

**COMPETITIVE EXAMINATION FOR THE RECRUITMENT OF  
ASSISTANT PROFESSORS - 2021**

**Subject: BOTANY / APPLIED BOTANY**

**SYLLABUS**

- Unit -1: Plant Biochemistry
- Unit- 2 : Cellular Organization
- Unit- 3 : Fundamental Processes
- Unit -4 : Cell Communication & Signaling
- Unit -5 : Diversity of Life Forms
- Unit -6 : Plant Systematics
- Unit -7 : Plant Embryology and Anatomy
- Unit – 8 : Plant Physiology
- Unit - 9 : Genetics & Plant Breeding
- Unit -10: Ecological Principles
- Unit -11 : Evolutionary Biology
- Unit -12 : Applied Plant Biology
- Unit -13: Methods in Biology

**Unit -1: PLANT BIOCHEMISTRY**

- A. **Enzymes** - classification, kinetics and mechanism of action.
- B. **Proteins and amino acids**: classification, structure - primary, secondary, tertiary and quaternary; biosynthesis and separation (amino acid sequence, C-terminal, N-terminal, disulfide bonds).
- C. **Lipids**: classification, structure, function and biosynthesis of fatty acids; Beta-oxidation.
- D. **Nucleic acids**: classification, structure, biosynthesis, functions and metabolism.
- E. **Vitamins** - classification, distribution, structure, production, function.
- F. **Secondary plant products**: structure, biosynthesis and distribution of terpenes, phenolics and nitrogen containing compounds.

**Unit- 2 : CELLULAR ORGANIZATION**

- A. **Cell Division & Cell Cycle**: Control & regulation of cell cycle, steps in cell cycle, meiosis & mitosis & their regulation.
- B. **Organization of Genes & Chromosomes**: Transposons, euchromatin, heterochromatin, the structure of chromosomes & chromatin, gene families, interrupted genes, repetitive & unique DNA, operon.

- C. **Structural Organization & Function of Intracellular Organelles:** Function & structure of cytoskeleton & its role in motility, chloroplast, vacuoles, plastids, peroxisomes, endoplasmic reticulum, lysosomes, Golgi bodies, mitochondria, nucleus, cell wall.
- D. **Membrane Structure & Function:** Electrical properties of membranes, regulation of intracellular transport, mechanism of sorting, membrane pumps, active transport, ion channels, osmosis, membrane & lipid bilayer protein diffusion, the structure of the model membrane.

### Unit- 3 : FUNDAMENTAL PROCESSES

- A. **DNA Replication, Repair & Recombination:** Site-specific & homologous recombination, DNA repair mechanisms, extrachromosomal replicons, fidelity of replication, replication fork and origin, enzymes involved, unit of replication.
- B. **RNA Synthesis & Processing:** Function & structure of various kinds of RNA transport & RNA, polyadenylation, splicing, RNA editing, RNA processing, termination, elongation, capping, RNA polymerases, transcription repressor & activator, the formation of initiation complex, transcription machinery & factors.
- C. **Protein Synthesis & Processing:** Post-translational modification of proteins, translational inhibitors, translational proof-reading, aminoacyl tRNA synthetase, tRNA-identity, aminoacylation of tRNA, genetic code, termination, elongation factors, initiation factors & regulation, initiation complex formation, the ribosome.
- D. **Control of Gene Expression at Transcription & Translation Level:** Chromatin's role in gene silencing & expression, regulating the expression of eukaryotic & prokaryotic, viruses, and phage genes.

### Unit -4 : CELL COMMUNICATION & SIGNALING

- A. **Cell Signaling:** Light signaling in plants, plant & bacterial two-component systems, regulation of signaling pathways, second messengers, signal transduction pathways, G-protein couple receptors mediated signaling, cell surface receptors, phytohormones & their receptors.
- B. **Host-Parasite Interaction:** Cell-cell fusion in both abnormal & normal cells, pathogen-induced diseases in plants, modification of host cell behaviour with pathogens, entry & recognition of various pathogens such as viruses & bacteria into plant host cells.

