

## SYLLABUS FOR LECTURER (10+2) BOTANY

### **I. VIRUSES, BACTERIA & ALGAE.**

#### **A. Viruses & Bacteria**

1. Classification of Bacteria – General characters of each group.
2. Nutrition of Bacteria – Autotrophy, Heterotrophy, Symbiosis.
3. General characters of Rickettsiae, Chlamydiae, Mycoplasmas and diseases caused by them.
4. Nature of virulence, Toxins and extracellular enzymes of pathogenic bacteria.
5. Bio – Conversion of waste products and microbes (with references to alcohol and biogas).
6. Morphology of TMV, Purification and quantitative assay of plant viruses.
7. Infection and replication (with reference to TMV and Bacteriophage)
8. Transmission of plant viruses and control measures.
9. Virus diseases with reference to hepatitis, Aids and Rabies.
10. Modern concept of oncogenic viruses and tumorigenesis.

#### **B. Algae**

1. Comparative survey of important systems of classification of algae, criteria used for algal classification; modern trends in algal classification.
2. Diagnostic features of algal phyla, range of thallus and reproductive diversity.
3. Life history among algae, parallelism in evolution, comparative account of algal pigments.
4. Light microscope, ultrastructure and function of cell wall, flagella, chloroplasts, pyrenoids and eyespots and their importance in taxonomy.
5. Study of cyanophyta, Chlorophyta, Xanthophyta, Basillareophyta, Phaeophyta and Rhodophyta upto ordinal level with reference to the following genera Anabaena, Gonium, Chlorella, Entomorpha, Closterium, Acetabularia, Nitella, Botrydium, Navicula, Pandina, Liagora & Ceramium.
6. General characters of Euglenophyta and Dinophyta.

### **II. MYCOLOGY AND PLANT PATHOLOGY.**

1. Recent trends in the classification of fungi with reference to morphological and Reproductive structures.
2. Physiology of fungi with reference to Biotrophs, Hemibiotrophs, Symbionts and necrotrophs.
3. Role of fungi in industries with reference to production of alcohol. Organic acids, Antibiotics, food and fodder yeast and Mushroom cultivation, Mycorrhizal application in agriculture and plant growth.
4. Comparative study of following: -
  - i. Mycomocotina – Physarium, Plasmodiophora.
  - ii. Mastigomycotina – Albugo, Peronospora.
  - iii. Zygomocotina – Rhizium, Mucor, Blackshea.
  - iv. Ascomycotina – Taphrina, Morchella.
  - v. Basidiomycotina – Puccinia, Melampsora, Ustilago.
  - vi. Deuteromycotina – Fusarium, Cercospora, Colletotrichum.
5. Symptomology of diseases with reference to fungal, viral and bacterial infections of plants.
6. Role of enzymes and toxins in pathogenesis.
7. Disease control of physical, chemical and biological methods, resistant varieties, crop rotation, plant quarantine, seed certification.
8. Etiology and control of the following crop diseases:
  - i. **Cereals**  
Paddy – Blast, Brown leaf spot, Bacterial leaf blight.  
Wheat – Black stem rust, Bunt of wheat.  
Maize – Leaf blight.

- ii. **Fruits**  
Grapes – Downy and powdery mildew  
Apple – Scab
- iii. Cotton – Wilt of cotton.

### **III. ARCHEOGONATEE**

#### **A. Bryophytes**

1. Classification of Bryophytes.
2. Origin and evolution of Bryophytes, Fossil Bryophytes.
3. Comparative morphology, sex organ development and sporophytes of Marchantiales, Andreales & Bryales.
4. Spore germination, Bud formation, apogamy and apospory in Bryophytes.
5. Economic importance of Bryophytes, Horticultural uses of Bryophytes.

#### **B. Pteridophytes**

1. Classification of Pteridophytes
2. Comparative organography, systematics, reproduction and phylogeny of Lycopodiales, Ophioglossales, Osmundales, Filicales, Marsileales and Salviniaceae.
3. Pteridophytic life cycle with reference to alternation of haploid and diploid phases, colonization of terrestrial environments.
4. Origin of land plants (Organ categories & internal tissue system), Telome theory.
5. Apogamy, apospory and apomixis.
6. Soral evolution (Eusporangiate & Leptosporangiate), Prothallial evolution.

#### **C. Gymnosperms**

1. Recent trends in classification of Gymnosperms.
2. Morphology & anatomy of vegetative and reproductive organs and interrelationships of Cycadales, Ginkgoales, Coniferales, Taxales, Ephedrales, Welwitschiales & Gnetales.
3. Structure and evolution of archegonium in Gymnosperms.
4. Distribution of living and fossil gymnosperms in India.
5. Evolution of Gymnosperms.
6. Survey of chromosomes in Gymnosperms.
7. Fossil Gymnosperms.

