Botany

Total: 5 hours /week
Lecture: 3 hours/week
Tutorial: 0 hour/week
Practical: 2 hours/week
Lab: 0 hours/week

Course Description

This course provides basic knowledge about botany, divided into eight units. The first unit gives general information about botany including different life components. The second unit talks about the structure and functions of a cell and its organelles including the cell reproduction. The third unit discusses the diversity of life, and includes basic information about algal plants, fungal plants, bacteria, and viruses. Unit four provides information about life processes of plants such as diffusion, osmosis, photosynthesis, respiration and transpiration. Unit five teaches about heredity and variation. This unit also provides information about genetic diseases/disorders in humans. Unit six provides information about the factors of our environment, their interrelationships, and effects of pollutants to human health. Unit seven includes information about selected medicinally and nutritionally important plants. Unit eight provides information about biotechnology and genetic engineering.

Course Objectives

At the end of the course, the student will be able to:

Explain the scope of botany and its different branches.

- Explain the life components, cell structures and their functions.
- Explain the different physiological processes in a plant body.
- Explain the role of genes and their transmission to the progeny.
- Describe how environmental factors and pollutants affect our lives.
- Identify different members of plant kingdom based on their general characteristics.
- Describe the life cycle of selected plant species from algae and fungi.
- Identify the economic importance of viruses, bacteria, algae, and fungi in the field of medicine.
- Describe the application of biotechnology in the field of medical science.

Contents

Unit 1. Life components **7hrs**

- Introduction
  - Define cellular pool, biomolecules, macro, and micro molecules.
  - Types of biomolecules i.e. inorganic and organic biomolecules
  - Inorganic biomolecules: definition
  - List of inorganic biomolecules, their roles and the condition caused due to their deficiency
  - Organic biomolecules: definition
  - List some important organic biomolecules namely,
    - Carbohydrate: Definition, Types, and Importance

- Lipids: Definition, Types, and Importance
- Amino acids and proteins: Definition, Types, and Importance
- Enzymes: Definition, Types, and Importance
- Nucleic acid: Definition,, composition, Types, Double helical structure of DNA, types of RNA and Importance

Unit 2: Cell biology **19hrs**

- Introduction of Cell Biology
- Introduction Of Cell Theory
- Component of Cell
- Cell wall
  - Definition
  - Layers in cell wall i.e. middle lamella, primary cell wall and secondary cell wall
  - Structures in cell wall i.e. plasmodesma and pit
  - Importances of cell wall
- Cell membrane
  - Definition
  - Listing components of cell membrane
  - Structure of phospholipids
  - Fluid mosaic model of cell membrane
  - Basic introduction to transport across membrane
  - Importances of cell membrane
- Cytoplasm
  - Definition and its composition
  - Regions in cell membrane
  - Importances of cytoplasm
  - Introduction of cell organelles and cell inclusions
- Mitochondria
  - Introduction
  - Components
  - Importances
- Plastids
  - Introduction
  - Types: leucoplast, chromoplast and chloroplast
  - Basic introduction of leucoplast and chromoplast
- Chloroplast
  - Introduction
  - Components
  - importance
- Endoplasmic reticulum (ER)
  - Introduction
  - Components
  - Types: SER and RER and their differences
  - Importance
- Golgi bodies
  - Introduction
  - Components

    - Importances
- Ribosomes
    - Introduction
    - Types and their subunits
    - Importances
- Vacuoles
    - Introduction
    - Types on the basis of contents
    - Importances
- Nucleus
    - Introduction
    - Components and their function
- Chromosomes
    - Introduction
    - Components
    - Types of chromosomes on the basis of position of centromere
    - Basic introduction of chromatid
- Cell division
    - Introduction and its significance
    - Introduction to cell cycle and its phases:
        - Interphase
        - M-phase
    - Introduction of interphase, its sub-phases with the changes that occur during them
    - Introduction of M-phase and its sub-phases: Karyokinesis and cytokinesis
    - Types of cell division:
        - Amitosis
        - Mitosis
        - Meiosis
- Introduction of amitosis, its examples with its disadvantages
- Introduction of mitosis, its phases and its importances
- Introduction of meiosis, meiosis I and meiosis II, their phases and its importances
- Differences between mitosis and meiosis