### Unit -5 : DIVERSITY OF LIFE FORMS

- A. Structure & replication of plant viruses, bacteriophage, viroids and prions.
- B. **Bacteria and Cyanobacteria:** Structure, nutrition, reproduction & economic importance; Phytoplasmata – a brief account.
- C. **Algae:** Structure, pigmentation, reproduction, classification and economic importance.

- D. **Fungi:** Structure, reproduction, classification, economic importance. Heterokaryosis, Heterothallism, Para sexuality, Mycorrhizae, Lichens: structure, reproduction and economic importance.
- E. **Plant pathology:** Classification of diseases, organism, symptoms and management of important diseases of cereals and pulses. Disease cycle and epidemiology. Defense mechanism, phytoalexins. genetics of plant pathology. Plant disease management.
- F. **Bryophytes:** structure, reproduction, classification and economic importance. Evolution of sporophyte in bryophytes.
- G. **Pteridophytes:** structure, reproduction, classification and economic importance. Apogamy, apospory: significance and experimental induction. Stelar evolution, Soral evolution, Heterospory and seed habit.
- H. **Gymnosperms:** Structure, reproduction, classification and economic importance.
- I. **Paleobotany :** Geological time scale, Methods of fossilization, Fossil pteridophytes and Gymnosperms, A Brief account on Living fossil plants.

#### **Unit -6 : PLANT SYSTEMATICS**

- A. **Principles & Methods of Taxonomy:** Quantitative & classical methods of the taxonomy of plants, Systems of Classification- Bentham and Hooker, Engler and Prantl, and APG System, Plant nomenclature & ICBN/ICN, hierarchical taxa, Taxonomical literature & concepts of species.
- B. **Biosystematics & Modern trends in Taxonomy –** Cytotaxonomy, Chemotaxonomy, Molecular taxonomy, Phylogenetics.
- C. **Study of the Angiosperm plant families with their phylogeny and economic importance –** Magnoliaceae, Annonaceae, Capparidaceae, Asteraceae, Fabaceae, Rutaceae, Asclepiaceae, Convolvulaceae, Oxalidaceae, Meliaceae, Sapindaceae, Rubiaceae, Santalaceae, Combretaceae, Nymphaeaceae, Loranthaceae, Cactaceae, Euphorbiaceae, Moraceae, Zingiberaceae, Orchidaceae, Poaceae, Aracaceae, Amaryllidaceae, Dioscoreaceae.
- D. **Field & Herbarium techniques:** Brief account on the herbaria of World and India and importance.
- E. **Botanical gardens-** A brief account on the botanical gardens of World & India - their importance; Botanical Survey of India.
- F. **Economic Botany:** Origin, evolution, botany, cultivation and uses of cereals, pulses, oil yielding , wood & fibre yielding, spices, condiments, and medicinal plants.
- G. **Ethnobotany:** History and importance of ethno-botany and ethnomedicine in modern health care system; Basic concepts and development of traditional systems of medicine- Ayurveda, Tibetan, Unani, and Siddha systems.

## Unit -7 : PLANT EMBRYOLOGY AND ANATOMY

- A. Microsporogenesis and Male gametophyte; Megasporogenesis and Female gametophyte; Pollination- Brief account, Structure, Histochemical details of style and stigma; Pollen germination and fertilization. Endosperm types and development. Embryogenesis- Monocot and dicot embryo development; Somatic embryogenesis; Polyembryony and Apomixis.
- B. **Palynology** and its applications.
- C. **Plant Cell and Tissue Culture**: concept of cellular differentiation, Totipotency, organogenesis and adventive embryogenesis; Fundamental aspects of morphogenesis, somatic embryogenesis and androgenesis-mechanisms, techniques and utility, Cryopreservation.
- D. Tissues & Tissue systems: Meristems, Simple and Complex; Secretory and dermal tissues systems – trichome and stomata.
- E. Diversity in Wood anatomy and its applications.
- F. Anomalous primary and secondary growth in *Achyranthus*, *Nyctanthus*, *Boerhaavia*, *Bougainvillia*, *Aristolochia*, *Tinospora* and *Dracaena*.

