4.1 – Plant Cell, Tissue and Organ Culture
4.2 – Genetic Engineering, Genomics, Proteomics and Bioinformatics
4.3 – Cytogenetics and Plant Breeding
4.4 – Elective papers:
    4.4a – Organic farming and Vermi composting
    4.4b – Horticulture and Landscaping

Course Outcome

After completion of Fourth semester the students will be able to

- Know the various procedures for micropropagation from plant tissues
- Gain knowledge about the production of transgenic plants with desirable characters
- Apply bioinformatic tools in Genetic engineering
- Understand the production and significance of hybrids
- Know the importance of molecular markers in plant breeding
- Gain knowledge about composition and preparation of organic manures
- Acquire knowledge necessary for installation of vermi composting unit
- Understand the cultivation practices and production of important fruit and vegetable crops
- Know the different designs for landscaping and maintenance of gardens

M.Sc. BOTANY

SEMESTER - I

PRACTICAL PAPER – I: BIOLOGY AND DIVERSITY OF VIRUSES, BACTERIA, ALGAE AND FUNGI AND BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PLANT FOSSILS

Biology and Diversity of Viruses, Bacteria, Algae and Fungi

1. Preparation of Nutrient agar medium
2. Isolation of bacteria from soil, air and water
3. Preparation of basic fungal medium
4. Isolation of fungi from soil, air and water
5. Isolation of *Aspergillus* from rotten fruits
6. Clearing and staining technique for observation of AM fungi in root system
7. Wet-sieving and decanting technique for observation of AM fungal spores in soil
8. Isolation of soil and marine algae
9. Observation of important fungal pathogens
10. Observation of some important viruses

Bryophytes, Pteridophytes, Gymnosperms and Plant fossils

1. Study of morphological and anatomical features of thalloid and leafy forms of representative members of Bryophyta
2. Study of external and internal features, and reproductive organs of representative members of Pteridophyta
3. Study of vegetative, anatomical and reproductive features of selected members of Gymnosperms
4. Observations of fossils of plants/ plant parts.

M.Sc. BOTANY

SEMESTER - I

PRACTICAL PAPER – II: PLANT SYSTEMATICS AND EHANOBOTANY AND ETHNOMEDICINE

Plant Systematics

1. Description of wild taxa representing different families and identification to species level
2. Study of flora of local area
3. Preparation of herbarium specimens of wild taxa
4. Construction of taxonomic keys
5. Nomenclatural exercise

Ethanobotany and Ethnomedicine

1. Ethno-botanico-medicinal importance and systematic position of *Cassia fistula, Ricinus communis, Emblica officinalis, Papaver somniferum, Jatropha curcas, Santalum album* etc.
2. Phytochemical tests for alkaloids, flavonoids, glycosides, steroids and tannins and their importance in plant defense and curing various human diseases as well.
3. Developing questionnaire for the usage of plants by local communities.
4. Study of herbal drug formulations and their adulteration available in the local market, e.g., Triphala powder, Chawanprash, cough syrups etc.
5. In vitro studies of plants used by local communities to treat diseases such as jaundice, psoriasis, kidney diseases and diabetes.
6. Field trips (at least 2) to agency areas to collect ethno-botanico-medicinal data from local communities

M.Sc. BOTANY
SEMESTER – II
PRACTICAL PAPER – I: CELL BIOLOGY AND CYTOLOGY OF PLANTS AND PLANT STRUCTURE AND DEVELOPMENT

Cell Biology and Cytology of Plants

1. Preparation of slides, observation and identification of various stages of mitosis from *Allium cepa* roots
2. Determination of Mitotic Index (MI)
3. Effect of chemical mutagens on dividing cells (mitosis)
4. Study of meotic stages in flower buds of *Allium cepa* / *Tradescantia spathacea*
5. Study of photographs of chromosomes with different banding patterns
6. Study of microscopic pictures of Polytene chromosomes, Lampbrush chromosomes, B- chromosomes etc.

