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**B.Sc., DEGREE  
(Semester)**

**BRANCH: V (A) Plant Biology and Plant Biotechnology**

**SEMESTER – 1: PAPER I: PHYCOLOGY**

**UNIT I:** Classification of Algae –F.E. Fritsch 1945.

**UNIT II:** General characters of Cyanophyceae, Chlorophyceae, Bacillariophyceae, Pheophyceae and Rhodophyceae.

**UNIT III:** Detailed study of distribution, habit pigmentation, plastids, food reserves, flagellation, reproduction and life cycles of the following forms of Cyanophyceae Bacillariophyceae and Chlorophyceae (No developmental studies)

**CYANOPHYCEAE-** Anabaena, Nostoc and Spirulina.

**CHLOROPHYCEAE-**Chlorella (unicellular), Scenedesmus (colonial), Coleochaete (heterotrichous) and Caulerpa (thalloid).

**BACILLARIOPHYCEAE-**Diatoms-Navicula

**UNIT IV:** Detailed study of distribution, habit, pigmentation, plastids, food reserves, reproduction and life cycles of the following forms of Phaeophyceae and Rhodophyceae. (No development studies)

**PHAEOPHYCEAE-** Sargassum

**RHODOPHYCEAE-** Gracilaria

**UNIT V:** Economic importance of Algae-Algae as food ( SCP), fodder, bio-fertilizer, oxidation ponds and as medicines. Industrial uses of Algae (alginates, agar and diatomaceous earth)

**PRACTICAL:**

A detailed study of the genera included in the theory.

## SEMESTER: 2

### I YEAR PAPER-II

#### MYCOLOGY, VIROLOGY & BACTERIOLOGY

##### THEORY:

##### MYCOLOGY:

1. **Fungi**-1 General characteristics, and broad classification of Alexopoulos.
  2. A detailed study of the structure and reproduction in the following genera:  
Pythium, Albugo, Yeast, Peziza, Aspergillus, Puccinia, Colletotrichum, Cercospora.
2. **Bacteria**- Ultra structure reproduction and their economic importance.
3. **Plant Viruses**- Salient features, classification, structure reproduction transmission disease caused by them.
4. **Lichens**- Occurrence, structure and reproduction of Fruticose type Lichen (No development studies)

##### PRACTICAL I : A detailed study of the following genera mentioned in the theory:

**Fungi:** Pythium, Albugo, Yeast, Peziza, Aspergillus, Puccinia, Colletotrichum.  
Cercospora

**Bacteria:** Grams staining-Demonstration only

**Lichens:** A general study of Fruticose type Lichen.

## SEMSTER : 3

### II YEAR: PAPER – III

#### BRYOPHYTES & PTERIDOPHYTES:

##### Bryophytes

1. General characters of Hepaticopsida, Anthocerotopsida and Bryopsida.
2. Detailed study of structure and reproduction of
  - a. Marchantia
  - b. Anthoceros
  - c. Polytrichum ( no developmental studies)

##### Pteridophytes

3. General characters, classification ( Reimer, 1954)
4. Stellar evolution, sporangial organization, apogamy, apospory, homospory and heterospory.
5. Detailed study of morphology, anatomy, reproduction and life cycle of following genera
  - a) Lycopodium, b) Equisetum, c) Dicranopteris, d) Marsilea (no developmental studies)

**PRACTICAL:** Detailed study of the genera included in the theory.

## **SEMSTER : 4**

### **GYMNOSPERMS, PALEOBOTANY & EVOLUTION**

**Theory:**

**Gymnosperms:**

1. General characteristics, distribution, morphology, structure and reproduction of Gymnosperms. Classification of Gymnosperms (Pilger & Melchior, 1954)
2. Detailed study of morphology, structure and reproduction in Cycas and Gnetum (no developmental studies)

**Paleobotany:**

3. Fossils and ideal conditions for fossilization, kinds of fossils – impression, casts, molds, Petrifications and coal ball . Geological time scale – era, period, epoch, evolution of the different flora. Brief study of the following fossils – Lepidodendron, Lepidocarpon and Calamites. Importance of Paleobotany.

**Evolution:**

4. Origin of life – Chemosynthetic theory on the origin of life. Evolutionary theories of Lamarck, Charles Darwin and De Vries. Synthetic theory of evolution.
5. Variation in nature:- Analysis of variation, source of variation (mutation, recombination, Adaptation and selection)

**PRACTICALS:** Study of morphology, anatomy and structure of the vegetative and reproductive Organs of Cycas and Gnetum.  
 Fossil slides of Lepidodendron, Lepidocarpon and Calamites  
 Photographs of evolutionists and any other photograph related to Evolution.

