

Syllabus for Entrance Exam (M. Sc. Botany) Session 2024-25

Bacteria: Structure, nutrition, reproduction and economic importance; General account of cyanobacteria (with reference to *Nostoc*).

Algae: General characters, classification upto classes (Lee 1980) and economic importance; Important features and life-history (excluding development) of *Volvox*, (Chlorophyceae), *Chara* (Charophyceae) *Vaucheria* (Xanthophyceae), *Ectocarpus* (Phaeophyceae) and *Polysiphonia* (Rhodophyceae).

Viruses: General account of Viruses including structure of TMV and Bacteriophages.

Fungi: General characters, classification upto classes (Ainsworth 1971) and economic importance; important features and life-history of *Phytophthora* (Mastigomycotina), *Mucor* (Zygomycotina), *Penicillium* (Ascomycotina), *Puccinia* (Basidiomycotina), *Colletotrichum* (Deuteromycotina); General account of Lichens.

Bryophyta: General characters, classification upto classes (Smith, 1935), alternation of generations, structure and reproduction (excluding development) of *Marchantia* (Hepaticopsida), *Anthoceros* (Anthocerotopsida), *Funaria* (Bryopsida).

Pteridophyta: General characters, classification upto classes (Proskauer 1957), alternation of generations, structure and reproduction (excluding development) of *Rhynia* (Psilopsida) Structure and reproduction (excluding development) of *Selaginella* (Lycopsida), *Equisetum* (Sphenopsida) and *Pteris* (Pteropsida).

Gymnosperms-General characteristics, classification up to family (Smith 1955), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Ephedra* (developmental details not to be included); Ecological and economic importance.

Introduction to Ecology: Definition; scope and importance; levels of organization.

Environment: Introduction; environmental factors-climatic (water, humidity, wind, light, temperature), edaphic factors (soil profile, physico-chemical properties), topographic and biotic factors (species interaction). Adaptations of plants to water stress and salinity (morphological and anatomical features of hydrophytes, xerophytes and halophytes).

Population Ecology: Basic concept; characteristics; biotic potential, growth curves; ecotypes and ecads. **Community Ecology:** Concepts; characteristics (qualitative and quantitative-analytical and synthetic); methods of analysis; ecological succession.

Ecosystem: Structure (components) and functions (trophic levels, food chains, food webs, ecological pyramids and energy flow)

Biogeochemical Cycles: Carbon and Nitrogen; Hydrological (water) cycle.

Phyto-geography: Phyto-geographical regions of India; vegetation types of India (forests).

Environmental Pollution: Sources, types and control of air and water pollution.

Global Change: Greenhouse effect and greenhouse gases; impacts of global warming; carbon trading.

Taxonomy and systematics, fundamental components of taxonomy (identification, classification, description, nomenclature and phylogeny). Role of chemotaxonomy, cytotoxicity and taxometrics in relation to taxonomy.

Botanical nomenclature, principles and rules, principle of priority. Type concept, author citation, taxonomic ranks.

Keys to identification of plants.

Herbarium: General introduction and importance of herbaria. Botanical gardens and their importance.

Documentation of Floristic Diversity: Brief idea about floras, monograph and journals. Flower and types of inflorescence.

Types of classification: Artificial, natural and phylogenetic.

Bentham and Hooker system of classification (upto series), Angiosperm Phylogeny Group (APG) - general introduction.

Diversity of Flowering Plants: Diagnostic features and economic importance of the following families: Ranunculaceae, Brassicaceae, Malvaceae, Euphorbiaceae, Rutaceae, Leguminosae, Apiaceae, Apocynaceae, Lamiaceae, Solanaceae, Asteraceae, Liliaceae and Poaceae.

Diversity in plant forms: Annuals, biennials and perennials.

Tissues: Meristematic and permanent (simple and complex). **Leaf:** Types of leaves (simple and compound); phyllotaxy.

Epidermis: Uniseriate and multiseriate, epidermal appendages and their morphological types. Anatomy of typical monocot and dicot leaf and cell inclusions in leaves; Leaf abscission.

Stomatal apparatus and their morphological types.

Shoot system: Shoot apical meristem and its histological organizations (monocot and dicot stem);

Cambium: Structure and functions; secondary growth in dicot stem; characteristics of growth rings; sap wood and heart wood, periderm.

Anomalous secondary growth (*Achyranthes*, *Boerhaavia*, *dracaena*).

Root System: Root apical meristem; histological organization of monocot and dicot roots.
Secondary growth in dicot root.

Structural modifications in roots: Storage (*Beta*), respiratory (*Rhizophora*), epiphytic (*Vanda*).
Anatomical aspects of adaptations in xerophytes, hydrophytes, halophytes.

Flower-a modified shoot; functions of various floral parts.

Microsporangium, its wall and dehiscence mechanism. Microsporogenesis, pollen grains and its structure (pollen wall).

Pollination (types and agencies); pollen germination (microgametogenesis). Pollen-pistil interaction; self-incompatibility.

Male gametophyte.

Structure of megasporangium (ovule), its curvatures.

Megasporogenesis and megagametogenesis.