### **IV. ANGIOSPERMS MORPHOLOGY TAXONOMY AND EMBRYOLOGY.**

#### **A. Plant Taxonomy**

1. Botanical exploration in India and J&K State.
2. Botanical survey of India, organization and its role.
3. Taxonomy as a synthetic discipline.
4. Phylogenetic classification – Hutchinson, Takhtajan, Cronquist, Dhalgren and Thorne.
5. Anatomy, Embryology and Palynology in Taxonomy.
6. The international code of Botanical nomenclature and amendments to the code of Botanical nomenclature.
7. An origin of angiosperms, mono & Polyphyletic concept, phylogeny of Ranales & Helobiales.

#### **B. Morphology**

1. General concept of morphology.
2. Origin and evolution of flower, co-evolution of flower vis-à-vis pollinators.
3. Stamen – origin and evolution from foliar to reduced condition.
4. Carpels – concept of foliar origin of carpel, alternative concepts and approaches, conduplicate and closure of the carpels.

#### **C. Angiosperm Anatomy**

1. Ultrastructure of cell wall, fine structure of plasmodesmata, microtubules, microfibrils, secondary wall structure.
2. Apical, Intercalary & lateral meristems.

3. Ontogeny, Phylogeny and function of Primary & Secondary xylem, wood anatomy.
4. Ontogeny Phylogeny and function of Primary & Secondary phloem.
5. Development and ultrastructure of Trichomes and stomata.
6. Nodal types, Nodal Anatomy, Phylogentic and evolutionary considerations.
7. Vascular cambium vs Cork Cambium, factors controlling their activity, Periderm; Lenticals, Abscission, wound healing.
8. Anatomy of monocot and dicot seeds & fruits. Seed appendages, their ontogeny, structure and functions.
9. Anatomy in relation to Taxonomy
  - a. Wood anatomy, floral anatomy & seed Anatomy in relation to taxonomy.
10. Contemporary plant anatomy – current trends and prospects.

**D. Embryology of Angiosperms**

1. **Microporangium:** Structure and function of wall layers, ultrastructural changes in tapetum and meiocytes during microsporogenesis, role of callose and tapetum in pollen development.
2. **Pollen wall morphogenesis:** Microspore/pollen mitosis, division of generative cell, heterogeneity in sperms. Pollen fertility and sterility; pollen storage, viability and germination.
3. **Ovule nutrition.**
4. **Megasporogenesis:** Sub cellular profiles of archesporial and megaspore mother cell, megaspore tetrad, dyad and Coenomegaspore (polarity of nuclei), determination of functional megaspore dyad.
5. **Embryosac:** Types, ultrastructure of components, synergids and antipodal haustoria nutrition of embryosac.
6. **Pollination:** Ultra structural and histochemical details of style and stigma, self and interspecific incompatibility, significance of pollen pistil interaction, role of pollen wall proteins and stigma surface proteins, barriers to fertilization, methods of overcoming incompatibilities.
7. **Fertilisation:** Heterosperms, differential behaviour of male gametes, discharge and movement of sperms syngamy and triple fusion, post fertilization metabolic and structural changes in embryosac.
8. Endosperms types, ultrastructure, cellularisation in nuclear endosperms, endosperms haustoria, their extension and persistence, function, storage metabolites.
9. **Embryo:** Polarization of Zygote, embryogenic types, histology and organogenesis of mono and dicot embryos, organless (undifferentiated) embryos; delayed differentiation of embryo, structure and function of suspensor, physiological and morphogenetic relationship of endosperms and embryo.
10. **Polyembryony:** Types, genetic & somatic, pollen embryos.
11. **Apomixis:** Diplospory, apospory, parthenogenetic development of embryo, Pseudogamous and autogamous development of endosperm, importance.
12. Another culture and androgenesis (ahaploia plants). In vitro pollination, post pollinated ovule culture, endosperm, culture, embryo culture.
13. Seed growth and development, seed appendages.

**E. Palynology**

1. Development and evolution of pollen types, stereo and ultrastructure of exine, apertures. And furrows.
2. Palynology & Taxonomy.
3. Aeropalynology, methods of aerospore survey and analysis.
4. Honey bee pollen load, role of apiaries in crop production.
5. Recent advances in palynological studies.

**V. BIOCHEMISTRY AND PLANT PHYSIOLOGY**

1. **Carbohydrates:** Classification, occurrence, structure and function of monosaccharides, oligosaccharides, Polysaccharides including starch, cellulose & pectins.

