

## 504. Botany

### 1. Phycology:

1. General characters and comparative study of important systems of classification of algae – Fritsch and Parker systems of classifications.
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 b) Fresh water algae and c) Marine algae.
4. Reproduction of algae - a) Vegetative b) Asexual - Different types of spores. Sexual Zygotic, Sporic and Gametic with suitable example.
5. Algal blooms and Toxic algae
6. Algal bio-fertilizers.
7. Algae as Food and Feed.
8. Role of algae in industry ( Alginic acid, Agar, Carrageenan)
9. Fossil Algae (A brief account only)
10. General characters, morphology, life history and classification of the following groups of algae:
  - a). Cyanophyceae – *Microcystis, Lyngbya and Aulosira*.
  - b) Chlorophyceae – *Eudorina, Pediastrum, Hydrodictyon, Pithophora, Ulva, Stigeoclonium, Draparnaldiopsis, Ciosmarium, Closterium and Bryopsis*.
  - c) Charophyceae – *Nitella*
  - d) Bacillariophyceae – *Cyclotella, Cymbella, Gomphonema*.
  - e) Euglenophyceae – *Euglena, Phacus*
  - f) Phaeophyceae – *Laminaria, Padina*
  - g) Rhodophyceae – *Porphyra, Gracillaria, Corallina*.

### 2. Mycology:

1. Introduction to Mycology – General characters of true fungi and fungi-like organisms; Hyphal Ultrastructure; fungal wall and septa; main growth forms of fungi; mode of nutrition in fungi.
2. General characteristics of fungal spores; asexual and sexual reproduction in different groups of fungi.
3. Fungal cytology and genetics; Heterokaryosis, Parasexual cycle; Sex Pheromones ( hormones) in Fungi; Mechanism of nuclear inheritance; Mechanism of extra-nuclear inheritance.
4. Outlines of nomenclature, ICN, Phylogeny and recent taxonomic criteria; Classification of Fungi (Alexopoulos and Mims, 1996 and Hibbett et. Al., 2007).
5. Fungi in Industry: Production of alcohol and organic acids.
6. Fungi in Medicine: Types of metabolites used in medicine and production of antibiotics.
7. Fungi in Agriculture and Forestry:
  - a) Fungi as plant parasites (Wilts, Leafspots, Root rots, Smuts and Rusts).
  - b) Fungi as bio-fertilizers: Ecto and Endomycorrhizae.
  - c) Fungi as biopesticides: mycofungicides, weedicides, and insecticides.
8. Fungi as human and animal parasites (medical mycology)
9. Fungi as food: Mushrooms: Types of mushrooms, biology and growth of mushrooms, Nutritional and medicinal value of edible mushrooms; Fungal protein (Yeast and *Fusarium*).
10. Systematic position, lifecycle (Hibbett et. Al., 2007) and brief account of the following types;

- Microsporidia - General account  
Chytridiomycota - *Synchytrium*  
Blastocladiomycota - *Allomyces, Pilobolus*  
Neocallimastigomycota - General account  
Ascomycota - *Taphrina, Emericella, Neurospora, Gibberella, Glomerella*  
*Morchella*  
Basidiomycota - *Melampsora, Phallus, Ustilago*  
Oomycota- *Peronospora*  
Fungi-like organisms - *Stemonitis*

11. General account of Archaeobacteria and Eubacteria; General characters of Plant Pathogenic Bacteria - Ultra structure of bacterial cell, biochemistry of cell wall, nutritional and growth factors of bacteria. Plasmids - significance of plasmids; molecular events in genetic transfer (conjugation, transformation and transduction) in bacteria.

12. Viruses: Characteristics and ultrastructure of virions; isolation, purification, detection and characterization of viruses; Classification (ICTV) of viruses; Symptomatology and Transmission of plant viruses; Importance of the viruses.

13. Mollicutes: General characters, transmission and diseases caused by Spiroplasmas and Phytoplasmas.

### **3. Bryophyta:**

1. Classification systems of Bryophytes.
2. Distribution, structure and reproduction of the following groups.
  - a). Marchantiales; Marchantiaceae-*Marchantia, Targionia*.
  - b). Jungarmanniales- *Porella*
  - c). Anthocerotales – *Anthoceros, Notothylas*
  - d). Sphagnales – *Sphagnum*
  - e). Polytrichales- *Polytrichum*.
3. Structure and evolution of gametophyte in Bryophytes.
4. Structure and evolution of sporophytes in Bryophytes.
5. Economic importance of Bryophytes.
6. Fossil & Fossilization, type of plant fossils
7. Fossil Bryophytes.