Unit 3. Diversity of life **29hrs**

- Biodiversity
    - Introduction, categories, importances and scopes of biodiversity
    - Concept of taxonomy and nomenclature: binomial nomenclature with its advantages
    - Binomial classification and its types: artificial, natural and phylogenetic
    - Taxonomic hierarchy
    - Classification of organisms,
        - Five kingdom system, its criteria, characteristics of those kingdom, its advantages, and disadvantages
- General characteristics of different plant groups
    - Introduction and listing the characteristics of plant groups:
        - Algae
        - Bryophytes
        - Pteridophytes

        - Gymnosperms
        - Angiosperms (also the differences between dicot and monocot plants)
- Algae
    - Introduction and its classification with their characteristics.
    - Spirogyra, its habitat, structure, mode of reproduction: vegetative, asexual and sexual methods, germination of zygospore
    - Economic importances of algae
- Fungi
    - Introduction and its classification with their characteristics.
    - Mucor, its habitat, structure, mode of reproduction: vegetative, asexual and sexual methods, germination of zygospore
    - Aspergillus, its habitat, structure, mode of reproduction: vegetative, asexual and sexual methods
    - Penicillium, its habitat, structure, mode of reproduction: vegetative, asexual and sexual methods
    - Mushroom, its habitat, basic structure, some basic differences between poisonous and non-poisonous mushrooms
    - Economic importances of fungi
- Bacteria
    - Introduction, characteristics with a typical structure of bacteria
    - Classifications on the basis of shape, flagella and nutrition
    - Gram staining
    - Koch's postulates
    - Bacterial growth curve
    - Economic importances of bacteria
- Cyanobacteria
    - Introduction, characteristics and cell structure
- Virus
    - Introduction with characteristics i.e. both living and non-living
    - Types of virus based on host and genetic material
    - Typical structure of bacteriophage
    - Life-cycle of bacteriophage: lytic and lysogenic
    - Effect of retrovirus
    - Some typical symptoms of viral disease in plants
    - Economic importances
- Lichens
    - Introduction, occurrence, types and economic importances

Unit 4. Physiology **16hrs**

- Introduction
    - Concept of physiology with five major processes:
        - Diffusion
        - Osmosis
        - Transpiration
        - Photosynthesis
        - Respiration
- Diffusion
    - Concepts of diffusion, rate of diffusion and diffusion pressure

- Experiment to demonstrate diffusion
- Factors affecting diffusion
- Importance with examples related to medical field

- Osmosis
  - Concept of osmosis in relation to solvent and solute
  - Some terms: water potential, solute potential, osmotic pressure, DPD, plasmolysis and deplasmolysis
  - Experiment to demonstrate osmosis by potato osmoscope and egg membrane method
  - Factors affecting osmosis
  - Importance with examples related to medical field
- Transpiration
  - Concept of transpiration and its types
  - Experiment to demonstrate transpiration by bell jar method
  - Basic structure of stomata in dicot and monocot
  - Experiment to demonstrate unequal transpiration in dorsiventral leaf
  - Factors affecting transpiration
  - Guttation and its differences with transpiration
  - Importances and disadvantages of transpiration
- Photosynthesis
  - Concept of photosynthesis and its stages: light dependent and light independent reactions (in brief)
  - Photosynthetic pigments (brief without structure)
  - Experiment to demonstrate CO_2 is necessary for photosynthesis (Moll's half leaf experiment)
  - Experiment to demonstrate chlorophyll is necessary for photosynthesis
  - Experiment to demonstrate O_2 is evolved during photosynthesis
  - Factors affecting photosynthesis
  - Photorespiration: definition, advantages and disadvantages
  - Translocation of photosynthates
  - Importances
- Respiration
  - Concept of respiration, its types and their differences
  - Experiment to demonstrate that CO_2 is evolved during aerobic respiration
  - Experiment to demonstrate that CO_2 is evolved during anaerobic respiration
  - Factors affecting respiration
  - Importances

