

Botany Optional Syllabus

Description

Paper I

1. Microbiology and Plant Pathology

Structure and Reproduction/Multiplication

- Viruses, viroids, bacteria, fungi, and mycoplasma.
- Prion and the Prion hypothesis.

Applications of Microbiology

- In agriculture, industry, and medicine.
- Control of soil and water pollution.

Crop Diseases

- Caused by viruses, bacteria, mycoplasma, fungi, and nematodes.
- Modes of infection and dissemination.
- Molecular basis of infection and disease resistance/defense.
- Physiology of parasitism and control measures.
- Fungal toxins.
- Modelling and disease forecasting.
- Plant quarantine.

2. Cryptogams

Structure and Reproduction

- Algae, fungi, lichens, bryophytes, and pteridophytes from an evolutionary viewpoint.

Distribution and Importance

- Distribution of Cryptogams in India.
- Ecological and economic importance.

3. Phanerogams

Gymnosperms

- Concept of Progymnosperms.
- Classification and distribution of gymnosperms.
- Salient features of Cycadales, Ginkgoales, Coniferales, and Gnetales (structure and reproduction).
- General account of Cycadofilicales, Bennettitales, and Cordaitales.
- Geological time scale; Types of fossils and their study techniques.

Angiosperms

- Systematics, anatomy, embryology, palynology, and phylogeny.
- Taxonomic hierarchy.
- International Code of Botanical Nomenclature.
- Numerical taxonomy and chemotaxonomy.
- Evidence from anatomy, embryology, and palynology.
- Origin and evolution of angiosperms.
- Comparative account of classification systems.
- Study of important angiospermic families:
 - Magnoliaceae, Ranunculaceae, Brassicaceae, Rosaceae, Fabaceae, Euphorbiaceae, Malvaceae, Dipterocarpaceae, Apiaceae, Asclepiadaceae, Verbenaceae, Solanaceae, Rubiaceae, Cucurbitaceae, Asteraceae, Poaceae, Arecaceae, Liliaceae, Musaceae, Orchidaceae.

Structural Details

- Types of stomata.
- Glandular and non-glandular trichomes.
- Unusual secondary growth.
- Anatomy of C3 and C4 plants.
- Xylem and phloem differentiation.
- Wood anatomy.

Developmental Biology

- Development of male and female gametophytes.
- Pollination and fertilization.
- Endosperm (development and function).
- Patterns of embryo development.
- Polyembryony and apomixis.
- Applications of palynology.
- Experimental embryology, including pollen storage and test-tube fertilization.

4. Plant Resource Development

Domestication and Origin of Cultivated Plants

- Vavilov's centers of origin.

Plants as Resources

- Sources for food, fodder, fibers, spices, beverages, edible oils, drugs, narcotics, insecticides, timber, gums, resins, dyes, latex, cellulose, and starch products.
- Perfumery.

Ethnobotany

- Importance in the Indian context.

Energy and Conservation

- Energy plantations.
- Botanical gardens and herbaria.

5. Morphogenesis

Concepts and Techniques

- Totipotency, polarity, symmetry, and differentiation.
- Cell, tissue, organ, and protoplast culture.

Applications

- Somatic hybrids and cybrids.
- Micropropagation.
- Somaclonal variation and its applications.
- Pollen haploids.
- Embryo rescue methods and their applications.

Paper II

Cell Biology

- Techniques of cell biology.
- Prokaryotic and eukaryotic cells's structural and ultrastructural details.
- Structure and function of extracellular matrix (cell wall) and membranes:
 - Cell adhesion, membrane transport, and vesicular transport.
- Structure and function of cell organelles:
 - Chloroplasts, mitochondria, ER, dictyosomes, ribosomes, endosomes, lysosomes, peroxisomes.

- Cytoskeleton and microtubules.
- Nucleus, nucleolus, nuclear pore complex.
- Chromatin and nucleosome.
- Cell signaling and cell receptors.
- Signal transduction, mitosis, and meiosis; molecular basis of the cell cycle.
- Numerical and structural variations in chromosomes and their significance.
- Chromatin organization and packaging of genome.
- Polytene chromosomes and B-chromosomes—structure, behavior, and significance.

Genetics, Molecular Biology, and Evolution

- Development of genetics and gene versus allele concepts (pseudoalleles).
- Quantitative genetics and multiple factors.
- Incomplete dominance, polygenic inheritance, and multiple alleles.
- Linkage and crossing over of gene mapping, including molecular maps (idea of mapping, function).
- Sex chromosomes and sex-linked inheritance.
- Sex determination and molecular basis of sex differentiation.
- Mutations—biochemical and molecular basis.
- Cytoplasmic inheritance and cytoplasmic genes (including genetics of male sterility).
- Structure and synthesis of nucleic acids and proteins.
- Genetic code and regulation of gene expression.
- Gene silencing and multigene families.
- Organic evolution—evidences, mechanisms, and theories.
- Role of RNA in origin and evolution.

Plant Breeding, Biotechnology, and Biostatistics

- Methods of plant breeding:
 - Introduction, selection, and hybridization (pedigree, backcross, mass selection, bulk method).
 - Mutation, polyploidy, male sterility, and heterosis breeding.
 - Use of apomixis in plant breeding.
- DNA sequencing and genetic engineering:
 - Methods of gene transfer and transgenic crops; biosafety aspects.
 - Development and use of molecular markers in plant breeding.
- Tools and techniques:
 - Probe, southern blotting, DNA fingerprinting, PCR, and FISH.
- Biostatistics:
 - Standard deviation and coefficient of variation (CV).
 - Tests of significance (Z-test, t-test, chi-square test).
 - Probability and distributions (normal, binomial, and Poisson).
 - Correlation and regression.

Physiology and Biochemistry

- Water relations, mineral nutrition, and ion transport; mineral deficiencies.
- Photosynthesis:
 - Photochemical reactions, photophosphorylation, and carbon fixation pathways.
 - C3, C4, and CAM pathways.
- Mechanism of phloem transport.
- Respiration:
 - Anaerobic and aerobic (including fermentation).
 - Electron transport chain and oxidative phosphorylation.
- Photorespiration, chemiosmotic theory, and ATP synthesis.
- Lipid metabolism, nitrogen fixation, and nitrogen metabolism.
- Enzymes, coenzymes; energy transfer, and conservation.
- Importance of secondary metabolites.
- Pigments as photoreceptors (plastidial pigments and phytochrome).
- Plant movements, photoperiodism, and flowering.
- Vernalization, senescence, and growth substances:
 - Chemical nature, roles, and applications in agri-horticulture.
 - Growth indices and growth movements.
- Stress physiology (heat, water, salinity, metal).
- Fruit and seed physiology:
 - Dormancy, storage, and germination.
 - Fruit ripening—its molecular basis and manipulation.

Ecology and Plant Geography

- Concept of ecosystem and ecological factors.
- Concepts and dynamics of community; plant succession.
- Concepts of biosphere, ecosystems, and conservation.
- Pollution and its control (including phytoremediation).
- Plant indicators; Environment (Protection) Act.
- Forest types of India:
 - Ecological and economic importance of forests.
 - Afforestation, deforestation, and social forestry.
- Endangered plants, endemism, IUCN categories, and Red Data Books.
- Biodiversity and its conservation:
 - Protected Area Network, Convention on Biological Diversity.
 - Farmers' rights and Intellectual Property Rights.
- Concept of sustainable development.
- Biogeochemical cycles, global warming, and climatic change.
- Invasive species and Environmental Impact Assessment.
- Phytogeographical regions of India.