Female gametophyte (monosporic, bisporic and tetrasporic)- organization and ultrastructure of mature embryo sac.

Double fertilization.

Endosperm types and their biological importance. Embryogenesis in dicot and monocot;
Polyembryony and apomixis.

Structure of dicot and monocot seed.

Fruit types; dispersal mechanisms in fruits and seeds.

Plant-water Relations: Importance of water to plant life; physical properties of water; Imbibition, Diffusion, Osmosis and Plasmolysis; absorption and transport of water; transpiration-types, physiology of stomata, factors affecting transpiration, importance of transpiration.

Mineral Nutrition: Essential macro and micro elements; criteria of essentiality of elements; Role of essential elements; mineral uptake; deficiency symptoms.

Transport of Organic Substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation

Seed dormancy; Plant movements; Concept of photoperiodism; Physiology of flowering; Florigen concept; Physiology of senescence; Fruit ripening.

Growth and Development: Definitions; phases of growth and development.

Plant Hormones: Auxins, Gibberellins, Cytokinins, Abscissic acid and Ethylene, history of their discovery, mechanism of action.

Photo-morphogenesis: phytochromes and their discovery, physiological role and mechanism of action.

Photosynthesis: Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photo-phosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration.

Respiration: ATP—the biological energy currency; aerobic and anaerobic respiration; Krebs cycle; electron transport mechanism (chemi-osmotic theory); redox -potential; oxidative phosphorylation; pentose phosphate pathway.

Nitrogen metabolism: Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation.

Lipid metabolism: Structure and functions of lipids; fatty acid biosynthesis; B-oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids

Basics of Enzymology: Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and co-factors; regulation of enzyme activity; mechanism of action.

Origin, distribution, botanical description, brief idea of cultivation and uses of the following:

Food plants: Cereals (Rice, Wheat and Maize).

Pulses: Gram, Arhar and Pea. **Vegetables:** Potato, Tomato and Onion. **Fibers:** Cotton, Jute and Flax.

Oils: Groundnut, Mustard and Coconut.

Morphology of plant part used, brief idea of cultivation and uses of the following:

Spices: Coriander, *Ferula*, Ginger, Turmeric, Cloves.

Medicinal Plants: *Cinchona*, *Rauwolfia*, *Atropa*, Opium, *Cannabis*, Neem, *Withania*

Botanical description and processing of:

Beverages: Tea and Coffee; **Rubber:** *Hevea*; **Sugar:**

Sugarcane. General account and sources of timber.

Energy plantations and bio-fuels.

Historical perspective of plant tissue culture; Composition of media; Nutrient and hormone requirements; Totipotency; Organogenesis; Embryogenesis; Protoplast culture; Plant tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production; Cryopreservation. Restriction Endonucleases- types and role. Brief idea about cloning vectors- Ti plasmid, BAC, Lambda phage, M13phagemid, cosmid, shuttle vector; eukaryotic vectors (YAC).

Recombinant DNA, bacterial transformation and selection of recombinant clones, PCR mediated gene cloning; Genomic and cDNA libraries

Methods of gene transfer- *Agrobacterium* mediated, electroporation, microinjection.

Cell as a unit of Life; The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components

The Cell Envelopes: Structure and functions of Cell Wall and Plasma Membrane. Ultrastructure and function of nucleus, Nuclear Envelope- structure of nuclear pore complex

Ultrastructure and function of following cell organelles: Golgi Apparatus, Endoplasmic Reticulum, Chloroplast, Mitochondria, Lysosomes, Peroxisomes and Vacuoles.

Cell Division: Mitosis and Meiosis.

Chromosome: Morphology, organization, ultrastructure of Centromere and Telomere; Chromosomal alterations- deletions, duplications, translocations, inversions; Variations in chromosome number- aneuploidy, polyploidy; sex chromosomes and sex determination.

Genetic material DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment. DNA structure, types of DNA, types of genetic material.

DNA Replication: Prokaryotes and eukaryotes; bidirectional replication, semi-conservative, semi discontinuous RNA priming, θ (theta) mode of replication, replication of linear, dsDNA, replicating the 5' end of linear chromosome including replication enzymes.

Transcription: Prokaryotes and Eukaryotes.

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types;

Translation: Prokaryotes and eukaryotes, genetic code.

Regulation of gene Expression in Prokaryotes: Lac operon and Tryptophan operon; regulation of gene expression in Eukaryotes.

Heredity: Brief life history of Mendel; Terminologies; Laws of Inheritance.

Modified Mendelian Ratios: Lethal Genes; Co-dominance, incomplete dominance; Gene interaction (9:7; 9:4:3; 13:3; 12:3:1, 15:1).

Cytoplasmic Inheritance: Kappa particles in Paramecium, leaf variegation in *Mirabilis jalapa*

Male sterility; Multipleallelism; Pleiotropism;

Chromosome theory of Inheritance. Sex-determination and Sex-linked Inheritance.

Linkage: Concept & history, complete & incomplete linkage recombination frequency.

Crossing over: concept and significance, cytological proof of crossing over. Mutations and Chromosomal Aberrations; Types of mutations, effects of physical & chemical mutagens.

Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy.

Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.