Unit 5. Genetics **11hrs**

- Introduction
  - Concept of genetics with heredity and variation, and types of variation i.e. acquired and germinal (continuous and discontinuous)
  - Concepts of clone and offspring
  - Importances of variations
  - Some terms in genetics
- Mendel's laws
  - Statement of law of dominance, law of segregation and law of independent assortment with suitable cross, observation and conclusion

- Genetic codon
  - Introduction with properties of genetic codon
- Mutation
  - Concept of mutation, muton and mutagens
  - Types of mutation: spontaneous and induced
  - Types of mutation:
    - Gene mutation: Introduction with types i.e. substitution, frame-shift and non-sense mutation
    - Chromosomal mutation: Introduction with types: chromosomal aberration and ploidy
      - Chromosomal aberration: Introduction and its types: intrachromosomal (introduction with types: deficiency and deletion, duplication and inversion) and interchromosomal (introduction with translocation and its types)
      - Ploidy: Introduction with types: aneuploidy (introduction with types) and euploidy (introduction with types)[No need of examples of polyploidy]
- Genetic disorder
  - Introduction and its types
  - Introduction to some common genetic disorder and their symptoms like,
    - Down's syndrome
    - Edward's syndrome
    - Turner's syndrome
    - Klinefelter's syndrome
    - Autism
    - Albinism
    - Alzheimer's disease
    - Haemophilia (with inheritance pattern)

Unit 6. Environmental biology **10hrs**

- Ecology
  - Concept of ecology with some commonly used terms like ecosystem, biotic and abiotic factors, population, community, autecology and synecology.
  - Structural components of ecosystem and their concepts
    - Abiotic factors: climatic, edaphic and topographic factors
    - Biotic factors: autotrophs and heterotrophs with their types
  - Functional components of ecosystem and their concepts
    - Food chain and its types
    - Food web
    - Ecological pyramid and its types
  - Pond ecosystem: Introduction with structural and functional aspects
  - Forest ecosystem: Introduction with structural and functional aspects
- Pollution of air and water
  - Introduction of pollution, pollutants and its types and sources of pollution and its types
  - Air pollution: Introduction, causes, consequences with examples of disease, and preventive and control measures
  - Water pollution: Introduction, causes, consequences with examples of disease, and preventive and control measures

- Environmental hazards
  - Introduction of environmental hazards
  - Greenhouse effect: Introduction along with greenhouse gases and global warming, causes, consequences, preventive and control measures, and recent development
  - Ozone layer depletion: Introduction along with ozone and ozone layer, causes, consequences, preventive and control measures, and recent development
  - Acid rain: Introduction, causes, consequences, preventive and control measures, and recent development
  - Biological invasion with examples, its effects, and preventive and control measures.

Unit 7. Economic Botany **5hrs**

- 7.1. Medicinally important plants
  - Introduction with scientific name and uses of following plants
    - Mint
    - Malabar nut
    - Ginger
    - Snake roots
    - Cinnamon
    - Poppy
    - White sandalwood
    - Cardamom
    - China berry
    - Holy basil
    - Indian aloe
    - Margosa tree
    - Cordycep
    - Marsh orchid
    - Thorn apple
- General concept of ethnobotany
  - Introduction, importance and approaches (also provide some examples of plants used as medicine in local areas)

Unit 8. Biotechnology **8hrs**

- Introduction
  - Concept, branches, areas and applications of biotechnology
- Plant tissue culture
  - Concept, types and applications
- Bio fertilizer
  - Concept and some major types of biofertilizers with examples
- Genetic engineering
  - Concept with an example of insulin, applications and possible dangers of genetic engineering
  - Basic concepts of DNA fingerprinting and DNA profiling
- Fermentation technology
  - Concept, types of fermentation and applications of fermentation technology

References Books

- Sharma, O.P. and Agrawal, V.K.S., Cell biology, Genetics, Evolution and Ecology.