## Unit – 8 : PLANT PHYSIOLOGY

- A. Plant water relations and SPAC Concept.
- B. **Solute Transport & Photoassimilate Translocation**: Mechanisms of unloading & loading of photoassimilates, transpiration, translocation, transport & uptake of macromolecules, solutes & ions via phloem & xylem, across membranes, and through cells.
- C. **Nitrogen Metabolism**: ammonium & nitrate assimilation. Biological nitrogen fixation – Types, physiology and mechanism.
- D. **Photosynthesis**: CO<sub>2</sub> fixation-CAM, C<sub>4</sub>, and C<sub>3</sub> pathways, photoprotective mechanisms, mechanisms of electron transport, light-harvesting complexes.
- E. **Respiration & Photorespiration**: Photorespiratory pathway, alternate oxidase, ATP synthesis & plant mitochondrial electron transport, citric acid cycle.
- F. **Plant Hormones**: Mechanism of action & physiological effects, transport & breakdown, storage, biosynthesis.
- G. **Sensory Photobiology**: Biological clocks, photoperiodism, stomatal movement, mechanism of action, function & structure of phytochromes, phototropin & cryptochromes.
- H. Senescence, Aging & Cell Death (PCD and Autophagosis).
- I. **Stress Physiology**: Plant responses to abiotic & biotic stresses.

## Unit - 9 : GENETICS & PLANT BREEDING

- A. **Mendelian Principles**: Independent assortment, segregation, dominance.

- B. **Concept of Gene:** Complementation tests, pseudoallele, multiple alleles, allele.
- C. **Extra Chromosomal Inheritance:** Maternal inheritance, the inheritance of chloroplast & mitochondrial genes.
- D. **Quantitative Genetics:** QTL mapping, heritability & its measurements, polygenic inheritance.
- E. **Extensions of Mendelian Principles:** Sex influenced & limited characters, sex linkage, crossing over & linkage, phenocopy, expressivity & penetrance, genomic imprinting, pleiotropy, gene interactions, incomplete dominance, codominance.
- F. **Gene Mapping Methods:** Plant population mapping development, somatic cell hybrid mediated mapping, molecular marker mediated mapping, tetrad analysis, linkage maps.
- G. **Recombination:** Non-homologous & homologous recombination.
- H. **Numerical & Structural alterations of Chromosomes:** Ploidy & their genetic implications, translocation, inversion, duplication and deletion.
- I. **Mutations:** Insertional mutagenesis, somatic versus germinal mutants, the gain & loss of function, biochemical, conditional, and lethal, detection, causes.
- J. **Plant Breeding:** Plant Introduction, Quarantine methods, Marker-Assisted Selection, Hybridization & Heterosis; Methods of vegetative propagation.

#### Unit -10: ECOLOGICAL PRINCIPLES

- A. **The Environment:** Abiotic & biotic interactions, biotic environment, physical environment.
- B. **Habitat and Niche:** Character displacement, resource partitioning, realized & fundamental niche, overlap & niche width, the concept of niche & habitat.
- C. **Species Interactions:** Symbiosis, pollination, insectivorous plants, herbivory, interspecific competition, interaction types; Allelopathy.
- D. **Community Ecology:** Ecotones & edges, species diversity levels & its measurements, community attributes & structure, nature of communities.
- E. **Ecosystem Ecology:** Function & structure of few Indian ecosystems: aquatic & terrestrial, decomposition & primary production, mineral cycling & energy flow, ecosystem function & structure.
- F. **Ecological Succession:** the concept of climax, alteration in succession, mechanism, types.
- G. **Biogeography:** Biogeographical zones in India, island biogeography theory, major terrestrial biomes. Endemism, Forests of Karnataka.
- H. **Applied Ecology:** Biodiversity management methods, major biodiversity changing aspects, Biodiversity-documentation; monitoring & status, global environmental change, and environmental pollution.

- I. **Biodiversity conservation:** Objectives, implication and action plans; International and National organizations for conservation of natural resources; *in situ* conservation protected areas, biosphere reserves, national parks, sanctuaries and sacred groves; *ex situ* conservation, botanical gardens, gene banks, medicinal & herbal gardens.
- J. **Conservation Biology:** Management strategy/Indian conservation case studies, major management approaches, conservation principles. Loss of biodiversity: Casual factors of threat, impact of habitat loss and habitat fragmentation; Categories - rare, endangered, vulnerable, threatened and extinct plant species; IUCN - Red Data Book; Environmental impact assessment and sustainable development.

