

Assistant Professor Examination – 2022

Syllabus of Botany

UNIT-I: Biology and diversity of lower plants

- Virology-General account of viruses: Characteristics, ultra structure, chemical nature, replication, transmission, viral disease and symptoms of viral infections and control. TMV and Bacteriophages, Viroid, virusoids and Prions, Plasmids, Actinomycetes, mycoplasma, Rickettsia, Chlamydia.
- Bacteriology---General account of Archebacteria and Eubacteria: ultra-structure, nutrition, reproduction and economic importance. Salient features and biological importance of Cyanobacteria.
- Mycology:—General characteristics and classification of fungi, cellular organization, and cell wall composition, nutrition, reproduction, Heterokaryosis, Heterothallism, and Parasexuality. General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.
- Economic importance of Fungi, Mycorrhiza, fungal disease in plants and humans, host parasite relationship, mycotoxins. Plant pathology and important plant diseases of M.P. General account of Lichens.
- Phycology: General characteristics and classification of algae, Habit and Habitat, Thallus organization, criteria for classification of algae, cell ultrastructure, Reproduction, flagellation, pigmentation, Reserve food materials. Economic Importance of algae, Algal blooms. General account of Prochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta.

UNIT-II:

Biology and Diversity of Bryophyta, Pteridophyta and Gymnosperms

- Bryophyta: General characteristics and classification of Bryophyta, Distribution, Study of Morphology, anatomy and Reproduction. General characteristics and classifications of Hepaticopsida, Anthocerotopsida and Bryopsida. Ecological and Economic Importance of Bryophyta.
- Pteridophyta: General characteristics and classification of Pteridophytes Morphology, anatomy, life history of Pteridophytes. Evolution of stele, Heterospory and origin of seed habit. Economic importance of Pteridophytes
- General Characteristics features, Anatomy, Life history, Alternation of generations of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.
- Gymnosperms: General Characteristics and classifications of Gymnosperms. Distribution of Gymnosperms in India, evolutionary tendencies among Gymnosperm and economic importance of Gymnosperms. Indian Contribution to gymnosperms. Geographical time scales and fossilization.
- General account of Pteridospermales, Cycadeodales, Corditales, Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.



UNIT-III:

Morphology and Taxonomy of Angiosperms.

- Origin and evolution of angiosperms, Floral Induction and development, morphology of stamens and carpels, and their evolution, Placentation their origin, types and evolution, Morphology of Angiospermic plant parts.
- Concept of species, Hierarchical, Salient feature of International code of Botanical nomenclature, Taxonomic tools and Techniques: Herbaria, Floras, Botanical garden, Museum, Taxonomic key, Taxonomic Literature, Histological, Biochemical, Cytological, Phytochemical, Serological and molecular techniques.
- Systematics of Angiosperm classifications(Natural and Phylogenetic) their relative Merits and Demerits, Modern Trends in Taxonomy, Morphology, Anatomy, Palynology, Embryology, Cytology and Phytochemistry, Including Molecular taxonomy and GIS, APG IV system, Endemism.
- Terminology for plants Description in semi technical language, Diagnostic characteristics and economic importance of Ranunculaceae, Brassicaceae, Papaveraceae, Malvaceae, Rutaceae, Fabaceae, Apiaceae, Magnoliaceae, Rosaceae, Dipterocarpaceae and Cucurbitaceae.
Diagnostic characteristics and economic importance of Rubiaceae, Asteraceae, Apocynaceae, Acanthaceae, Asclepiaceae, Solanaceae, Verbinaceae, Lamiaceae, Euphorbiaceae.
- Diagnostic characteristics and economic importance of Musaceae, Liliaceae, Araceae, Poaceae, Orchidaceae. General characteristics and phylogeny of Ranales, Amentiferae, Tubiflorales, Santales, Centrospermales and Hellobiales.