## **SEMSTER : 5**

### **III YEAR: PAPER – V**

#### **PLANT MORPHOLOGY & TAXONOMY**

- UNIT 1:** Morphology – Root systems – modifications. Shoot system – branching, modifications – Aerial, sub – aerial and underground. Leaf – simple and compound, phyllotaxy, Modifications – phyllode, pitcher, tendrils, stipules, inflorescences – Definition and types - racemose, cymose, mixed and special types. Types of fruits.
- UNIT 2:** Taxonomy and its importance, Herbarium techniques. Concept of a taxon – Genus and Species. Citation of authors, binomial nomenclature, I.C.B.N. and taxonomic hierarchy.
- UNIT 3:** Categories of classification – Artificial (Linnaeus), Formal (Bentham & Hooker), Modern & Phylogenetic (Cronquist) only outline classification needed – Merits and Demerits.
- UNIT 4:** A detailed study of the range of characters of the following families and the economic importance in these families. Dicotyledons – Annonaceae, Rutaceae, Leguminosae, Cucurbitaceae, Sapotaceae, Asclepiadaceae & Apocynaceae.
- UNIT 5:** Detailed study of the range of characters of the following families and its economic importance. Monochlamydeae – Euphorbiaceae. Monocotyledons – Orchidaceae & Poaceae.

## **SEMESTER : 5**

### **PAPER – VI**

#### **CELL BIOLOGY AND MOLECULAR BIOLOGY**

##### **CELL BIOLOGY**

1. Introduction – definition, scope, cell organization – prokaryotic and eukaryotic. Cell boundaries, cell wall – gross layers i.e. middle lamella, Primary wall, Secondary wall structure, Chemistry and functions of cell wall - pits (simple and bordered), plasmodesmata, Plasma membrane – occurrence, Structure. (light microscopic, electron microscopic & molecular) chemistry, function and origin.
2. Occurrence, structure, function and origin of endoplasmic reticulum, golgi bodies, lysosomes, Ribosomes, peroxisomes, mitochondria and chloroplast. DNA autonomy of organelles.
3. Nucleus, nuclear membrane, chromosomes, euchromatin, heterochromatin, giant chromosomes, Polytene and lampbrush. Cell cycle, cell division, mitosis and meiosis, cytokinesis.

##### **MOLECULAR BIOLOGY**

4. Nature and function of genetic materials – DNA – structure and replication – RNA types and DNA Repair. Protein synthesis – transcription, translation, genetic code evidence of triplet nature of the code.
5. Gene regulation in prokaryotes – Lac – operon and tryp – operon as biosynthetic system, Auto regulation and feedback inhibition. Genetic engineering – recombinant DNA, isolation of DNA – vector, restriction enzymes.

Transformation – screening for recombinants.

## **SEMESTER : 5**

### **PAPER : VII**

#### **PLANT ANATOMY AND APPLIED EMBRYOLOGY**

**UNIT 1:** Tissues - Definition, types – simple permanent – parenchyma, collenchyma, sclerenchyma. Fibres and Sclereids – Structure and functions; Complex permanent tissues – Xylem and Phloem, Development, arrangement, Meristems – Classifications. Vegetative shoot apex – Theories of Shoot apex Organization, Root apex – Theories of Structural development and differentiation.

**UNIT 2:** Tissue systems – Dermal tissue system – Fundamental or ground tissue system, vascular tissue System, types of vascular bundles – nodal anatomy. The stem – primary and secondary structure. Anatomy of Dicotyledonous and Monocotyledonous - stems – secondary growth in Dicotyledonous and Monocotyledonous stems. Anomalous secondary growth in Nyctanthus, Boerhaavia and Dracaena.

**UNIT 3:** The Root – Primary and Secondary anatomy of Dicotyledonous roots. Anatomy of monocot Roots, Anatomy of storage roots. Secondary growth in dicot roots, Leaf - anatomy of dicot and monocot Leaf. Leaf abscission.

**UNIT 4:** Microsporangium, Microsporogenesis – development of male gametophyte. Megasporangium (ovule) Different types, Megasporogenesis. Development of female gametophyte – Monosporic – polygonum and Oenothera, Bisporic – Allium, Tetrasporic – Penaea and Peperomia.

**UNIT 5:** Gametic fusion. Tripple fusion. Development of dicot embryo – Capsella, Development of Monocot embryo – Luzula. Endosperm – Definition, different types - free nuclear, cellular , heliobial, Endosperm haustoria. Apomixis – Definition and types. Polyembryony – Different types, tissue culture, Embryo culture, Parthenogenesis – induction and parthenocarpy.