### Unit -11 : EVOLUTIONARY BIOLOGY

- A. **Emergence of Evolutionary Thoughts:** The evolutionary synthesis, spontaneity of mutations, Mendelism, natural selection & fitness, struggle, Neo-Darwinism and Modern Synthetic theory of Evolution.
- B. **Origins of Unicellular & Cellular Evolution:** aerobic & anaerobic metabolism, photosynthesis, the evolution of unicellular eukaryotes, the origin of eukaryotic cells, the evolution of prokaryotes, the first cell, Miller's experiment, Haldane & Oparin's concept, abiotic synthesis of organic polymers and monomers, the origin of fundamental biomolecules.
- C. **Molecular Evolution:** gene divergence & duplication, the origin of new proteins & genes, nucleotide & protein sequence analysis, molecular tools in identification; classification & phylogeny, molecular clocks & divergence, neutral evolution concepts.
- D. **Mechanisms:** Co-evolution, sexual selection, convergent evolution, sympatric & allopatric speciation, isolating mechanisms, adaptive radiation, random genetic drift & migration, natural selection-mediated gene frequency change concepts and rates, Role of Polyploidy and Whole Genome Duplications, Hardy-Weinberg Law, gene frequency, gene pool in populations.

### Unit -12 : APPLIED PLANT BIOLOGY

- A. Role of microbes in Agriculture and industry.
- B. Mushroom cultivation.
- C. Biosensors.
- D. Phytoremediation & Bioremediation.
- E. Biodiversity Uses & Bioresources: Biofertilizers, Biopesticides, Petrocrops.
- F. Genomics & its applications in Agriculture & Health like Gene Therapy.
- G. Molecular Approaches to Identify Strain & Diagnose, transgenic plants.
- H. Production of macro & small molecules and microbial fermentations.
- I. Plant derived Nutraceuticals.

### **Unit -13: METHODS IN BIOLOGY**

- A. **Microscopic Techniques:** Microscopical image processing methods, freeze-fracture & freeze-etch EM methods, EM staining & fixation techniques, transmission & scanning microscopes, living cell microscopy, resolving powers of various microscopes, and subcellular and cellular component visualization with light microscopy.
- B. **Recombinant DNA & Molecular Biology Methods:** Isolation & analysis of lipid & carbohydrate molecules - AFLP, RAPD, and RFLP techniques, large scale expression - microarray-based techniques, gene expression analysis at protein & RNA level, strategies of genome sequencing, DNA sequencing methods, protein's post-translational modification detection, protein sequencing methods, eukaryotic & bacterial gene knock-out, in vitro deletion & mutagenesis techniques, BAC & YAC, cosmid, phage, and plasmid vector-mediated generation of cDNA and genomic libraries; plant and bacterial vector-based recombinant protein expression, eukaryotic & bacterial molecular cloning of RNA or DNA fragments, isoelectric focusing gels, 2 and 1- D gel electrophoresis-based protein, DNA and RNA analysis, separation methods for protein, DNA (plasmid & genomic) and RNA.
- C. **Immuno & Histochemical Techniques:** GISH & FISH based in situ localization, detection of molecules within living cells, immunofluorescence microscopy, flow cytometry, immunoprecipitation, western blot, RIA, and ELISA based molecule detection, and antibody generation, radio-isotopes & radiolabeling in plant biology.
- D. **Biophysical Methods:** Chromatographic separation techniques – TLC, HPLC and CC. Spectrophotometric studies- Mass, UV, IR, NMR in the molecule structure analysis.
- E. **Statistical Methods:** Basic introduction to multivariate statistics, X<sup>2</sup> test, analysis of variance, t-test, correlation & regression, levels of significance, errors, confidence interval, comparison of parametric & non-parametric statistics, sampling distribution, probability distributions, measures of dispersal & central tendency.

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