2. Occurrence, structure and function of amino acids, stereoisomers, amphoteric properties, synthesis of amino acids by reductive amination, GS-GOGAT system, transamination.
3. Classification of proteins according to solubility and structure, function of major structural proteins, conjugate proteins, lectins and their importance.
4. **Enzymes:** Classification and mode of action.
5. Structure and function of DNA, Different kinds of RNA, role in protein synthesis.
6. Biosynthesis and functions of secondary metabolites (Lignin, suberin, terpenes & alkaloids).
7. Physico-chemical organization of the plant cell and cell organelles, structure and composition of membranes, Fluid Mosaic – lipoproteins model. Endomembrane system.
8. **Water relation of plants:** Unique physico-chemical properties of water, chemical potential, water potential in the plant, apparent free space, bulk movement of water, soil-plant-atmosphere continuum (Spac), Stomatal regulation of transpiration, hormonal and energy-dependent hypothesis.
9. **Inorganic nutrition:** Physico-chemical aspects of solute transport, diffusion and facilitated diffusion, Passive & active transport, Nernst equation. Donnan's potential, role of ATPase as a carrier, co-transport (symport), counter transport (antiport), ion channel. Role of calmodulin importance of foliar nutrition and role of chelates.
10. **Photosynthesis:** Energy pathway in photosynthesis, chloroplast as an energy transducing organelle, characterization of photosystem I & II, Electron flow through cyclic, non-cyclic and pseudocyclic photophosphorylation pathway of CO<sub>2</sub> fixation, differences between C<sub>3</sub> & C<sub>4</sub> photosynthesis, different kinds of C<sub>4</sub> pathways; CAM pathway, occurrence, biochemical events and adaptive advantages, regulation of photorespiration.
11. **Respiration:** Concept of free energy and entropy high energy compounds, ATP synthesis through oxidative electron transfer chain (cytochrome system), chemiosmotic regeneration of ATP, Gluconeogenesis.
12. Mechanism of nitrogen fixation.
13. A critical discussion of hormonal effects on growth, morphogenesis and development, Bioassay of plant growth regulators & their mode of action.
14. **Phytochrome:** Occurrence, Chemistry and photomorphogenetic effects role of phytochrome in movements and in flowering.

## **VI. ECOLOGY AND ENVIRONMENT**

1. Concept of ecosystem, ecological niche.
2. Bio-geochemical cycles-carbon, phosphorus, nitrogen and hydrological cycle.
3. Energy flow ecosystem, Law of thermodynamics, Primary productivity. Food Chains and food webs, Energy Pyramids.
4. Patterns in communities.
5. **Succession:** Models, theories of climax community formation.
6. **Plant population:** Characteristic, Natality, mortality population regulation. Negative interactions-competition, Predation and parasitism. Positive interactions (Mutualisms)
7. Soil subsystem.
8. Air and water pollution and their effect.
9. Green house effect.
10. Conservation of Bio-diversity.
11. Afforestation, social forestry, agroforestry, wind breaks, International biological programme man and Biosphere programme, United Nations Environment programme, Biosphere reserves.

## **VII. GENETICS, CYTOGENETICS AND PLANT BREEDING**

1. Chromosome structure and organization in Prokaryotes Eukaryotes.
2. Specialized/accessory chromosomes – B – chromosomes their behaviour, origin and function. Organization of chloroplast and mitochondrial genomes.
3. Concept of gene in higher plants, fine structure and analysis, Gene function and regulation in pro & Eukaryotes.
4. Gene controlled biosynthetic pathways – Anthocyanins.

5. **Mobile genetic elements:** Insertion elements, transposons in bacteria, Ty elements in yeast, P & Copia elements in Drosophila, Ac-DS, Spm and Mu elements in maize, molecular characteristics and proprieties their significance in development and evolution.
6. Gene amplification.
7. Meiotic behaviour types of polyploids, Inheritance pattern in autopolyploids, Induction and characterization of trisomics, monocomics, their role in chromosome mapping, Allien addition and deletion and substitution and their role in gene transfer.
8. Chromosomal abberations.
9. Molecular basis of mutations, mechanism of DNA repair.
10. Objectives of plant breeding.
11. Breeding methods in self and cross pollinated plants, Apomictic plants.
12. Heterosis and inbreeding depression.
13. Hybrid and synthetic varieties.

## **VII BIOTECHNOLOGY**

1. Concept and scope biotechnology.
2. Plant tissue culture, another and pollen culture. Selection of mutants, in-vitro-auxotrophs, disease resistance, salt and drought tolerance, nutritional quality, herbicide resistance.
3. Protoplast culture and somatic hybridization.
4. Plotoplast culture and somatic hybridization, Isolation of protoplasts, culture and fusion methods, selection of fusion products, production of hybrids and cybrids.
5. **Recombinant DNA:** Technology-Isolation and purification of DNA; Restriction endonucleases, agarose gel electrophoresis, pulsed gel electrophoresis, southern/northern/western blotting, DNA sequencing, selection and screening of recombinant clones.
6. **Cloning vehicles:** Salient features, plasmids, cosmids, single standard DNA viruses, Ti-plasmids, construction of plasmid vectors, Lambda phage vectors, uses of vectors in cloning and sequencing.
7. **Cloning strategies:** Geonomic libraries, CDNA libraries, cloning into plant cells.
8. Application of Recombinant DNA technology in plant improvement.

**Sd/-  
Secretary & COE  
JK PSC**