

Course Code	Course Name	Credits
26BY502	ADVANCED PLANT PHYSIOLOGY	04

Course Objectives

- Explain plant water relations and transport mechanisms.
- Describe pigments, secondary metabolites, and plant defense roles.
- Analyze photosynthesis, respiration, and nitrogen metabolism pathways.
- Evaluate hormone functions, photoperiodism, and stress responses.

Learning Outcomes

Upon successful completion of this course, it is intended that a student will be able to:

- Measure water potential components and explain aquaporin roles.
- Identify pigment functions and secondary metabolite defense mechanisms.
- Compare C3/C4/CAM photosynthesis and calculate photorespiration rates.
- Design hormone application experiments for growth/stress regulation.

Unit 1 - Introduction to Plant Physiology and Plant–Water Relationship (12 Hrs.)

Introduction to plant physiology. Water and its role in plants. Osmosis and water potential of plant cells. Aquaporins and membrane transport proteins involved in transport across membranes. Solute transport and photo-assimilate translocation: uptake, transport, and translocation of water, ions, solutes, and macromolecules from soil through cells, across membranes, and through xylem and phloem. Transpiration and factors affecting it. Mechanisms of loading and unloading of photo-assimilates, and related theories.

Unit 2 – Plant Pigments, Secondary Metabolites and Plant Defence (12 Hrs.)

Plant pigments – structure, properties and functions of chlorophylls, carotenoids, xanthophylls and lycopene. Secondary metabolites – terpenoids, phenolic compounds, and nitrogen-containing compounds. Flavonoids, alkaloids, and their physiological roles. Role of secondary metabolites in plant defence mechanisms and plant–environment interactions.

Unit 3 - Photosynthesis, Respiration, and Nitrogen Metabolism (12 Hrs.)

Photosynthesis: light harvesting complexes, mechanisms of electron transport, and photoinhibition and photoprotective mechanisms. CO₂ fixation pathways – C₃, C₄, and CAM pathways. Photorespiratory pathway. Respiration: Glycolysis, citric acid cycle, plant mitochondrial electron transport and ATP synthesis, alternative oxidase pathway. Malate shuttle Pathway. Nitrogen metabolism: nitrate and ammonium assimilation and amino acid biosynthesis. Sulfate assimilation.

Unit 4 – Plant Growth Regulators and Photoperiodism (12 Hrs.)

Plant Growth Regulators: biosynthesis, storage, transport, physiological effects, and mechanisms of action. Signal transduction pathways in plant hormone responses. Photoreceptors: structure and function of phytochromes, cryptochromes, phototropins, and UVR8. Photoperiodism and biological clocks – circadian rhythms. Floral induction and development. Seed development, germination, and vernalization.

Unit 5 - Stress Physiology (12 Hrs.)

Abiotic and biotic stress factors. Oxidative stress and reactive oxygen species (ROS). Role of antioxidant scavenging systems, including superoxide dismutase and catalase. Responses of plants to biotic (pathogens and insects) and abiotic (water, temperature, heavy metals, and salt) stresses. Mechanisms of resistance and tolerance. Senescence and aging.

Reference Books:

1. Taiz, L., Møller, I. M., Murphy, A., & Zeiger, E. (2022). *Plant Physiology and Development* (7th ed.). Oxford University Press.
2. Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). *Biochemistry and Molecular Biology of Plants* (2nd ed.). Wiley-Blackwell.
3. Jain, V. K. (2025). *Fundamentals of Plant Physiology* (21st ed.). S. Chand Publishing.
4. Hopkins, W. G., & Hüner, N. P. A. (2014). *Introduction to Plant Physiology* (4th ed.). Wiley.
5. Salisbury, F. B., & Ross, C. W. (1992). *Plant Physiology* (4th ed.).