

## 505. Botany

### Algae

1. General characters and comparative study of important systems of classification of Algae (Fritsch, Round and Parker), 2. Criteria used in the primary classification of Algae: a) Pigments b) Reserve food materials c) Flagella d) Cell wall e) Gross cell structure, 3. Algae of diverse habitats: a) Terrestrial algae b) Freshwater algae c) Marine algae, 4. Reproduction of Algae: a) Vegetative b) Asexual c) Sexual reproduction, 5. General characters, morphology, life history and classification of the following groups of algae: a) Cyanophyceae: *Microcystis*, *Lyngbya*, *Microcoleus*, *Aulosira*, b) Chlorophyceae : *Eudorina*, *Oocystis*, *Pediastrum*, *Hydrodictyon*, *Ulva*, *Pithophora*, *Stigeoclonium*, *Draparnaldiopsis*, *Closterium*, *Cosmarium* and *Bryopsis*, c) Charophyceae : *Nitellaa*. d) Xanthophyceae : *Botrydium* e) Phaeophyceae: *Laminaria*, *Padina* f) Rhodophyceae : *Porphyra*, *Callithamnion*, *Gracillaria*, *Corallina*. g) Bacillariophyceae: *Cyclotella*, *Synedra*, *Cymbella*, *Gomphonema*, 6. Algal blooms and toxic algae, 7. Algal Biofertilizers, 8. Algae as food and feed, 9. Fossil algae (A brief account only).

### Fungi

1. General characters of fungi: Recent trends in the classification of fungi; Evolution and Phylogeny of the fungi, 2. Substrates of fungi, Nutrition (Saprophytic, Parasitic and symbiotic) and Reproduction in fungi (Sexual and Asexual), 3. Fungal cytology and genetics; Heterothallism: Heterokaryosis, Parasexuality, Physiological specialization of races, 4. Comparative study of the following sub-divisions (brief account of the types), a) Myxomycotina – *Stemonitis*, b) Mastigomycotina – *Peronospora*, c) Zygomycotina - *Mucor*, *Pilobolus*, d) Ascomycotina - *Yeast*, *Emericella*, *Chaetomium*, *Pleospora*, *Morchella*, e) Basidiomycotina - *Melampsora*, *Phallus*, *Polyporus*, f) Deuteromycotina - *Drechslera*, *Phoma*, *Colletotrichum*, 5. Fungi in Industry: Production of alcohol, organic acids and antibiotics, 6. Fungi in Agriculture and Forestry: a) Fungi as plant parasites (Wilts, leafspots, root rots, smuts and rusts) b) Fungi as bio-fertilizers: Mycorrhizae: Ecto and Endomycorrhizae, 7. Fungi as human and animal parasites (medical mycology), 8. Fungi as food: Mushrooms: Types of mushrooms, biology and growth of mushrooms, nutritional and medicinal value of edible mushrooms.

### Microbiology

1. Bacteria: a) General account, ultrastructure, nutrition (autotrophy, heterotrophy and symbiosis) reproduction in bacteria and economic importance 2. Viruses: Characteristics and ultra structure of virions, isolation and purification of virion b) Chemical properties of plant

viruses (TMV, bacteriophages) c) Transmission of viruses d) Economic importance of the viruses 3. Mycoplasma: a) General account and systematic position of the mycoplasma b) Economic importance of the mycoplasma

## **Bryophyta**

1. A general account of the structure, reproduction, life history, classification, distribution of Archegoniatae and economic importance of Bryophytes with reference to: a) Marchantiales, b) Jungermanniales, c) Anthocerotales, d) Sphagnales, e) Funariales, f) Polytrichales, 2. Structure and evolution of gametophytes in Bryophytes, 3. Structure and evolution of sporophytes in Bryophytes, 4. Fossil history of Bryophytes – a general account, 5. Economic importance of Bryophytes.