### **4. Pteridophyta:**

1. Classification systems of Pteridophytes.
2. Distribution, structure and reproduction of the following groups: Psilotales – *Psilotum*  
AzollaLycopodiales- *Lycopodium, Phylloglossum*  
Selaginellales- *Selaginella*  
Isoetales – *Isoetes*.  
Equisetales – *Equisetum*  
Filicales– *Ophioglossum, Adiantum, Salvinia*  
Stelar evolution in Pteridophytes.
3. Telome theory & its application
4. Heterospory & seed habit
5. Geological timescale.

6. Techniques employed in the types of fossils
7. Origin & evolution of early vascular plants
8. General characters of Lepidodendrales, Calamitales and Sphenophyllales.

### **5. 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 and male and female cones 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. Development and trends of evolution of male gametophyte in Gymnosperms
7. Structure of Ovule and development of female gametophyte.
8. Embryogeny in Gymnosperms
9. General Account of Pteridospermales, Pentoxylales and Cordaitales.

### **6. Embryology:**

1. Microsporangium: Anther, sporogenous tissue, formation of pollen wall, vegetative and generative nucleus.
2. Megasporangium: Ovule, types of ovule, Nucellus, Megasporogenesis, embryosac types, a special account of mature embryosac.
3. Fertilization: Double fertilization, self-incompatibility, barriers of fertilization.
4. Endosperm: Development and types of endosperms. Embryogeny of dicots. A general account of Apomixis and Parthenocarpy.
7. Embryology in relation to Taxonomy.

### **7. Plant 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 in Gymnosperms and Angiosperms.
  - 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 Quiescent 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 ultrastructure of guard cells. Ontogeny of Paracyctic, diacytic, and anisocytic stomata.
- d) Trichome complex-Basic structure with reference to foot and body. Classification of trichomes.
- 6. Transfer cells: Structure, distribution, ontogeny and function.
- 7. a). Secondary growth with reference to Dicot stem:
  - b) Significance of Dicots wood anatomy.
  - c). Morphology and arrangement of Vessels, Axial Parenchyma Fibres and Ray parenchyma and their value in wood identification.
- 8. Salient features of the following woods.
  - a). *Tectonagrandis*
  - b). *Terminalia tomentosa*
  - c). *Shorea robusta*
  - d) *Pongamia pinnata*

### **8. Palynology:**

- 1. Palynology: Definition, Scope and importance.
- i). Methods in Palynology: Acetolysis.
  - ii). Morphology of pollen – Polarity, symmetry, size and shape, apertural pattern (NPC Classification), exine stratification and ornamentation of pollen wall.
- 2. Aeropalynology –Allergenic spores and pollen in atmosphere and types of allergic reactions, Symptoms of pollen allergy in human beings, diagnosis (ELISA) and clinical treatment.
- 3. Melissopalynology– quantitative methods in Melissopalynology. Applications of melissopalynology in codification of honeys.
- 4. Role of Palynology in Taxonomy and Forensic science.

### **9. Taxonomy of Angiosperms:**

- 1. Taxonomy: Definition, Principles, Scope and historical development.
- 2. Taxonomic tools :Herbarium, floras, Botanical gardens, GPS, GIS.
- 3. Plant nomenclature: Salient features of International Code of Nomenclature for algae, fungi, and plants (ICN), brief account of The Shenzhen Code 2018.
- 4. ICN Articles and Recommendations about Ranks and Nomenclature, Typification, Author Citation, Effective and valid publication.
- 5. Web resources for proper nomenclature - BHL, IPNI, Species 2000 and The Plant List.
- 6. Biosystematics – Introduction, Principles and Methods.
- 7. Synthetic approach to the systematic of Angiosperms: - Palynology, Phytochemistry.
- 8. Classification of angiosperms: Natural, Artificial, Phylogenetic system of classification
- 9. Systems of angiosperm classification: Phenetic versus Phylogenetic system; cladistics in taxonomy;
- 10. Relative merits and demerits of major systems of classifications- Bentham & Hooker; Takhtajan and Cronquist; Introduction to APG system of classification.
- 11. Study of following families with particular reference to systematic position, phylogeny, Evolutionary trends and economic importance. Dicot families; Magnoliaceae, Meliaceae, Fabaceae, Cucurbitaceae, Apiaceae, Lamiaceae, Verbenaceae, Euphorbiaceae.
- 12. Study of following families with particular reference to systematic position, phylogeny,

Evolutionary trends and economic importance, Monocot families- Zingiberaceae, Cyperaceae, Poaceae.

### **10. Medicinal Botany:**

1. Medicinal Botany:
  - a. Role of plants in medicine, its origin and development
  - b. Morphology, active principles and medicinal value of the following:
    - i. *Andrographispaniculata*
    - ii. *Asparagus racemosus*
    - iii. *Clitoriaternata*
    - iv. *Phyllanthusemblica*
    - v. *Gymnemasyvestre*
2. Flora of Telangana State: Salient features of vegetational aspects.