Plant Structure and Development

1. Observe the variations in SAM of different monocots and Dicots
2. Study of storied and non storied cambia
3. Observe the variations in anatomical features of Dicots and monocots
4. Observation of anomalous secondary growth in both Dicots and monocots
5. Study the variations in anatomical features of leaves
6. Study of stomata structure and types
7. Study of nodal patterns
8. Study of anatomical differences between C4 and CAM plants
9. Seed viability test

M.Sc. Botany

SEMESTER - II

PRACTICAL PAPER – II: PLANT ECOLOGY AND BIODIVERSITY AND PLANT PHYSIOLOGY

Plant Ecology and Biodiversity

1. Construction of Ombrothermic diagram
2. Determination of minimum size of a quadrat by Species Area Curve method
3. Determination of frequency, density and abundance by Quadrat method
4. Determination of frequency by Point frame method
5. Determination of Importance Value Index (IVI)
6. Determination of Leaf area and kemp' s constant
7. Determination of Leaf area index
8. Soil textural analysis
9. Mapping of hot spots of India and World
10. Mapping of National Parks and Biosphere Reserves in India
11. Identification of endemic species
12. Visits to seed banks and gene banks

Plant Physiology

1. Determination of water potential
2. Estimation of chloride content
3. Demonstration of osmosis by using egg membrane
4. Estimation of seed germination as effected by red and far –red radiation
5. Determination of osmotic potential of cell sap by plasmolytic method
6. Effect of osmotic potential of external solution on the rate of imbibition
7. Determination of stomatal index, frequency and pore area
8. Effects of chemicals and temperature on the permeability of protoplasmic membrane
9. Determination of gibberellic acid by half seed (cereal) method
10. Hormonal effects on senescence
11. Seed viability test

M.Sc. BOTANY

SEMESTER - III

PRACTICAL PAPER – I: PLANT PATHOLOGY AND MOLECULAR BIOLOGY OF PLANTS

Plant Pathology

1. Field trips for collection and identification of common diseases of crop plants of the region
2. Microscopic study of plant pathogen interactions – observation of stained sections of diseased materials and with respect to the diseases included in the theory and other common diseases
3. Study on the effect of fungicides on the germination and growth of plant pathogenic fungi.
4. Isolation of pathogenic bacteria and fungi from infected leaves
5. Effect of fungal toxins of seed germination
6. Isolation and estimation of enzymes produced by pathogens

Molecular Biology of Plants

1. Isolation of plant DNA
2. Determination of λ max of DNA
3. Estimation of DNA quantity by Diphenylamine method
4. Isolation of RNA
5. Determination of λ max of RNA
6. Estimation of RNA quantity by Orcinol method
7. Effect of pH and temperature on DNA and RNA
8. Determination of λ max of Proteins
9. Estimation of Protein quantity
10. Isolation and separation of leaf proteins by SDS-PAGE
11. Assignments on DNA structure, Replication and Gene expression

M.Sc. BOTANY

SEMESTER - III

PRACTICAL PAPER – II: REPRODUCTIVE BIOLOGY OF PLANTS AND PLANT METABOLISM

Reproductive Biology of Plants

1. Preparation of permanent slide for light microscopic studies
2. Transverse section of an anther and study of different stages of pollen development
3. Use of DNA fluorochromes to localize nuclei during pollen and ovule development
4. Study of the stages of ovule development in the wild and mutant plants using permanent slides, electron micrograph and available phenotypes.
5. Aniline blue fluorescence method to localize pollen tubes for the study different aspects of pollen-pistil interaction
6. Structure of Monocot Style and Stigma
7. Structure of Dicot Style and Stigma
8. Assessment of stigma receptivity by localizing peroxidases, non-specific esterases and phosphatases
9. Ultrastructure of Female Gametophyte (Embryosac)
10. Dissection of Dicot Embryo and Monocot Embryo
11. Study of different types of Endosperms
    i. Cellular endosperm
    ii. Nuclear endosperm
    iii. Ruminate endosperm
12. *In vitro* germination of pollen
13. Correlation between fertility (stainability), viability (TTC and FDA staining) and germinability (in vitro) of pollen grains
14. Study of post-fertilization stage with the help of permanent slides and electron micrographs

Plant Metabolism

1. Separation of chloroplast pigments into two and four groups
2. Physiological anatomy of C_3 and C_4 plants
3. Absorption spectrum of chlorophylls
4. Estimation of Chl *a* and Chl *b* in C_3 and C_4 plants
5. Seperation of proteins by gel electrophoresis
6. Estimation of nitrogen and protein content of plant materials by Micro-Kjeldhal method
7. Preparation of standard curve for proteins (BSA) and estimation of protein from the extracts of plant material by Lowry's method
8. Determination of aerobic and anaerobic respiration by continuous current method
9. Determination of reducing sugars of fruits by Nelson-Somogyi's method
10. Principles of calorimetry and spectrophotometry