## **Pteridophyta**

1. A general account of vegetation, morphology, reproduction and evolutionary trends in a. Psilotales, b. Lycopodiales, c. Selaginellales, d. Isoetales, e. Equisetales, f. Filicales (*Ophioglossum*, *Salvinia*, *Azolla*), 2. Telome concept and its application, 3. Stellar evolution in pteridophytes, 4. Heterospory and origin of seed habit, 5. Principles of Paleobotany and importance of fossil plants in the classification of vascular plants, 6. Origin and evolution of primitive and advanced vascular plants with suitable examples from: a.) Rhyniales, b.) Zosterophyllales, c.) Asteroxylales, d.) Psilophytales, e.) Sphenophyllales, 7. A general account of Lepidodendrales, Calamitales and Sphenophyllales, 8. Origin and Evolution of Lycopsida with reference to Lycopodiales, Selaginellales, Isoetales and Lepidodendrales, 9. Origin and Evolution of Sphenopsida with reference to Sphenophyllales, Calamitales and Equisetales.

## **Gymnosperms**

1. Distribution of Gymnosperms-Past and present, 2. Classification of Gymnosperms – Proposed by Sporne and Pant, 3. Economic importance of Gymnosperms, 4. Wood anatomy of Conifers, 5. A general account of Gymnosperms with reference to their vegetative morphology and anatomy of the following taxa, a). Cycadales (*Cycas*, *Zamia*), b). Ginkgoales (*Ginkgo*), c). Coniferales (*Araucaria*, *Podocarpus*, *Cupressus* and *Cedrus*), d) Taxales (*Taxus*), e). Gnetales (*Ephedra*, *Welwitschia*), 6. Structure of male and female cones in the following, a) Cycadales, b) Ginkgoales, c) Coniferales, d) Taxales, e) Gnetales, 7. Development and trends of evolution of male gametophyte in Gymnosperms, 8. Structure of Ovule and development of female gametophyte, 9. Embryogeny in Gymnosperms, 10. General Account of: a). Pteridospermales, b). Cordaitales, c). Pentaxylales.

## **Taxonomy of Angiosperms**

1. Systems of classification: Phenetic and Phylogenetic systems. Critical account of the systems of classifications of a) Hutchinson b) Cronquist and c) Takhtajan, 2. Taxonomic evidence and techniques used therein a) Morphology b) Micromorphology c) Epidermology d) Cytology e) Phytochemistry f) Nucleic acid hybridization, 3. Nomenclature: a) Concept of ICBN b) Salient features of Botanical Nomenclature c) Ranks and Nomenclature of taxa d) Typification e) Rules of Priority f) Effective and valid publication g) Author citations. 4. Biosystematics: a) Concept b) Categories c) Species concept, 5. A comparative study of the following pairs of families and their treatment in recent systems: a) Magnoliaceae & Winteraceae, b) Malvaceae & Sterculiaceae, c) Rutaceae & Meliaceae, d) Apocynaceae & Asclepiadaceae, e) Verbenaceae & Lamiaceae, f) Amaranthaceae & Chenopodiaceae, g) Cyperaceae & Poaceae, 6. Origin of angiosperms, with reference to recent findings on fossil pollen, leaf remains and flower fossils

## **Medicinal Botany**

1) Role of plants in medicine, its origin and development 2) Morphology, active principles and medicinal value of the following: i. *Andrographis paniculata* ii. *Asparagus racemosus* iii. *Clitoria ternate* iv. *Phyllanthus emblica* v. *Gymnema sylvestre* 3. Flora of Andhra Pradesh: Salient vegetational aspects and features.

## **Structural and Developmental Anatomy**

1. Introduction, importance and relationships of Plant Anatomy, 2. Shoot Development, a) Recent views on organization of shoot Apical Meristem and types of vegetative shoot apex, b). Cytological zonation – Anneau initial and Meristem: c) d' attente, d). Sub-apical differentiation of tissues, 3. Root Development: a) Organization of root apex and significance of Quiscent center, b) Recent experimental studies on differentiation of tissues, 4. Leaf: Structure with reference to C3 and C4 plants – Kranz and CAM Syndrome, 5. Epidermology: a) Structural composition of Epidermal cells, stomata and trichomes, b). Epidermal cell complex – Structure, orientation and arrangement, c). Stomatal complex – Basic structure with reference to subsidiaries and ultra structure of guard cells, d) Ontogeny of paracytic, diacytic, and anisocytic stomata e) Trichome complex-Basic structure with reference to foot and body, classifications – uniseriate, biseriate and multiseriate types, 6. Phloem structure and differentiation of Phloem elements, ultrastructure of sieve elements, companion cells, 7. Transfer cells: Structure, distribution, ontogeny and function, 8). Secondary growth with reference to stem: a) Wood:

