



ENTRANCE EXAMINATION SYLLABUS

FOR DOCTOR OF PHILOSOPHY (Ph.D.)

DEPARTMENT OF BOTANY

MOHAMMAD ALI JAUHAR UNIVERSITY, RAMPUR

PART--I: Research Methodology (60 Questions, common for all science subjects)

Research Aptitude: Research concept, steps involved, identification, selection and formulation of research problem, justification, hypothesis; literature collection---textual and digital resources (internet). Advances in Microscopic Techniques- LM, EM, Confocal Microscopy, Karyotyping, Image analysis softwares.-Use of HPLC, amino acid analyzer and Bomb Calorimeter. Centrifuge, paper chromatography, spectrophotometer. Basic concepts of extraction and quantification of nucleic acid and proteins. Protein and nucleic acid electrophoresis, Northern and southern blots, FISH and GISH. Protein and DNA band profiling through gel documentation system, PCR, cloning, sequencing, microarray

Research design, data collection and interpretation: Research design; sampling techniques, collection and documentation, presentation, analysis and interpretation of data

Scientific writing: Forms of scientific writing--- Article, notes, reports, review article, monographs, dissertations, popular science articles, bibliographies,

Formulation of scientific communication: Outline preparation, drafting title, sub titles, tables, illustrations; Formatting tables---title, body footnotes; figures & graphs---structure, title and legends, Impact factor, citation indices, plagiarism

Computer application: MS office, excel, power point, graphics (Sigma plot), statistical software (SPSS)

Biostatistics: Statistical Methods: Measures of central tendency and dispersal; probability, distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non---parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t---test; Analysis of variance; X^2 test; Basic introduction to Multivariate statistics, etc.

PART – II (Subject specific 60 questions)

Plant Diversity-

Microbial world, Structure of a bacteria; reproduction and recombination in bacteria; Viruses, general characteristics, Structure of viruses, Bacteriophages, Lytic and Lysogenic cycles, viroids, Prions & mycoplasma, Range of thallus organization in Algae, Pigments, Reserve food –Reproduction, Classification & Economic importance of algae. General characteristics, nutrition, life cycle, Economic importance of Fungi, Classification upto class. Bryophytes: General characteristics, Range of thallus organization. Classification & economic importance of bryophytes. General characteristics & Classification of Pteridophytes, Heterospory and seed habit, stelar evolution, economic importance of Pteridophytes. Classification and distribution, structure, reproduction & economic importance of Gymnosperms.

Biomolecules and their interactions:

Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins); Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.); Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers; Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis.

Cellular Organization:

Membrane structure and function (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes); 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); Organization of genes and chromosomes (Operon, unique and repetitive DNA, interrupted genes, structure of chromatin and chromosomes, heterochromatin, eu chromatin); Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).

Molecular biology:

Identification of DNA as genetic material: Transformation experiment, Hershey Chase experiment RNA as the genetic material in some viruses. Important features of Watson and Crick model of DNA structure, Chargaff's rules, preferred tautomeric forms of bases. RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases capping elongation and termination RNA processing, Protein synthesis and their regulation, elongation and elongation factors, termination, genetic code

Developmental & Reproductive Botany:

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristem and floral development. Vascular cambium and cork cambium: Structure and function, factors affecting cambial activity, secondary growth in vascular and cortical region, structure of bark. Anomalous secondary growth in dicots and monocots. Morphological and structural adaptations in different ecological groups - hydrophytes, xerophytes, epiphytes and halophytes. Brief study of structure and function of anther wall components Micro-sporogenesis; and its significance, microgametogenesis, pollen wall development, MGU (male germ unit) structure, pollen viability, megasporogenesis and megagametogenesis: Organization and ultrastructure of mature embryo sac. Pollination types and significance; adaptations; pollen-pistil Interaction; structure of stigma and style; fertilization and double fertilization. Endosperm: Types, development and functions, development of Embryo, (monocot and dicot).

Plant Physiology:

Photosynthesis --Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation---C₃, C₄ and CAM pathways. Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway. Nitrogen metabolism--Nitrate and ammonium assimilation; amino acid biosynthesis. Plant hormones Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Solute transport and photo assimilate 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 photo---assimilates. Secondary metabolites--Biosynthesis of terpenes, phenol and nitrogenous compounds and their roles. Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Genetics:

Mendelian principles: Dominance, segregation, independent assortment. Concept of gene, Allele, multiple alleles. Extensions of Mendelian Principles: Codominance, incomplete dominance, gene interactions, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and nonhomologous recombination including transposition.

Plant Taxonomy:

Principles & methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, Major systems of angiosperm classification with special emphasis on the conceptual basis of the classifications of; (i) Linnaeus (ii) Bentham & Hooker (iii) Engler & Prantl (iv) Takhtajan. Functions of field study, herbarium, botanical gardens, BSI, Floras/Taxonomic literature and GIS (Geographic Information System).

Ecology & Environmental Botany:

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, Types of interactions, inter specific competition, herbivory, carnivory,. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement. Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition. Biogeography: Major terrestrial biomes; 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.