### **PRACTICALS:**

#### **Anatomy:**

Study of simple and complex tissues by maceration. Study of internal structure of young and old dicot stems. Internal structure of aerial root and monocot stem. Structure of monocot and dicot anomalous Stems in Boerhaavia, Nyctanthus and Dracaena. T.S. of dicot and monocot leaves; Stomatal types.

#### **Embryology:**

T.S. of anther at various stages of development

Stages in microsporogenesis in pollenia-pollen architecture to be studied from the pollen of different plants.

Types of ovules, megasporogenesis, polygonum, Allium and Peperonia type of embryo sac development. Male gametophyte and female gametophyte development to be studied from permanent slides.

Stages in development of embryo in Monocotyledons (Najas ovary or any other plant ) and Dicotyledons (Capsella).

Types of Endosperm . Culture of Anther /Ovule/Endosperm/Embryo (any one to be demonstrated).

### **SEMESTER : 5**

#### **PAPER : VIII**

### **ECONOMIC BOTANY**

**UNIT 1:** Introduction – Food plants – Plant and Plant Products of Industrial value. Cereals – Rice & Wheat. Millets – Cholam & Pearl Millet. Nuts – Nuts with protein content, Soya & Pea nuts – Nuts With fat content, Castor & Arachis.

**UNIT 2:** Fibers & Fiber yielding plants – Cultivation , Classification, Extraction and uses of Fibres. Soft Fibres, Corchorus & Linum – Hard Fibres. Manila Hemp – Musa textiles, Surface Fibres – Gossypium. Timber – Detailed study of Harvesting and processing of wood in Tectona. Rubber – Extraction and Processing with reference to Hevea brasiliensis.

**UNIT 3:** Sugar – cultivation , Harvesting and extraction with reference to Saccharum officinarum. Species: Cultivation and harvesting of Eugenia caryophyllata – Beverages: Cultivation, harvesting and Preparation of Coffea arabica and Thea sinensis. Pulp and Paper Industry – Raw materials, pattern of cultivation – Resource availability – Manufacture of pulp – Gums – Resins – Turpentine.

**UNIT 4:** Definition, History and Scope of Pharmacognosy, Indigenous systems of medicine – Ayurvedic, Siddha, Unani and Homeopathy. Laxatives – Preparation, Sources, Descriptions, constituents, Chemical Tests and Uses – Aloe, Castor oil. Carminatives, Nutmeg, Black pepper & Cinnamon. Antitussives - Adhatoda and Ocimum.

**UNIT 5:** Sources, Descriptions, Constituents and uses of the following. Antirheumatic – Colchicine, Antitumour – vinca, Antidiabetic – Gymnema, Antiseptic – Neem and Diuretic – Chota Gokhru. Vitamins – Amla, Enzymes – Papaya, Pharmaceutical aids – Different types of Starch and lemon grass oil.

**PRACTICAL :** Items included in the theory.

## **SEMESTER : 5**

### **PAPER :IX**

#### **APPLICATION ORIENTED SUBJECT – I MODERN PLANT PATHOLOGY**

##### **Theory:**

**UNIT 1:** A brief history of plant pathology; Principles of plant pathology; Symptomatology – study of Infection – entry of fungal, Bacterial and Viral Pathogens; Leaf spot, Blight, Wilt, Rot, Rust, Smut, Powdery mildew, Downy mildew, Leaf mosaic and Phyllody.

**UNIT 2:** Dissemination of Pathogens – Spore dispersal, role of vectors in viral transmission, influence of weather – Wind, temperature and humidity.

**UNIT 3:** Disease resistance – morphological, cytological, biochemical and genetical. Cross protection. Role of toxins and enzymes in plant pathogenesis.

**UNIT 4:** Modern methods of disease forecast – epiphytotic – causes, course, decline and prophylaxis; Cultural, breeding and chemical control – protectant and systemic fungicides. Molecular techniques in plant pathology; detection of plant pathogens using molecular tools. Incorporation of resistant genes.

**UNIT 5:** Study of causal organisms and symptoms of a) Blast disease of Rice b) Red Rot of Sugarcane c) Tikka of Ground-nut d) Bacterial blight of Rice e) Citrus canker f) Leaf curl of Papaya. g) Fusarium wilt of cotton. Plant protection – Prevention; eradication-chemical, biological, genetical-breeding, hybridization-Immunization.