Significance of study of 3-dimensional structure of wood b). Morphology and arrangement of Vessels, Axial Parenchyma, Fibres and Ray parenchyma and their value in wood identification, 9. Salient features of the following woods, a). *Tectona grandis*, b). *Terminalia tomentosa*, c). *Shorea robusta*, d) *Pongamia pinnata* 10. Palynology: a). Introduction and scope of palynological science, b). Pollen preparation, pretreatment, acetolysis, c). Morphology of pollen – Polarity, symmetry, size and shape, apertural pattern, exine stratification and ornamentation of pollen wall, 11. Aeropalynology – principles, dissemination, distribution of aerospora and meteorological factors. Monitoring of aerospora with air samplers; pollen and spore allergy and clinical treatment, 12. Melittopalynology and Bee botany – pollen and nectar collection by Honey bees Importance of melittopalynology, 13. Role of Palynology in Taxonomy, 14. Application of palynology in oil exploration and Forensic science.

### **Embryology**

Introduction of embryology. 1. Fertilization: Pollen stigma interaction, Pollen germination, Pollen tube growth and Pollen tube discharge, mechanism of nuclear fusion. 2. Breeding systems: a. Introduction b. factors recombination in plants c. Self-incompatibility d. Incompatibility mechanism; Multigenic system, Heterostyly, protandry and protogyny; unisexuality and dioecism e. Establishment of in breeding f. Advantages of self – incompatibility g. Biological significance of incompatibility and methods to overcome them. 3. Apomixis: a). Causes of Apomixis b). Diplospory c). Apospory d). Causes of Apomixis e). Significances of Apomixis. 4. Parthenocarpy: Genetical parthenocarphy, Environmental parthenocarpy, Chemically induced parthenocarpy. 5. A brief account of experimental embryology - Embryology in relation to taxonomy.

### **Plant Biochemistry**

I) Thermodynamics principles: First law of thermodynamics a) energy b) enthalpy ii) second law of thermodynamics a) spontaneity and disorder b) entropy c) free energy, 2. Enzymes properties of enzymes, classification and nomenclature, co-factors enzyme kinetics, Michaelis – Menten equation, mechanism of enzyme action, regulation of enzyme action, Isozymes, allosteric enzymes, 3. Carbohydrates: Classification, structure and function of carbohydrates a) monosaccharides b) oligosaccharides c) polysaccharides, storage polysaccharides, structural polysaccharides, glycoproteins, 4. Lipids: Classification of lipids – simple lipids, compound lipids, sterols and terpenoids, biosynthesis of fatty acids, polyunsaturated fatty acids, lipoproteins, oxidation of fats, - oxidation, -oxidation, glyoxylate cycle, gluconeogenesis, 5. Amino acids and proteins: Amino acids- a) General properties, b) Classification and characteristics, c) non protein amino acids, d) peptide bonds, e) Biosynthesis of amino acids

with reference to GOGAT and GS. Proteins- a) Classification of proteins, 6. Structure and function of membranes, c) Chemical composition, b) Membrane models, e) Function of Membranes, 7. Respiration: Glycolysis, fermentation, tricarboxylic acid cycle, Regulation of TCA cycle, electron transport and oxidative phosphorylation, coupling oxidative phosphorylation to electron transport, chemiosmotic hypothesis, hexose monophosphate shunt and its significance, Cyanide – resistant respiration.