UNIT-IV:

Developmental Biology: Morphogenesis and Organogenesis in Plants:

- Meristematic Tissue, Classification of meristems, Root System: Root Apical meristems, Tissue differentiations of Primary and Secondary Tissue, and their role. Anatomy of Dicot and Monocot Root, Secondary growth in Root, Modification of root for various functions. Root interaction with Microbes.
- Organization of shoot apical Meristems, Histological organization, Shoot Development, Modifications of shoot for different functions, Anatomy of Dicot and monocot Stem, Vascular cambium and its function, Secondary growth in Stem, growth rings, Sap wood and Heart wood, Secondary phloem, cork cambium and periderm. Anomalous structure (Primary and Secondary Anomalous structure).
- Leaf: Origin and development of leaf, diversity in size, shape and arrangement (phyllotaxy), Anatomy of Dicot leaf and Monocot leaf. Adaptation to photosynthesis and water stress.
- Transition of Flowering, Floral meristems and floral development in Arabidopsis and Antirrhinum. Structure of Stamen, anther, Microsporogenesis and development of male gametophyte, Structure of pistil, Structure and types of ovules, Megasporogenesis, and Development of female gametophyte, (embryo sac and its type), Pollination: its Mechanism and agencies of pollination. Self-incompatibility.



- Double fertilization and triple fusion, Development and types of Endosperms, and its morphological nature, Development of Embryo in Dicot and Monocot plants, Fruit: structure Development and Maturation, Types of Fruits, Seed structure, types Development and Dispersion, Importance of seed. Vegetative propagation and their types.

UNIT-V: Plant Physiology and Biochemistry -

- Plant water relations, transpiration, Stomatal movement, Solute transport and photo assimilate Translocation; Update transport, translocation of water, ion solutes and micromolecules from soil through across membranes through xylem and phloem, mechanism of loading and unloading photoassimilates, Mineral Nutrition.
- Photosynthesis: light harvesting complex, Mechanism of electron transport, Photo protective mechanism, CO₂ fixation, C₃, C₄ and CAM pathways.
- Respiration and Photorespiration: Glycolysis, Citric acid cycle, plant mitochondrial electron transport system, ATP synthesis, Alternative pathways, photo respiration.
- Nitrogen Metabolism: Nitrate and Ammonium assimilation, Amino acid biosynthesis, Plants Hormones: Biosynthesis, physiological effects, mechanism of action, storage breakdown and transport; Aging and senescence.
Sensory photobiology: Structure, Function and mechanism of action of phytochromes, Cryptochromes and phototropins. Photoperiodism and Vernalization, Biological clock.
Stress physiology: Responses of plants to biotic (Pathogen and Insects) and Abiotic (Water, Temperature and Salts) Stresses, Mechanism of resistance and tolerance to biotic stress.
- Fundamentals of Enzymology: General aspects, Principles, Classification, Mechanism and Regulation of Enzymes. Allosteric mechanism, and enzyme kinetics,
Structure, function and classifications of biomolecules: Carbohydrate, Protein, Lipids, Amino acids, nucleic acids and Vitamins
Secondary metabolites: biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

UNIT-VI: Plant Ecology

- Community Ecology: Nature of communities, community structure and attributes; levels of species diversity and its measurements.
Ecological adaptations: Morphological, Anatomical and Physiological responses, Water, temperature, and Light adaptation.
Ecological successions: type, mechanism, changes involved in succession, concept of climax. Ecades and Ecotone.
Population Ecology: Characteristics of a population, Growth curve, population regulation, life history strategies (r and k selection).
- Ecosystem: Structure and Function, Abiotic and Biotic Components, Trophic levels, Food Chain, Food, Web, Ecological Pyramids, energy flow and mineral cycling (C,N,S,P), Productivity, decomposition, Structure and function of Indian ecosystems, terrestrial (Forest and Grasslands), and aquatic (Fresh water, Marine, estuarine), wetlands.
- Species interaction: Biotic and abiotic interactions, interspecific competition, herbivorous, carnivorous, symbiosis and Pollination. Concept of Habitats and Niche, resource partitioning, character displacement.



The environment: Physical environment, biotic environment.