##### **PRACTICAL:**

1. A detailed study of diseased specimens included in the theory.
2. Demonstration of isolation and culturing of plant pathogens.
3. Effect of fungicide on the growth of plant pathogen (Demonstration only).

## **SEMESTER : 6**

### **PAPER - X**

#### **GENETICS, PLANT BREEDING & BIOSTATISTICS**

##### **THEORY:**

##### **GENETICS:**

1. Mendelian Genetics – Monohybrid, Dihybrid and Test cross ratios Deviations – Allelic, Non-allelic Gene interactions, Polygenic inheritance, Pseudoalleles, Lethal alleles.
2. Chromosome theory of linkage, Crossing over, recombinations and mapping of genes on Chromosomes. Sex determination in plants.
3. Chromosome number and structure. Polyploid origin, types and significance.
4. Extra nuclear inheritance and its application. Male sterility in Corn.
5. DNA structure and replication. RNA structure and types.
6. Mutation – types; Mutagenic agents (physical & chemical); significance.

7. Population genetics – Hardy-Weinberg principle.

**PLANT BREEDING:**

1. Principles involved in plant breeding – its importance in Green revolution with reference to Wheat, Rice, Sugarcane, Maize and Cotton.
2. Methods of Crop improvement: Selection (pure line, mass and clonal), hybridization, introduction & acclimatization.
3. Heterosis – causes and effects.
4. Polyploidy in plant breeding, Breeding for disease resistance.
5. Improved seed production and testing techniques.

**BIOSTATISTICS:**

1. Measures of central tendency – Mean, Median and Mode.
2. Measures of dispersion – Standard deviation, Mean deviation and Quartile deviation.
3. Testing of hypothesis.  
Simple definition of Null hypothesis, Alternate hypothesis, Type-1 error, Type-II Error, level of Significance problems based on large samples, t-test, Chi-square test.
4. Vital statistics and Non-parametric tests-Rank test, Median test, Run test.

**PRACTICAL:**

1. Genetic problems –test cross, back cross and allelic interactions.
2. Biostatistical problems covered in the theory.
3. Gene mapping –3 point test cross.
4. Models/ photographs/charts/equipments/chemicals.
  - a) Any mutagen.
  - b) Protein synthesis.
  - c) DNA structure and replication.
  - d) Types of RNA (m-RNA,t-RNA).

**SEMESTER : 6**

**PAPER : XI**

**ENVIRONMENTAL SCIENCE AND PHYTOGEOGRAPHY**

**THEORY:**

**Unit I.** Biotic and Abiotic factors and their influence on vegetation – a brief account of microbes , Plants, animals, soils, wind, light, temperature, rainfall and fire. Plant succession – primary and secondary -xerosere, hydrosere, Adaptation in xerophytes, hydrophytes and epiphytes.

**Unit II.** Ecosystem- concept processes and components, food chain, food web, energy and Grassland. Flow, pyramids, Nutrient cycle. Types of ecosystem: Coastal .

**Unit III.** Biodiversity: Ecological species and genetic species, concept :- classical and modern. Inter And intraspecific species diversity. Allopatric and Sympatric speciation- endemism, relics and Palaeoendemism- genetic variation ( isozymes: RFLP and PCR techniques).

**Unit IV.** Principles and need for conservation In situ conservation and on-farm conservation. Ex situ conservation, afforestation. Seed banks, gene banks, culture collections, disadvantages of ex situ conservation. A brief account of national and international agencies of conservation. Pollution- Air, water, soil-causes and consequences. Types of pollution: Primary and secondary. Secondary pollution: physical and chemical. Remedial measures.

**Unit V.** Phytogeography: principles- vegetation types of India – Tropical rain forest, Mangrove Vegetation and scrub jungle.



**PRACTICAL:**

1. Study of morphological and structural adaptations of locally available hydrophytes, mesophytes, Halophytes and epiphytes and correlate to their particular habitats.

Hydrophyte: Nymphaea, Hydrilla  
Xerophyte: Nerium, Casuarina.  
Mesophyte: Tridax, Vernonia.  
Halophyte: Avicennia, Rhizophora.  
Epiphyte: Vanda.

2. Construction of quadrat – to study percentage of frequency.
3. Field trips to places for study and observation of vegetational types prescribed in the syllabus for 2 to 5 days under the guidance of teachers.
4. Map of phytogeographical regions of India.
5. Estimation of microbial species diversity in soil samples. Study of endangered plant species.

**SEMESTER : 6****PAPER XII****PLANT PHYSIOLOGY**

**Unit I.** Water relations – diffusion, permeability, osmosis, water potential and its components.

Absorption of water – apoplast and symplast. Mechanism – passive and active. Transpiration- types and Significance. Factors, stomatal mechanisms.