## **Plant Physiology**

1. Water relations: i) Water potential ii) SPAC concept iii) stomatal regulation of transpiration – energy and hormonal dependent hypothesis, 2. Mineral nutrition: i) Role of micronutrients in plant nutrition ii) Mechanism of ion uptake iii) role of ATPase as a carrier, iv) ion channels, 3. Photosynthesis: i) Photosynthetic apparatus ii) properties of light and absorption of light by photosynthetic pigments, iii) composition and characterization of photo systems I and II, iv) Photophosphorylation, v) path of carbon- a) differences between C3 and C4 photosynthesis b) CAM pathway and its regulation vi) Photorespiration, biosynthesis of glycolate and regulation of photorespiration, 4. Nitrogen metabolism: i) Physiology and biochemistry of nitrogen fixation ii) nitrate reductase and its induction iii) protein biosynthesis, 5. Sulphur metabolism: i) Assimilation of sulphate ii) sulphur reduction, 6. Calmodulin i) Structure ii) Function iii) Protein phosphorylation, 7. Hormonal control of growth and development: i) General role of auxins, Gibberellins, Cytokinins, ethylene and Abscisic acid ii) mechanism of hormonal regulation- hormone receptors, secondary messengers, amplification of kinases. 8. Physiology of flowering i) Photoperiodism ii) Phytochrome – structure and function, 9. Physiology and biochemistry of seed dormancy and germination: i) Causes of dormancy and methods of breaking dormancy ii) Biochemical changes accompanying seed germination.

## **Cell biology and Genetics**

1. Basic principles of microscopy, computer assisted karyotype analysis, Flow cytometry and *in situ* hybridization, 2. Brief account of DNA replication and transcription. Introns and exons. 3. Brief study of regulation of gene expression in prokaryotes (Lac-operon) and eukaryotes (promoters, transcription factors and enhancers), 4. Overview of cell cycle. Control mechanisms: role of cyclins and cyclin-dependent kinases, retinoblastoma and E2F proteins. Apoptosis and Programmed cell death, 5. Brief account of Mutations: Single base substitutions: Frame-shift mutations; Insertions and Deletions; Inversions and Translocations; Transposon-induced mutations; Site-directed Mutagenesis, 6. Brief study of types of DNA damage and repair mechanisms, 7. General account of inherited human diseases and Gene therapy, 8. Brief account of Proto-oncogenes, oncogenes and tumor suppressor genes, 9. Mendelian inheritance.

Gene interaction (12:3:1; 9:3:4; 9:7 ratios), 10. Linkage and chromosome mapping in eukaryotes, 11. Extra nuclear inheritance: Cytoplasmic male sterility, 12. Hardy-Weinberg Law. Gene frequency and genotype frequency, 13. Brief account of plant tissue culture and micropropagation, 14. Overview of recombinant DNA technology. restriction mapping, gene cloning, genomic/cDNA libraries, blotting methods, polymerase chain reaction and DNA fingerprinting, 15. General account of transgenic plants, 16. Basic concepts of gene sequencing, microarrays, genomics and proteomics, 17. Basic concepts of Bioinformatics, 18. Mean, Variance, Standard deviation and Standard error, 19. Chi-square and Student's "t" test. Concept of Probability: Addition and multiplication rule, 20. Introduction to computers. Use of Word and PowerPoint in the preparation and presentation of documents. Use of Internet and World Wide Web in research.

### **Ecology and Phytogeography**

The Environment: Physical environment; biotic and abiotic interactions, Habitat and Niche: Concept of habitat and niche; Niche width and overlap; Fundamental and realized niche; Resource partitioning; Character displacement—Allopatric and Sympatric, Ecosystem Ecology: Ecosystem structure and function; Food Chain, Food Web, Energy flow and Mineral cycling (C,N); Primary production and Methods of measurement of primary productivity. Population, Ecology: Characteristics of population (Density, Natality, Mortality, Dispersion Population size, Age structure, Life tables); Population growth curves; Population regulation; life history strategies (r and k selection); Species Interactions: Types of Interactions, Interspecific Competition, Herbivory, Carnivory, Pollination, Symbiosis, Community Ecology: Characteristics of communities (Analytical and Synthetic); Raunkiaer concept; Community structure and attributes; Levels of species diversity and its measurement; Ecotones. Biodiversity: Status, Monitoring; Hotspots, Major drivers of biodiversity change; Ecological Succession: Types; mechanisms; Changes involved in succession; Concept of climax, Biogeography: Plant distribution, Theory on plant distribution (Age and area theory, Theory of tolerance) Descriptive Phytogeography, Endemism – Types of endemics, Major terrestrial biomes; Biogeographical zones of India, Applied Ecology: Pollution – Global environmental change (Atmosphere composition and structure, Green house gases, Global warming, Ozone depletion), Conservation Biology: Principles of conservation (*In situ* and *Ex situ*). Indian case studies on conservation/management strategy – Project Tiger, Biosphere reserves.