### **11. Plant Biochemistry:**

1. **Bioenergetics:** Metabolic pathways and oxidation–reduction process with reference to Photophosphorylation and Glycolysis, Energy Currency –ATP structure and reactions; other energy rich compounds.
2. **Thermodynamic Principles applicable to bioenergetics:** Conservation of Energy, Entropy, Disorder, Gibb’s free Energy and energy coupled reactions.
3. **Enzymes:** Properties of enzymes, Co-factors, Isozymes, enzyme kinetics, Michaelis – Menten equation, mechanism of enzyme action, regulation of enzyme action.
4. **Carbohydrates:** Classification, structure and function of carbohydrates: a) monosaccharides b) oligosaccharides c) polysaccharides, storage polysaccharides, structural polysaccharides, glycoproteins.
5. **Lipids:** Classification of lipids – simple lipids, compound lipids, sterols and terpenoids, biosynthesis of fatty acids, polyunsaturated fatty acids, lipoproteins, oxidation of fats,  $\alpha$ -oxidation,  $\beta$ -oxidation, glyoxylate cycle, gluconeogenesis.
6. **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 GS and GOGAT.
7. **Proteins:** a) Classification of proteins, b) Structure of proteins and Ramachandran plot.
8. **Nucleic acids:** a) Structure of DNA and types – B, A and Z forms and DNA Structure of RNA – m-RNA, t-RNA, r-RNA
9. **Structure and function of membranes:** a) Chemical composition b) Membrane models c) Functions of Membranes d) Membrane proteins e) Membrane lipids.
10. **Biochemistry of plant cell wall:** cellulose, hemicelluloses, lignin, pectin, suberin and cutin.
11. **Secondary metabolites:** introduction, classification, distribution and functions.

### **12. Plant Physiology:**

1. **Water relations:**
  - a. Water potential
  - b. SPAC concept
2. **Mineral nutrition:** Mechanism of ion uptake
  - a. Electrochemical potential
  - b. Uptake of solutes and macromolecules from soil
  - c. Ion channels

d. ATPase carrier

e. Aquaporins

**3. Assimilation of Nutrients:**

a. Physiology and biochemistry of nitrogen fixation

b. Sulphate reduction and assimilation

**4. Photosynthesis:**

a. Properties of light and absorption of light by photosynthetic pigments

b. Composition and characterization of photo systems I and II

c. Photophosphorylation

d. Path of carbon

Differences between C3 and C4 photosynthesis

CAM pathway and its regulation

e. Photorespiration, biosynthesis of glycolate and regulation of photorespiration.

**5. Respiration:**

a. Glycolysis, fermentation, tricarboxylic acid cycle, Regulation of TCA cycle.

b. electron transport and oxidative phosphorylation, Coupling oxidative phosphorylation to electron transport, chemiosmotic hypothesis.

c. Hexose monophosphate shunt and its significance, Cyanide – resistant respiration.

**6. Hormonal control of growth and development**

a. General role of auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid

b. Mechanism of hormonal regulation-hormone receptors, secondary messengers,

c. Amplification of kinases.

d. Structure and functions of Calmodulin

**7. Physiology of flowering**

a. Photoperiodism

b. Phytochrome – structure and function

**8. Physiology and biochemistry of seed dormancy and germination:**

a. Causes of dormancy and methods of breaking dormancy

d. Biochemical changes accompanying seed germination.

**13. Cell Biology, Genetics and Biostatistics:**

1. Principles of microscopy, Light microscopy and Electron microscopy, (SEM, TEM), Fluorescent microscopy

2. Brief account of DNA replication and transcription in Prokaryotes, Eukaryotes (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: Mitosis, Meiosis and significance.

5. Cell cycle Control: Role of cyclins and cyclin-dependent kinases. Apoptosis and Programmed cell death.

6. Mutations: Gene mutations (substitutions and frame-shift mutations), Chromosomal aberrations (structural & numerical), Site-directed mutagenesis.