- Major terrestrial Biomes: Phytogeographical zones of India, forest and grassland Types of M.P. Natural Resources, Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation. Soil conservation and water shade management, National parks, Sanctuaries and Biosphere Reserve.
- Soil: Physical and chemical properties of soil, Soil formation, Development of Soil Profile, Soil classification, Soil Composition and soil factors;
Environmental pollution: Types, Causes and control; Global environmental change. (Global warming, Acid Rain, Climate change, ozone layer and Ozone Hole) Plant Indicator, Environmental Protection Act.
Biodiversity: Status of Biodiversity, Monitoring, and Documentation, major drives of Biodiversity change, biodiversity management approaches. Hot spot.

UNIT-VII: Ethnobotany and Applied Botany

- Definition and scope of Ethnobotany Historical review and outline idea of Archaeoethnobotany, Ethnomedicine Ethno taxonomy, Ethno ecology, Ethno orthopaedics, Ethno paediatrics, Ethnoophthalmology, Ethnopharmacology, Ethnogynacology, Ethno toxicology, Ethnocosmetics, Ethnonarcotics, Ethno musicology and EthnoLinguistics
- Prevention of Genetic Diversity, Plants used in various system of Medicines, Ayurvedic, Unani, and Homeopathic system. Allopathic system, Plants used by villagers and tribal people, Role of Ethnobotany in the development of society. Plants in Mythology, Taboos and Totems in relations to plants, Folklore and folk talks, Wildlife protection in tribal, plants domestication by the tribal, Plants in simile and metaphores.
- Ethnobotanical Importance of: *Aconitum napellus*, *Allium cepa*, *Allium Sativum*, *Atropa belladonna*, *Aloe vera*, *Azadirachta indica*, *Butea monosperma*, *Cassia fistula*, *Cannabis sativa*, *Embolica officinalis*, *Eugenia aromatic*, *Eugenia jambolana*, *Hollarhena antidysentrica*, *Jatropha curcas*, *Lawsonia inermis*, *Mentha arvensis*, *Nux- vomica*, *Ocimum sanctum*, *Piper nigrum*, *Pterocarpus mrsupium*, *Papaver somniferum*, *Rauwolfia serpentine*, *Ricinus communis*, *Santalum album*, *Terminelia chebula*, *Terminelia arjuna* and *Terminelia bellerica*, *Withania somnifera*, *Zingiber officinalis*.
- Detail study of the common plants and their parts used in the treatment of following disease. Expulsion of worms, Skin disease, asthma and Bronchial inflation, Urinogenital Problem, Amoebic dysentery, Malaria, Rheumatism, Jaundice, Heart disease leukaemia, tuberculosis, Blood purifier, piles, Leucoderma, Heart Disease Leprosy.
- Applied Botany: Microbial fermentation and their importance in industrial production, Types of fermenters.
Plant Cell and tissue culture, Totipotancy, Aseptic and Sterilization techniques, Explant techniques of tissue culture, Meristems, Anther, Embryo culture, organogenesis, somatic hybridization, Cryopreservation, application of Plant tissue culture. Transgenic plants, phytoremediation.
Economic Botany: cereals, pulses, fibres, oil yielding and drug yielding plants with special reference to Madhya Pradesh.



UNIT-VIII: Cell biology and Evolution

- The Cell envelop, Structure and functions of cell wall, Ultra Structure and functions of Plasma membrane, different Structural model of plasma membrane, lipid bilayer and membrane protein, Diffusion, Osmosis, Ion channels, Active transport, ion pumps, mechanism of ion sorting and regulation of intracellular transport, electrical properties of membrane.
- Structure and function of cell organelles: Golgi complex, mitochondria, chloroplast, peroxisome, ribosome, Endoplasmic reticulum, Vacuole, lysosomes and nucleus.
- Structure and function of chromosome, special types of chromosome, Packaging of DNA, Karyotype, Binding Pattern, operon interrupted gene, structure of chromatin and chromosome, unique and repetitive DNA, heterochromatin and euchromatin, Chromosome walking, transposons.
- Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle, Crossing over and linkage. Gene structure and expression, CIS and Trans test of recombination, introns, exons, and their significance.
Structural Changes (Deletion, Duplication, Translocation, Inversion,) and numerical Changes (Aneuploidy and Polyploidy) in Chromosome, Extra nuclear Genome: Presence and function of mitochondrial and plastid DNA, Plasmid. Mendel's Law, Interaction of Gene. Polygenic inheritance.
- Evolution: Emergences of evolutionary thoughts, Lamarck, Darwin, Concepts of Variations, Adaptations, Struggle, fitness and natural selection, spontaneity of mutations, the evolutionary synthesis.