**Unit II.** Elementary concept of bioenergetics – entropy and free energy . Enzymes:- properties, Coenzymes and activators, nomenclature, classification, mode of action, factors. Regulation – feedback inhibition.

**Unit III.** Photosynthesis:- radiant energy, Emerson's enhancement effect, pigment systems, Absorption Spectrum and Action spectrum, photoelectron transport, photophosphorylation, Calvin cycle, Hatch and Slack pathway, photorespiration.

Respiration:- Aerobic – Glycolysis, Krebs cycle, electron transport system, oxidative phosphorylation, Respiratory quotient.

**Unit IV.** Nitrogen assimilation:- importance of nitrogen in plant life, conversion of nitrate to ammonia by Plants, biological nitrogen fixation – nitrogen fixing organisms, legume – Rhizobium symbiosis; synthesis Of amino acids – reductive and transamination.

**Unit V.** Growth – Plant growth regulators (auxins, gibberellins, cytokinins, ethylene and abscisic acid)- Mechanism of action and practical application.

Photomorphogenesis – photoperiodism, vernalization, phytochromes. Dormancy (seed and bud), seed Viability and germination.

### **PRACTICALS:**

1. Determination of water potential by plasmolytic method.
2. Determination of water potential by gravimetric method.
3. Effect of temperature and chemicals on membrane permeability.
4. Study of rate of transpiration under different environmental factors.
5. Determination of degree of porosity of leaves.
6. Separation of plant pigments by paper chromatography.
7. Study of rate of photosynthesis under different light intensities.
8. Study of rate of photosynthesis under different wavelengths (red & blue) of light.
9. Comparison of rate of respiration of different respiratory substrates.
10. Determination of RQ using respirometer.
11. To test the germination capacity of seeds using Tetrazolium chloride.
12. Measurement of pH of expressed cells sap and different soils using pH meter.
13. Determination of ratio of water absorption and transpiration by weighing method.

### **Demonstration-Experiments**

1. Demonstration of stomatal movement.
2. Induction of roots in leaves by auxins.
3. Amylase activity.
4. Effect of pH on catalase in leaf discs.

## **SEMESTER : 6**

### **PAPER : XIII**

#### **PLANT BIOTECHNOLOGY**

1. Biotechnology – definition, history and scope.
2. Isolation and cultivation of economically important microbes
  - a) Fresh water Alga (*Scenedesmus*)
  - b) Fungus (*Aspergillus*)
3. Tissue culture – media, callus formation and protoplast fusion with reference to improvement of Plants.
4. Single cell protein (SCP) – micro – organisms used in SCP (*Scenedesmus* and *Spirulina*) nutritional Value of SCP. Algal biomass production and maintenance.
5. Mushroom cultivation – paddy straw and oyster mushrooms, Nutritional value and methods of Cultivation. Control of pests and pathogens.
6. Biofertilizers – Blue green algae, Azolla, Fungi, Mycorrhiza (VAM) Bacterium – *Azospirillum* sp.
7. Production of primary metabolites – ethanol production by yeast, citric acid production by *Aspergillus niger*.  
Production of secondary metabolites – Antibiotics – Penicillin. Enzymes from microbes and their Application – Amylase, Proteases, Renin, Pectinase and Glucose oxidase.
8. Improvement of plants: Alkaloid production, Vaccine productions, Luminescent plants, Protein Sweetener, conversion of photosystems C3 to C4.

## **SEMESTER : 6**

### **PAPER : XIV**

### **APPLICATION ORIENTED SUBJECT –II MICROTECHNIQUE**

#### **THEORY:**

- Unit I.** Light microscopy – History and - Optical principles use and care of Microscopes - A brief Survey of different types of microscopes including E.M.
- Unit II.** Microtechnical processes – principles and techniques:  
(A) Fixation and Fixatives  
(B) Temporary staining and stains
- Unit III.** Microscopic preparation, Semipermanent and Permanent
- Unit IV.** Special techniques : smear, squash & maceration
- Unit V.** Microtomy: types of microtomes and their use.  
Methods of specific materials:  
(A) Whole mount of algae & fungi  
(B) Sectioning of bryophytes , pteridophytes and gymnosperms.  
(C) Maceration & sectioning of angiosperm materials.

#### **PRACTICALS:**

1. Preparing and recording microscopic preparation as in unit 3.
2. Learning the skills of special techniques as in unit 4.
3. A record note book submitted in the practical examination shall carry marks.