7. Brief study of DNA damage and repair mechanisms

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. Inherited human diseases: Haemophilia and Sickle cell Anaemia. Gene therapy
12. Extra nuclear inheritance: Cytoplasmic male sterility
13. Brief account of Plant tissue culture, Micropropagation and Transgenic plants.
14. Overview of recombinant DNA technology. Gene cloning, Restriction enzyme, Vectors Genomic / cDNA libraries.
15. Blotting methods, Polymerase chain reaction and DNA fingerprinting.
16. Basic concepts of gene sequencing (Sanger's Method)
17. Genomics, Proteomics and Bioinformatics.
18. Hardy-Weinberg Law. Gene pool, Gene frequency and genotype frequency
19. Mean, Variance, Standard deviation and Standard error.
20. Chi-square and Student's "t" test. Probability distribution (Binomial, Poisson and

#### **14. Horticulture and Plant breeding:**

1. Importance and propagation of horticultural plants:
  - a. Propagation through seeds.
  - b. Propagation through cuttings i.e., leaf, stem and roots.
  - c. Grafting- normal and special grafting procedures.
2. Nutrient management: General account of chemical fertilizers and bio-fertilizers. Symptoms of deficiencies of macro and micro nutrients.
3. Disease and pest management of horticultural plants:
  - a. Identification/Symptoms
  - b. Remedies/Control measures
  - c. IPM (Integrated Pest Management)
4. Mass production of horticultural plants and plantation crop plants through tissue culture and micropropagation.
5. Plant breeding objectives. Traits of interest for field crops, fruits and vegetable crops (yield, duration, adaptability and tolerance / Resistance to Biotic and Abiotic stresses.
6. Selection. Back cross breeding and usefulness of Marker-Assisted Selection.
7. Development of inbred cultivars and commercial hybrids. Heterosis, Combining ability and Heritability.
8. Mutation breeding. Induced polyploidy in plant breeding. Importance of haploids and dihaploids.
9. Transgenic technology and its acceptance. Bt-cotton and Bt-brinjal, Herbicide resistant crops and Golden rice.
10. PCR based zygosity analysis and ELISA.

#### **15. Environmental pollution and protection:**

1. Kinds of pollution, Air pollution-Sources of air pollution,
2. Major air pollutants, Primary and Secondary Pollutants stationary and mobile sources.
3. Effects of air pollutants on plants, human beings and materials, control of air pollution.
4. Noise pollution- sources, effects and control measures.
5. Acid rain- causes and effects on terrestrial and aquatic systems.
6. Water pollution- Sources, Effects and control of water pollution.
7. BOD, COD, Hardness of water, criteria of water quality.
8. Primary treatment (Industrial wastewater) – Segregation, equalization, neutralization,

sedimentation, flotation and oil separation.

9. Secondary treatment (Biological treatment)- Principles of biological treatment
10. Waste stabilization ponds, Aerated lagoons-Activated sludge process, Trickling filters.
11. Soil pollution – Sources, effects and control measures.
12. Bioremediation- In-situ and Ex-situ bioremediation
13. Bioremediation of toxic metals.
14. Concept of Phytoremediation
15. Classification of solid wastes, types and sources. Disposal methods,
16. Management of Municipal waste,
17. Hazardous and Biomedical waste.
18. Environmental (protection) Act-1986.

### **16. Ecology and Phytogeography:**

1. **The Environment:** Physical environment; biotic and abiotic interactions.
2. **Habitat and Niche:** Concept of habitat and niche; Niche width and overlap; Fundamental and realized niche; Resource partitioning; Character displacement- Allopatric and Sympatric.
3. **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;
4. **Population Ecology:** Characteristics of a population (Density ,Natality, Mortality ,Dispersion Population size, Age structure , Life tables); Population growth curves; Population regulation; life history strategies (r and K selection);
5. **Species Interactions:** Types of Interactions,Positive interactions- Mutualism,Symbiosis, commensalism, Protocooperation.
6. Negative interactions – Exploitation, Herbivores, Carnivores, antibiosis, competition.
7. **Community Ecology:** Characteristics of communities Analytical Quantitative – Frequency, density, Abundance, Cover and Basal area. Qualitative – Physiognomy, Phenology,Stratification, sociability, vitality and Life form and Synthetic - Presence and constance, Fidelity, Dominance.); Raunkiaer concept ; Levels of species diversity and its measurement; Ecotones. Biodiversity: Monitoring; Hotspots (with reference to India), Major drivers of biodiversity change;
8. **Ecological Succession:** Types; mechanisms; Changes involved in succession;
9. Concept of climax- Monoclimax and Polyclimax theories.
10. **Biogeography:** Plant distribution , Theory on plant distribution( Age and Area theory, Theory of tolerance), Major terrestrial biomes; Biogeographical zones of India. Classification of climate – Koppens and Thornthwaites classification.
11. **Applied Ecology:** Pollution -Global environmental change -Atmosphere composition and structure ,Green house gases , Global warming, Ozone depletion.
12. **Conservation Biology:** Principles of conservation In situ - Protected areas, National parks, Wildlife sanctuaries, Biosphere reserves and Project tiger. Ex situ - Botanical gardens, Zoological parks and cryopreservation.