UNIT-IX: Molecular Genetics

- Nuclear DNA content, DNA structure and Forms of DNA (A, B, Z,) replication of DNA, (unit of replication, enzyme involved replication origin, fork fidelity of replication,) DNA damage and Repair, Restriction Mapping, Multigene Families and Their evolution. Recombinant DNA: C Value Paradox, Cot curve and its application.
- RNA synthesis and Processing: Transcription factors machinery, Formation of initiation complex, Transcription activators and repressors, RNA polymerases capping, elongation, termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.
- Protein synthesis and processing: Ribosomes structure and site of protein synthesis, formation of initiation complex, initiation factor and their regulation, elongation and elongation factors, termination, Genetic Code, amino assimilation of tRNA, tRNA identity, amino acyl tRNA synthetase, Translation Proof reading, Translation inhibitor, post translation Modification of proteins. Protein sorting, targeting of protein to organelles.
- Control of gene expression of transcription and translation level: regulation and genetics of bacteria and virus, (genetic transformation, conjugation and transduction, Recombination in phage), Regulation of gene expression in eukaryotes, role of euchromatin in regulation of gene. Gene silencing. Gene Mutation.
- Plant breeding: In situ Hybridization, concept and techniques, genetic basis of in breeding and heterosis, exploitation of hybrid vigour, Cancer oncogene, apoptosis, immune innate and adaptive immune system.

Bar

UNIT-X: Tools, Techniques in Biology and Biotechnology

- Microscopic techniques; light microscopy, Phase contrast, Dark field Microscope, fluorescence microscopy, Electron microscope. Scanning and Transmission microscopes. Different types of fixations and staining techniques for Electron microscope. Freeze-etching and freeze fracture method for Electron microscope, image processing methods in Microscopy. Electrophoresis, Chromatography, colorimeter, pH meter, Centrifuge, Microtome and Laminar Air Flow
- Biophysical methods: Analysis of biomolecules; using UV, Visible, Fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determining using X-RAY. Differentiations and NMR; analysis using light scattering, different types of mass spectrometry, and surface plasma resonance methods.
- Histochemical and Immunotechniques: Antibody generation, detection of molecules, using ELISA,RIA, Western Blotting, Southern Blotting, Immunoprecipitation, Flow cytometry, and Immuno detection of molecules in living cells, in situ localization by techniques such as FISH,GISH.
- In vitro mutagenesis and deletion techniques, gene knock out technology in bacterial and eukaryotic organisms, large scale expression analysis such as a micro array based techniques, Isolation Separation and analysis of carbohydrate and lipid molecules, RFLP, RAPD and AFLP techniques.

Molecular biology and Recombinant DNA technology: methods of isolation and purification of RNA, DNA (Genomic and Plasmid) and Proteins, Different separation Methods, analysis of RNA, DNA and Proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels.

Molecular cloning of DNA or RNA Fragments in Bacterial and eukaryotic systems, expressions of recombinant proteins using bacterial, animal and plant vectors; Isolation of specific nucleic acid sequences; generation of genomic and c-DNA libraries in Plasmid, phage, cosmid, BAC and YAC vectors.

- Biotechnology: Principles and application of biotechnology in agriculture, horticulture, forestry, food industries, healthcare, immunology, environmental biotechnology and ethics, IPR (Intellectual Property rights) Genetic Engineering of plants, PCR, DNA finger printing,
