

**IV Semester/ Botany Core Course – 4**  
**Plant Physiology and Metabolism**  
(Total hours of teaching – 60 @ 04 Hrs./Week)

**Theory:**

**Learning outcomes:**

On successful completion of this course, the students will be able to;

- Comprehend the importance of water in plant life and mechanisms for transport of water and solutes in plants.
- Evaluate the role of minerals in plant nutrition and their deficiency symptoms.
- Interpret the role of enzymes in plant metabolism.
- Critically understand the light reactions and carbon assimilation processes responsible for synthesis of food in plants.
- Analyze the biochemical reactions in relation to Nitrogen and lipid metabolisms.
- Evaluate the physiological factors that regulate growth and development in plants.
- Examine the role of light on flowering and explain physiology of plants under stress conditions.

**Unit – 1: Plant-Water relations**

**10 Hrs.**

1. Importance of water to plant life, physical properties of water, diffusion, imbibition, osmosis. water potential, osmotic potential, pressure potential.
2. Absorption and lateral transport of water; Ascent of sap
3. Transpiration: stomata structure and mechanism of stomatal movements ( $K^+$  ion flux).
4. Mechanism of phloem transport; source-sink relationships.

**Unit – 2: Mineral nutrition, Enzymes and Respiration**

**14 Hrs.**

1. Essential macro and micro mineral nutrients and their role in plants; symptoms of mineral deficiency
2. Absorption of mineral ions; passive and active processes.
3. Characteristics, nomenclature and classification of Enzymes. Mechanism of enzyme action, enzyme kinetics.

4. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle; electron transport system, mechanism of oxidative phosphorylation, Pentose Phosphate Pathway (HMP shunt).

**Unit – 3: Photosynthesis and Photorespiration**

**12 Hrs.**

1. Photosynthesis: Photosynthetic pigments, absorption and action spectra; Red drop and Emerson enhancement effect
2. Concept of two photosystems; mechanism of photosynthetic electron transport and evolution of oxygen; photophosphorylation
3. Carbon assimilation pathways (C<sub>3</sub>, C<sub>4</sub> and CAM);
4. Photorespiration - C<sub>2</sub> pathway

**Unit – 4: Nitrogen and lipid metabolism**

**12 Hrs.**

1. Nitrogen metabolism: Biological nitrogen fixation – asymbiotic and symbiotic nitrogen fixing organisms. Nitrogenase enzyme system.
2. Lipid metabolism: Classification of Plant lipids, saturated and unsaturated fatty acids.
3. Anabolism of triglycerides,  $\beta$ -oxidation of fatty acids, Glyoxylate cycle.

**Unit – 5: Plant growth - development and stress physiology**

**12 Hrs.**

1. Growth and Development: Definition, phases and kinetics of growth.
  2. Physiological effects of Plant Growth Regulators (PGRs) - auxins, gibberellins, cytokinins, ABA, ethylene and brassinosteroids.
  3. Physiology of flowering: Photoperiodism, role of phytochrome in flowering.
  4. Seed germination and senescence; physiological changes.
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**Practical Syllabus of Botany Core Course – 4 / Semester – IV**

**Plant Physiology and Metabolism**

(Total hours of laboratory exercises 30 Hrs. @ 02 Hrs. /Week)

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**Course outcomes:** On successful completion of this practical course, students shall be able to:

1. Conduct lab and field experiments pertaining to Plant Physiology, that is, biophysical and biochemical processes using related glassware, equipment, chemicals and plant material.
2. Estimate the quantities and qualitative expressions using experimental results and calculations
3. Demonstrate the factors responsible for growth and development in plants.

**Practical Syllabus**

1. Determination of osmotic potential of plant cell sap by plasmolytic method using *Rhoeo/ Tradescantia* leaves.
2. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
3. Determination of rate of transpiration using Cobalt chloride method / Ganong's potometer (at least for a dicot and a monocot).
4. Effect of Temperature on membrane permeability by colorimetric method.
5. Study of mineral deficiency symptoms using plant material/photographs.
6. Demonstration of amylase enzyme activity and study the effect of substrate and Enzyme concentration.
7. Separation of chloroplast pigments using paper chromatography technique.
8. Demonstration of Polyphenol oxidase enzyme activity (Potato tuber or Apple fruit)
9. Anatomy of C<sub>3</sub>, C<sub>4</sub> and CAM leaves

10. Estimation of protein by biuret method/Lowry method
11. Minor experiments – Osmosis, Arc-auxonometer, ascent of sap through xylem, cytoplasmic streaming.

# Model Question Paper for Practical Examination

Semester – IV/ Botany Core Course – 4

## Plant Physiology and Metabolism

Max. Time: 3 Hrs.