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- Saxena A.L. and Sarabhai, R.P., A Textbook of Botany, Batan Prakashan Mandor.
- Textbook of Botany, Akshav publication.
- Bilgrami, K.S., Shrivastava, L.M., and Shremali, J.L., Fundamentals of Botany, Vani Educational Books.
- Dey, N.C., and Dey, T.K., Medical Bacteriology, Messers Allied Agency.
- Sharma, D.P., Hill's Economic Botany, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
- Winchester, A.M., Biology and Its Relation to Mankind 3rd ed.
- Singh,V., and Sinha, S., Cytogenetics.
- Man Dhar, C. L., Introduction to Plant Virus, S. Chand and Company Ltd., Delhi.
- NCERT Biology.

Final written exam marking scheme

Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Unit Hours	**7**	**19**	**29**	**16**	**11**	**10**	**5**	**8**	105
Marks	**5**	**15**	**22**	**12**	**8**	**8**	**4**	**6**	80

Practical 70 hours

- Differentiate between simple and compound microscope.
- List different parts of a compound microscope and their uses.
- Calculate the magnifying power of a compound microscope in different combinations of objective lens/eye-piece lens.
- Demonstration of handling a compound microscope.
- Draw a well labeled diagram of a compound microscope by observation.
- List the apparatus required to prepare temporary slides of plant cells.
- List the chemicals required to prepare temporary slides of plant cells.
- List the function of safranine and glycerine.
- Demonstration of method of slide preparation from the epidermal layer of onion scale, Tradescantia leaf, Hydrilla leaf, Geranium leaf.
- Compare the cell structure of Onion scale, Tradescantia leaf, Hydrilla leaf, and Geranium leaf.
- List the characteristics of the cellular structure of each.
- Demonstration of method to peel out the epidermal layer in each case.
- Use glycerin instead of water when mounting a temporary slide.'
- Draw diagrams of each by observing temporary slides under the microscope

2.2: Different stages of mitosis and meiosis divisions from permanent slides.

- Demonstration of nuclear changes in each stage of mitosis using charts.
- Give the examples of mitotic cell division in plants.
- Demonstration of nuclear changes in each stage of meiosis using charts.
- Give the examples of cells where meiotic cell division occurs.
- Draw figures of mitosis and meiosis by observing under the microscope

Unit 3: Biodiversity

3.1: Monera

- Perform the experiment of Gram staining.
- Differentiate Gram positive bacteria from Gram negative bacteria.
- Draw diagrams of bacteria by observing under the microscope.
- Observe the vegetative structure of *Nostoc*.
- Draw figures of these as observed under the microscope.

3.2: Vegetative structure and reproductive stages of Spirogyra

- Observe the vegetative structures of Spirogyra.
- Observe the reproductive stages of Spirogyra.
- Draw figures of these as observed under the microscope.
- Mention the systematic position of Spirogyra.

3.3: Vegetative structure and reproduction of selected fungi

- Observe the vegetative structure and reproductive stages of:
- Mucor
- Aspergillus
- Penicillium
- Differentiate between poisonous mushrooms and edible mushrooms.
- Draw figures of both poisonous and nonpoisonous mushrooms.

3.4: Bryophytes, Pteridophytes, Gymnosperms and Angiosperms

- List the morphological features of bryophytes and pteridophytes, and differentiate between them.
- List the morphological features of gymnosperms and angiosperms and differentiate between them.
- Differentiate dicot plants from monocot plants.
- Observe the parts of at least two flowers:
  - Calyx
  - Corolla
  - Androecium
  - Gynoecium
- Draw figures of each of the plants which are observed during the lab experience.

Unit 4: Plant physiology

4.1: Demonstration of physiological experiments (diffusion, osmosis, transpiration, photosynthesis and respiration)

- Demonstrate the procedure of each physiologic experiment, observation, result and conclusion with precautions.
- Draw the necessary figures to show the demonstration of each experiment.

Unit 5: Ecology

5.1: Ecosystem and Adaptation features of selected plants

- Observation of aquatic ecosystem during field visit.

Unit 6: Genetics

6.1: Structure of DNA

- Draw a figure of the Watson and Crick model of DNA by observation of a model

6.2: Demonstration of some common genetic disorders using charts

- Down's Syndrome
- Edward's Syndrome
- Albinism
- Haemophilia
- Autism