

**ENTRANCE TEST SYLLABUS FOR INTEGRATED Ph.D. PROGRAMME IN
BOTANY-2016**

Unit: A (VIRUSES, BACTERIA, FUNGI AND PLANT PATHOLOGY)

- A. **Bacteria:** origin and evolution, diversity and classification of eubacteria, bacterial growth and nutrition; reproduction and ecological importance; Archaeobacteria: general account and evolutionary significance; Cyanobacteria salient features and importance
- B. **Viruses:** general characteristics, replication and transmission; economic importance
- C. **Fungi:** cell ultrastructure, nutrition and reproduction, heterothallism, heterokaryosis, parasexuality; fungi as bio-control agents, economic importance
- D. **Plant Pathology:** disease symptoms and control measures with special reference to paddy blast, powdery mildews, damping off of seedlings, apple scab; human diseases viz. actinomycosis and blastomycosis.

Unit: B (ALGAE, BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS)

- A. **Algae:** range of thallus structure in algae, pigmentation in algae, vegetative, asexual and sexual reproduction in algae; economic importance of algae
- B. **Bryophyta:** general characteristics, structure and reproduction in bryophytes; alternation of generations; evolution of gametophyte and sporophyte in bryophytes
- C. **Pteridophyta:** general characteristics, structural and reproductive features, evolution of stele; heterospory and seed habit
- D. **Gymnosperms:** general characteristics, classification, reproduction and economic importance of gymnosperms; life cycle patterns in gymnosperms

Unit: C (TAXONOMY, BIODIVERSITY AND CONSERVATION BIOLOGY)

- A. **Principles and methods of taxonomy:** botanical classification (phenetic and cladistic approaches); botanical nomenclature (principles & procedures, typification); botanical identification (taxonomic keys, computers & DNA Barcoding); sources of taxonomic characters (morphology, palynology, cytology, phytochemistry, molecular biology), herbarium (methods & uses); botanic garden (concept & role).
- B. **Taxonomy and Phylogeny:** taxonomic hierarchy & categories, species concepts; isolating mechanisms; speciation (allopatric & sympatric); co-evolution; parallel and convergent evolution; diversity and evolutionary relationships of major groups of plants.
- C. **Biodiversity:** components, levels & values of biodiversity; present status of global biodiversity; plant diversity in Kashmir Himalaya - present status, socio-economic utility, extent of threat and conservation needs.

- D. **Loss of biodiversity:** loss of genetic variation and its consequences; species extinction (causes & methods of estimation); IUCN threatened categories (concept & criteria); threatened ecosystems (forests, grasslands, wetlands, mangroves and coral reefs).
- E. **Conservation biology:** principles, practice & characteristics; *in-situ* and *ex situ* conservation strategies; global and national conservation efforts (initiatives & organizations); biogeographical zones of India.

Unit: D (PLANT RESOURCES)

- A. Plant resource utilization through ages and origin of agriculture.
- B. World centres of origin and domestication as proposed by de Candolle and Vavilov
- C. Green revolution - concept and concerns.
- D. Origin and domestication of major cereals.
- E. Agricultural Biotechnology, synthetic crops and arid agriculture-potential and impact
- F. Hard and soft wood sources with special reference to their economic potential

Unit: E (DEVELOPMENTAL BIOLOGY)

- A. **Gametogenesis, fertilization and early development:** production of gametes; embryo sac development and double fertilization in plants; zygote formation; embryogenesis; seed formation and germination.
- B. **Pollination, Pollen pistil interactions:** pollination mechanisms and vectors, breeding systems, pollen stigma interactions, sporophytic and gametophytic self-incompatibility.
- C. **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*.
- D. **Programmed cell death, aging and senescence.**

Unit: F (ECOLOGICAL PRINCIPLES)

- A. **The Environment:** physical environment; biotic environment; biotic and abiotic interactions.
- B. **Habitat and niche:** concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
- C. **Population ecology:** characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation, demes, age structured populations.
- D. **Species interactions:** types of interactions, interspecific competition, herbivory, parasitism, mutualism (pollination, symbiosis etc).
- E. **Community ecology:** nature of communities; community structure and attributes; edges and ecotones.
- F. **Ecological succession:** types; mechanisms; changes involved in succession; concept of climax.

- G. **Ecosystem:** structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).
- H. **Biogeography:** major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
- I. **Applied ecology:** environmental pollution (effect of SO₂, O₃ and heavy metals on plants), Causes and consequences of global environmental change (greenhouse effect-global warming, ozone layer depletion and acid rain).

Unit: G (SYSTEM PHYSIOLOGY – PLANT)

- A. **Photosynthesis:** light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C3, C4 and CAM pathways.
- B. **Respiration and photorespiration:** 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

Unit: H (MOLECULES AND THEIR INTERACTION)

- A. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- B. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics colligative properties).
- C. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
- D. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
- E. Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds).
- F. Conformation of nucleic acids (A-, B-, Z-,DNA), t-RNA, micro-RNA).

- G. Stability of protein and nucleic acid structures.
- H. Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

Unit: I (CELLULAR ORGANIZATION)

- A. **Membrane structure and function:** structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- B. **Structural organization and function of intracellular organelles:** cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.
- C. **Organization of genes and chromosomes:** operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.
- D. **Cell division and cell cycle:** mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

Unit: J (FUNDAMENTAL PROCESSES)

- A. **DNA replication, repair and recombination:** unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra chromosomal replicons, DNA damage and repair mechanisms.
- B. **RNA synthesis and processing:** transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, 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, translational proof-reading, translational inhibitors, post- translational modification of proteins.
- D. **Control of gene expression at transcription and translation level:** regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

Unit: K (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, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- D. **Microbial genetics:** methods of genetic transfers – transformation, conjugation, transduction and sex-duction, fine structure of gene-rII locus.
- E. **Mutation:** types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.
- F. **Structural and numerical alterations of chromosomes:** deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- G. **Recombination:** homologous and non-homologous recombination, including transposition, site-specific recombination.
- H. **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

Unit: L (METHODS IN BIOLOGY)

- A. **Molecular biology and recombinant DNA methods:** molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors; DNA sequencing methods, strategies for genome sequencing; methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques; RFLP, RAPD and AFLP techniques
- B. **Histochemical and immunotechniques:** techniques of southern and western blotting, flowcytometry and immunofluorescence microscopy, *in situ* localization by techniques such as FISH and GISH.
- C. **Statistical Methods:** measures of central tendency and dispersion; sampling techniques and hypothesis testing, difference between parametric and non-parametric statistics; confidence interval; standard error; levels of significance; regression and correlation; t-test; experimental designs and analysis of variance; χ^2 test.
- D. **Microscopic techniques:** concept of light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.