Max. Marks: 50

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1. Conduct the experiment 'A' (Major experiment), write aim, principle, material and apparatus/equipment, procedure, tabulate results and make conclusion. 20 M
2. Demonstrate the experiment 'B' (Minor experiment), write the principle, procedure and give inference. 10 M
3. Identify the following with apt reasons. 3 x 4 = 12 M
  - C. Plant water relations / Mineral nutrition
  - D. Plant metabolism
  - E. Plant growth and development
4. Record + Viva-voce 5 + 3 = 8 M

**IV Semester / Botany Core Course –5**  
**Cell Biology, Genetics and Plant Breeding**  
(Total hours of teaching – 60 @ 04 Hrs./Week)

**Theory:**

**Learning outcomes:**

On successful completion of this course, the students will be able to:

- Distinguish prokaryotic and eukaryotic cells and design the model of a cell.
- Explain the organization of a eukaryotic chromosome and the structure of genetic material.
- Demonstrate techniques to observe the cell and its components under a microscope.
- Discuss the basics of Mendelian genetics, its variations and interpret inheritance of traits in living beings.
- Elucidate the role of extra-chromosomal genetic material for inheritance of characters.
- Evaluate the structure, function and regulation of genetic material.
- Understand the application of principles and modern techniques in plant breeding.
- Explain the procedures of selection and hybridization for improvement of crops.

**Unit – 1: The Cell**

**12 Hrs.**

1. Cell theory; prokaryotic vs eukaryotic cell; animal vs plant cell; a brief account on ultra-structure of a plant cell.
2. Ultra-structure of cell wall.
3. Ultra-structure of plasma membrane and various theories on its organization.
4. Polymorphic cell organelles (Plastids); ultrastructure of chloroplast. Plastid DNA.

**Unit – 2: Chromosomes**

**12 Hrs.**

1. Prokaryotic vs eukaryotic chromosome. Morphology of a eukaryotic chromosome.
2. Euchromatin and Heterochromatin; Karyotype and ideogram.
3. Brief account of chromosomal aberrations - structural and numerical changes
4. Organization of DNA in a chromosome (solenoid and nucleosome models).

**Unit – 3: Mendelian and Non-Mendelian genetics****14Hrs.**

1. Mendel's laws of inheritance. Incomplete dominance and co-dominance; Multiple allelism.
2. Complementary, supplementary and duplicate gene interactions (plant based examples are to be dealt).
3. A brief account of linkage and crossing over; Chromosomal mapping - 2 point and 3 point test cross.
4. Concept of maternal inheritance (Corren's experiment on *Mirabilis jalapa*); Mitochondrial DNA.

**Unit – 4: Structure and functions of DNA****12 Hrs.**

1. Watson and Crick model of DNA. Brief account on DNA Replication (Semi-conservative method).
2. Brief account on Transcription, types and functions of RNA. Gene concept and genetic code and Translation.
3. Regulation of gene expression in prokaryotes - Lac Operon.

**Unit – 5: Plant Breeding****12 Hrs.**

1. Plant Breeding and its scope; Genetic basis for plant breeding. Plant Introduction and acclimatization.
  2. Definition, procedure; applications and uses; advantages and limitations of : (a) Mass selection, (b) Pure line selection and (c) Clonal selection.
  3. Hybridization – schemes, and technique; Heterosis (hybrid vigour).
  4. A brief account on Molecular breeding – DNA markers in plant breeding. RAPD, RFLP.
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**Practical Syllabus of Botany Core Course – 5/IVSemester**

**Cell Biology, Genetics and Plant Breeding**

(Total hours of laboratory exercises 30 Hrs. @ 02 Hrs. /Week)

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**Course Outcomes:** After successful completion of this practical course the student shall be able to:

1. Show the understanding of techniques of demonstrating Mitosis and Meiosis in the laboratory and identify different stages of cell division.
2. Identify and explain with diagram the cellular parts of a cell from a model or picture and prepare models
3. Solve the problems related to crosses and gene interactions.
4. Demonstrate plant breeding techniques such as emasculation and bagging

**Practical Syllabus:**

1. Study of ultra structure of plant cell and its organelles using Electron microscopic Photographs/models.
2. Demonstration of Mitosis in *Allium cepa*/*Aloe vera* roots using squash technique; observation of various stages of mitosis in permanent slides.
4. Demonstration of Meiosis in P.M.C.s of *Allium cepa* flower buds using squash technique; observation of various stages of meiosis in permanent slides.
4. Study of structure of DNA and RNA molecules using models.
5. Solving problems monohybrid, dihybrid, back and test crosses.
6. Solving problems on gene interactions (at least one problem for each of the gene interactions in the syllabus).
7. Chromosome mapping using 3- point test cross data.
8. Demonstration of emasculation, bagging, artificial pollination techniques for hybridization.



**Model paper for Practical Examination**  
Semester-IV / Botany Core Course – 5  
**Cell Biology, Genetics and Plant Breeding**

Max. Time: 3 Hrs.

Max. Marks: 50

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1. Make a cytological preparation of given material 'A' (mitosis or meiosis in Onion) by squash technique, report any two stages, draw labeled diagrams and write the reasons.

15 M

2. Solve the given Genetic problem (Dihybrid cross/ Interaction of genes/ 3-point test cross) 'B' and write the conclusions.

15 M

3. Identify the following and justify with apt reasons.

3 x 4 = 12 M

C. Cell Biology (Cell organelle)

D. Genetics (DNA/RNA)

E. Plant Breeding

4. Record + Viva-voce

5 + 3 = 8 M