



DEPARTMENT OF BOTANY
School of Biosciences & Biotechnology
Baba Ghulam Shah Badshah University, Rajouri (J&K) -185234

Ref No BGSBU/Bot/23/112

Dated:06-06-23

Syllabus for Entrance Test for Admission to Ph.D in Botany- 2023

1. Algae, Bryophytes - diversity in structure and reproduction

- a. Algae: general characteristics; criteria for algal classification; Round's system of classification; general characters of structure and reproduction of various groups of algae.
- b. Economic importance of algae with special emphasis on algal blooms, indicators of pollution, algae as alternate source of energy.
- c. General characters of bryophytes, criteria used for classification, classification as given by Proskauer (1957), alternation of generation in the life history of bryophytes, bryophytes as amphibians of plant kingdom.
- d. Hepaticopsida: distinguishing features, morphology and anatomy of sporophyte and gametophyte, vegetative and sexual reproduction in Marchantiales (*Riccia*, *Marchantia*) and Jungermanniales (*Pellia*, *Porella*).
- e. Anthocerotopsida: distinguishing features, morphology and anatomy of sporophyte and gametophyte, vegetative and sexual reproduction in *Anthoceros*, *Notothylus*
- f. Bryopsida: distinguishing features, morphology and anatomy of sporophyte and gametophyte, vegetative and sexual reproduction in *Funaria*, *Polytrichum*

2. Fossils of bryophytes, pteridophytes and geological time scale.

- a. Geological time scale: concepts of epoch, era, period; origin of important plant groups during different periods in geological history.
- b. Fossils- types, causes of fossil formation, methods to study fossils and reorganization of fossil genera.
- c. Fossil bryophytes: *Naiadita lanceolate*, *Sporogonites exuberans*, *Hepaticites kidstonii*.
- d. Fossil pteridophytes: *Rhynia*, *Calamites*, *Sphenophyllum*, *Lepidodendron*

3. Cell organelles - structure and function

- a. Mitochondria: Structure and functions, genome organization, protein import and mitochondrial assembly (protein targeting to the mitochondrial inner membrane, outer membrane and intermembrane space)
- b. Chloroplast: Structure and functions; genome organization, import and sorting of chloroplast proteins. Peroxisomes: structure, functions of peroxisomes, peroxisome assembly and import of peroxisomal proteins.
- c. Endoplasmic Reticulum: Structure, types, targeting to ER (Cotranslational and Posttranslational translocation of proteins into the ER), protein folding and processing in the ER, protein misfolding and unfolded protein response, protein export from ER.
- d. Golgi complex: organization of Golgi, protein glycosylation within Golgi, mannose phosphorylation, protein sorting and export from the Golgi apparatus, mechanism of vesicular transport and vesicle fusion.

4. Cell Signaling

- a. Basic elements of cell signaling system, signaling molecules (extracellular and intracellular secondary messenger), receptors (intracellular and cell surface), specific example of plant receptors.
- b. Signaling via G-protein-coupled receptors; G-proteins, cyclic AMP and protein kinase A, protein kinases and phosphatases, calcium as an intracellular messenger, calcium calmodulin complex, inositol phospholipid.
- c. Signaling via enzyme-coupled receptors: receptor tyrosine kinases, tyrosine kinases associated receptors, serine/threonine kinases receptor
- d. Nitric oxide as an intracellular messenger, bacterial and plant two-component signaling systems, light signaling in plants, chemotaxis, quorum sensing, scatchard plot

5. DNA - structure, replication, damage and repair

- a. DNA structure and types, DNA as genetic material, Denaturation and renaturation of DNA, Concept of melting temperature (T_m).
- b. Mechanism of DNA replication, Rolling-Circle Replication, Semi-conservative replication of double stranded DNA.
- c. Chromatin structure, Nucleosome organization, Chromosome structure - centromere and telomere.
- d. Molecular basis of gene mutation, Gain and Loss of function mutation and their consequences, DNA damage, Repair of DNA; Photo-reactivation, Base excision, Nucleotide excision and Mismatch repair.

6. Translation and post-translational modifications

- a. Genetic code: Concept, degeneracy, wobble hypothesis.
- b. Translation: Mechanism of protein synthesis in prokaryotes and eukaryotes, inhibitors of translation.
- c. Post-translational modifications, ubiquitin mediated protein degradation (ubiquitin proteasome pathway).
- d. Analysis of gene expression: Restriction fragment length polymorphism, DNA fingerprinting, DNA Microarray.

7. Plant taxonomy: bases and historical background

- a. Classification, taxonomy, systematics; historical background of angiosperm classification (concept of artificial, natural and phylogenetic approaches to classification).
- b. Importance of and need for taxonomy: importance of taxonomy in biology; relevance of taxonomy to society; need for taxonomy in unraveling biodiversity.
- c. Bentham & Hooker's and Engler & Prantl's systems of classification (outline and merits & demerits)
- d. Takhtajan's system of classification (outline and merits & demerits); Angiosperm Phylogeny Group (APG) (outline of APG classification).

8. Photochemistry and photosynthesis

- a. Photosynthesis: concept, historical background, photosynthetic pigments (types and role), photosystems (concept, constitution and role).
- b. Electron transport system; mechanism of electron transport pathways (cyclic and noncyclic electron transport).
- c. Carbon assimilation pathways: Calvin cycle (C3 pathway), C4 pathway ; relative efficiency of C3 and C4 plants.
- d. Crassulacean acid metabolism (CAM) pathway; photorespiration and its significance.