11. Radioisotope methodology, autoradiography, instrumentation and Scintillation counter) and principles involved
12. Determination of saponification value of fats and oils
13. Qualitative tests for carbohydrates (Iodine, Anthrone, Fehlings, Benedict etc.)
14. Determination of V max and km values
15. Determination of catalase activity
16. Demonstration of polyphenol oxidase

M. Sc BOTANY
SEMESTER - IV
PRACTICAL PAPER – I: PLANT CELL, TISSUE AND ORGAN CULTUREAND GENETIC ENGINEERING, GENOMICS, PROTEOMICS AND BIOINFORMATICS

Plant Cell, Tissue and Organ Culture

1. Preparation of Stock solutions and Media
2. Production of Aseptic seedlings
3. Isolation and culture of embryos of Maize, *Crotalaria*, *Cyamopsis* etc.
4. Induction of callus and histological/cytological studies of callus
5. Direct organogenesis and somatic embryogenesis from Tobacco explants
6. Androgenesis and production of haploids from *Datura* flower buds
7. Establishment of Cell cultures and determination of plating efficiency
8. Enzymatic isolation and culture of protoplasts
9. Fusion of protoplasts using PEG
10. Preparation of synthetic seeds using sodium alginate
11. Estimation of IAA using Salkowski reagent

Genetic Engineering, Genomics, Proteomics and Bioinformatics

1. Isolation of Genomic DNA
2. Agarose Gel Electrophoresis of DNA and Southern Blotting
3. Isolation of Yeast RNA and Quantification by Spectrophotometry
4. Isolation of Plasmid DNA
5. Restriction digestion of the plasmid DNA
6. Ligation of DNA fragments
7. Bacterial Transformation and Identification of Transformants
8. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study of GUS activity histochemically
9. Determination of quality and quantity of DNA by spectrophotometry
10. PCR Amplification of DNA. RAPD profiling
11. Document files creation using MS word. Creating document style
12. Internet – E-mail and mail attachment Downloading webpage; Saving a web page; Printing the web page; Document Search engine; Image
13. Visit to genebank database; NCBI; EMBL
14. Visit to protein database; Swiss- Prot; PDB
15. Use of literature database Virtual library; Agricola; PubMed
16. Use of similarity search tools: NBLAST; PBLAST

M.Sc. BOTANY
SEMESTER – IV
PRACTICAL PAPER – II: CYTOGENETICS AND PLANT BREEDING AND ORGANIC FARMING AND VERMI COMPOSTING/ HORTICULTURE AND LANDSCAPING

Cytogenetics and Plant Breeding

1. Construction of linkage maps by using three point cross
2. Calculation of gene frequencies by Hardy-Weinberg law
3. Problems - Genome mapping
4. Exercises - Polyploidy breeding
5. Problems in Chi-square analysis
6. Problems in biostatistics - Mean, variance, Standard deviation and standard error
7. Problems - on students t-test
8. Problems - on ANOVA
9. Experiment - Seed Viability test
10. Exercises - on correlation path analysis

Organic Farming and Vermi composting

1. Determination of seed viability
2. To prepare manure and check manure quality
3. Sampling of manure and check manure quality - Moisture determination, bulk density, pH
4. Preparation of compost
5. Preparation of vermicompost
6. Preparation of biofertilizers
7. Isolation of rhizobium from agricultural fields
8. Staining and identification.
9. Clearing and staining technique of Arbuscular mycorrhizas
10. Wet sieving and decanting technique
11. Rearing of indigenous earthworms.

Horticulture and Landscaping

1. Mapping of horticulture zones of India and Andhra Pradesh
2. Study of pre-germination treatments to seeds and seed viability tests
3. Types of cuttings and layering and their preparation
4. Visit to local farmer fields for *Chrysanthemum*, roses and *Jasminum* cultivation
5. Visit to commercial orchards to study cultural practices of important fruit crops
6. Identification and description of varieties of vegetables
7. Identification of ornamental bulbous plants, foliage plants, palms and cacti
8. Study of different types of Gardens
9. Identification of trees, shrubs, ground covers and indoor plants