

**Syllabus for the post of Assistant Professor (College Cadre) in the Subject of  
Botany (Advt. No. 42/2024)**

1. Molecules and their Interaction Relevant to Biology
2. Cellular Organization
3. Fundamental Processes
4. Developmental Biology in relation to plants
5. Plant Physiology
6. Inheritance Biology
7. Diversity of Plants
8. Systematic, Anatomy, Embryology, Economic Botany
9. Ecological Principles
10. Applied Biology
11. Methods in Biology

  
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1. **MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY**

- A. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- B. Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.
- C. Enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes, Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
- D. Enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozyme
- E. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).

2. **CELLULAR ORGANIZATION**

- A. **Structural organization and function of intracellular organelles:** Cell wall, Cell membrane, lipid bilayer and protein diffusion, osmosis, ion channels, active transport, ion pumps, Nucleus, Mitochondria, Golgi Bodies, Lysosomes, Endoplasmic Reticulum, Peroxisomes, Plastids, Vacuoles, Chloroplast, Structure & Function of Cytoskeleton and its role in motility).
- B. **Organization of genes and chromosomes:** Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.
- C. **Cell Division and Cell Cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

3. **FUNDAMENTAL PROCESSES**

- A. **DNA replication, repair and recombination:** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.
- B. **RNA synthesis and processing:** Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.
- C. **Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins.
- D. **Control of gene expression at transcription and translation level:** Regulating the expression of prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

  
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4. DEVELOPMENTAL BIOLOGY IN RELATION TO PLANTS

- A. **Gametogenesis, fertilization and early development:** Production of gametes, embryo sac development and double fertilization in plants; zygote formation, embryogenesis, establishment of symmetry in plants; seed formation and germination.
- B. **Morphogenesis and organogenesis in plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*

5. PLANT PHYSIOLOGY -

- A. **Photosynthesis** - Light harvesting complexes; mechanisms of electron transport; photo protective mechanisms; CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways.
- B. **Respiration and photorespiration** –Glycolysis, oxidative phosphorylation, Citric acid cycle, plant mitochondrial electron transport and ATP synthesis, alternate oxidase; photorespiratory pathway.
- C. **Nitrogen metabolism** - Nitrate and ammonium assimilation; amino acid biosynthesis.
- D. **Plant hormones** – Biosynthesis, storage, breakdown and transport, physiological effects and mechanisms of action.
- E. **Sensory photobiology** - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins, stomatal movement, photoperiodism and biological clocks.
- F. **Solute transport and photoassimilate translocation** – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
- G. **Secondary metabolites** - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.
- H. **Stress physiology** – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses, mechanisms of resistance to biotic stress and tolerance to abiotic stress
- I. **Senescence and Abscission: Changes associated** with senescence and abscission, their regulation by plant growth regulators. Programmed cell death
- J. **Seed Biology:** Germination and dormancy of seeds, factors affecting its regulation by plant growth regulators and environmental factors.

  
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6. INHERITANCE BIOLOGY

- A. **Mendelian principles:** Dominance, segregation, independent assortment deviation from Mendelian inheritance.
- B. **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests
- C. **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- D. **Gene mapping methods:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.
- E. **Extra chromosomal inheritance:** Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.
- F. **Microbial genetics:** Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.
- G. **Quantitative genetics :** Polygenic inheritance, heritability and its measurements, QTL mapping.
- H. **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.
- I. **Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- J. **Recombination:** Homologous and non-homologous recombination including transposition, site specific recombination.

7. DIVERSITY OF PLANTS

- A. **Bacteria and Viruses:** Structure, nutrition, reproduction and economic importance of Bacteria, Structure and replication of viruses and bacteriophage.
- B. **Algae:** Structure, reproduction, classification and economic importance. Salient features and biological importance of cyanobacteria
- C. **Fungi:** Structure, reproduction, classification, economic importance. Heterokaryosis, Heterothallism, Parasexuality, Mycorrhizae, **Lichen:** structure, reproduction and economic importance. Causal organism, symptoms and management of important diseases of cereals and pulses.
- D. **Bryophytes:** General Structure, reproduction, classification, economic importance. Evolution of sporophyte in bryophytes.

  
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- E. **Pteridophytes: General Structure**, reproduction, classification and economic importance. Apospory, Apogamy, Stelar evolution, soral evolution, Heterospory and origin of seed habit in Pteridophytes.
- F. **Gymnosperms: Structure**, reproduction, classification, economic importance

## 8. **Systematic, Anatomy, Embryology, Economic Botany**

- A. **Principles & methods of taxonomy:**  
Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, ICN, B.S.I. Botanical Gardens, Herbarium.
- B. **Systems of classification of angiosperms:** Bentham and Hooker, Engler and Prantl, Takhtajan.
- C. **Economic Botany:** Origin, evolution, botany and cultivation of cereals, pulses, oil yielding plants, fibre yielding plants, spices, important medicinal plants.
- D. **Embryology:** Pollen pistil interaction, Sporophytic and gametophytic incompatibility, endosperm development, Experimental embryology; in vitro fertilization, anther pollen and embryo culture.
- E. **Anatomy:** simple and complex tissues, Anatomy in relation to taxonomy, Monocot and Dicot Root and stem, phyllotaxy, shoot apical meristem, root apical meristem, secondary growth in dicot stem and dicot root, anomalous secondary structures.

## 9. **ECOLOGICAL PRINCIPLES**

**The Environment:** Physical environment; biotic environment; biotic and abiotic interactions.

**Habitat and Niche:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

**Population Ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies ( $r$  and  $K$  selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

**Species Interactions:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

**Community Ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

**Ecological Succession:** Types; mechanisms; changes involved in succession; concept of climax.

**Ecosystem Ecology:** Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

  
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**Biogeography:** Major terrestrial biomes, theory of island biogeography biogeographical zones of india

**Applied Ecology:** Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

**Conservation Biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

**Population genetics** – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution

10. **APPLIED BIOLOGY:**

- A. Microbial fermentation and production of small and macro molecules.
- B. Transgenic plants for insect resistance, herbicide resistance, abiotic resistance stress, disease resistance long shelf life of fruits and flowers, male sterile lines, molecular approaches to diagnosis and strain identification.
- C. Genomics and its application to agriculture and forestry
- D. Bioresource and uses of biodiversity.
- E. Breeding in plants
- F. Bioremediation and phytoremediation

11. **METHODS IN BIOLOGY**

**MOLECULAR BIOLOGY AND RECOMBINANT DNA METHODS:**

Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, different separation methods. Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, Isoelectric focusing gels. Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors. Isolation of specific nucleic acid sequences. Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms. Protein sequencing methods, detection of post translation modification of proteins. DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques. Isolation, separation and analysis of carbohydrate and lipid molecules RFLP, RAPD and AFLP techniques

**PLANT CELL AND TISSUE CULTURE:** Concept of cellular differentiation, totipotency, organogenesis and adventive embryogenesis, Fundamental aspects of morphogenesis, somatic embryogenesis and androgenesis- mechanisms, tissue culture techniques and cryopreservation.

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