9. Plant nitrogen, sulfur metabolism and plant hormones/physiology of flowering

- a. Enzymes: concept, definition, properties and classification; kinetics of single-substrate enzyme catalyzed reactions- Michaelis-Menton equation and its significance.

b. Sulfur uptake, reduction of sulfate, significance of ATP sulfurylase, Amino acid biosynthesis

c. Nitrogen metabolism: nitrogen in environment; mechanism of nitrate uptake and assimilation; ammonium assimilation; need for nitrogen in metabolism.

d. Biological nitrogen fixation; nodule formation and nod factors, importance of nitrogen fixation, nitrogen fixing plants.

e. Physiology of flowering: photoperiodism; vernalization. plant movements: tropic and nastic movements.

f. Plant hormones: history of discovery and physiological effects of auxins, gibberellins, cytokinins, abscissic acid, ethylene, brassinosteroids and jasmonic acid.

10 Genetic engineering techniques

a. Polymerase Chain Reaction: Principle, Types –Multiplex, Hot-start, Nested, Touch down, RT, qRT; Applications and importance.

b. Cloning: TA cloning, Restriction enzyme dependent and independent cloning, linkers and adapters and homopolymer tailing.

c. Site-directed mutagenesis, construction and screening of genomic and cDNA libraries.

d. DNA sequencing - chemical degradation, enzymatic methods and next generation sequencing.

11. Population and Community ecology

a. Characteristics of populations: density, natality, mortality, survivorship curves, dispersion, age structure and pyramids, dispersal, life tables: age-specific mortality and survival. Population growth curves: exponential growth and logistic growth curve, population regulation: density dependent and density independent factors

b. Community structure and characteristics, species richness and evenness, levels of diversity, species area curve, disturbance and species diversity, guilds, plant communities; life forms, stratification and phenology, ecotones, edges, keystone species and community control, Nagoya protocol.

c. Ecological niche: concept of habitat and niche, niche width and overlap, fundamental and realized niche, ecological compression, competitive exclusion principle, coexistence, resource partitioning and character displacement.

d. Ecological successions: types, mechanism of succession, changes involved in succession, concept of climax communities, models of succession.

12. Chromosome organization

- a. Structure of eukaryotic chromosome; nucleosome model; banding patterns for identification of chromosomes (Q, C, N, G and R bands).
- b. Morphology of chromosomes: centromeres, secondary constriction; knob; telomeres; satellite and nucleolar organizer region (NOR).
- c. Specialized chromosomes: Structure, occurrence and behaviour of B and Sex chromosomes, Polytene and lampbrush chromosomes.
- d. Karyotype symmetry; chromosome numbers; symbols & terminology; Karyotype evolution, euchromatin and heterochromatin. Organization of Chloroplast and Mitochondrial genome.

13. Fungi

- a. Recent trends and criteria used in the classification of fungi with reference to vegetative and reproductive structures.
- b. Structure, Reproduction and Life cycle of Gymnomycota (Cellular slime moulds (*Dictyostelium*), Plasmodial slime moulds (*myxomycetes*); Mastigomycota- (*Coelomomyces*, *Plasmodiophora*).
- c. Structure, Reproduction and Life cycle of Amastigomycota and Zygomycotina – (*Mucor*, *Synephalastrum*, *Blakeslea*).
- d. Structure, Reproduction and Life cycle of Ascomycotina (*Morchella*, *Neurospora*, *Claviceps*); Basidiomycotina (*Puccinia*, *Melampsora*) and Deutromycotina (*Fusarium* and *Curvularia*).

14. Recombinant DNA technology

- a. Overview of recombinant DNA technology. Restriction and modification systems, restriction endonucleases and other modifying enzymes used in manipulating DNA molecules.
- b. Separation of DNA by gel electrophoresis. Extraction and purification of plasmid DNA.
- c. Plasmids, cosmids, binary, shuttle and bacteriophages as vectors for gene cloning. Cloning vectors based on *E. coli*, plasmids, pBR322, pUC8, pGEM3Z.
- d. Joining of DNA fragments: DNA ligases, ligation of DNA molecules. sticky ends, blunt ends, linkers and adapters

15. Plant anatomy

- a. Organization of Shoot Apical Meristem (SAM) and Root Apical Meristem (RAM); Development of leaf from shoot apical meristem

- b. Primary vascular tissues: structure and components of xylem and phloem; cambium structure, development and types role in wound healing.
- c. Cork: structure, ontogeny, function and commercial importance of cork. Anomalous secondary growth; secondary growth in monocots and dicots.
- d. Salient features of the following woods. a) *Tectona grandis* b) *Shorea robusta* c) *Cedrus deodara* d) and *Tectona grandis*

16. Research methodology

- a. Microscopic techniques: Visualization of cells and subcellular components by 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.
- b. Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.
- c. Methods in field biology: Methods of estimating population density of plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization-ground and remote sensing methods, plant sampling and Herbarium techniques.
- d. Computational methods: Nucleic acid and protein sequence databases; data mining methods for sequence analysis, web-based tools for sequence searches motif analysis and presentation. e. Statistical methods: Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); sampling distribution; difference between parametric and nonparametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test; analysis of variance; X test; basic introduction to Multivariate statistics.

Sd/

Dr. Mohd Asgher

Coordinator

Department of Botany