Syllabus

BOT-75T-301- Plant Biochemistry and Physiology

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	BOT-75T-301	Plant Biochemistry and Physiology			7	4
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	4	0	4	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	BOT-75T-301 Plant Biochemistry and Physiology	CA- 1Hrs EoSE -3Hrs	CA- 20 Marks EoSE- 80 Marks	CA- 08 Marks EoSE-32 Marks

Objectives of the Course:	1. Understand the classification, structure, and function of major biomolecules (proteins, carbohydrates, lipids, nucleic acids). 2. Explain the nature and types of biological bonds such as glycosidic, peptide, and phosphodiester bonds. 3. Describe enzyme classification, structure, and factors affecting their activity. 4. Illustrate mechanisms of water and nutrient transport in plants, including osmosis, transpiration, and pressure flow. 5. Identify essential macro- and micronutrients in plants and symptoms of their deficiencies. 6. Analyze key processes of photosynthesis and respiration, including electron transport and energy pathways. 7. Interpret plant growth and development stages, hormonal regulation, and responses to environmental cues like photoperiodism and vernalisation

Unit – I

Biomolecules: Nomenclature, classification, importance, molecular structure and function of Proteins (primary, secondary, tertiary, conjugated), Carbohydrates (monosaccharides, disaccharides, polysaccharides), Lipids (saturated and unsaturated), General account of Secondary Metabolites in plants.

Nature of Bond: Glycosidic linkage, Peptide bond, Phosphodiester bonds, Alpha and Beta oxidation.

Enzymes: Nomenclature, classification, Structure, mechanism of action, factors affecting enzymeactiviy

(15 lectures)

Unit –II

Transport in Plants: Facilitated diffusion, active absorption, Passive and Active Transport (uniport, co-transport, symport, antiport), Concept and Mechanism of Water Potential, Osmosis, Plasmolysis, Ascent of Sap, Root Pressure, Guttation, Transpiration (Pressure Flow Hypothesis).

Mineral Nutrition and translocation: Macro- and Micro nutrients in Plants and deficiency symptoms, Translocation of Solutes, Phloem transport, Source-sink relationship, Factors affecting translocation of nutrients, Nitrogen Metabolism, Biological Nitrogen Fixation, Nodule formation.

(15 lectures)

Unit –III

Photosynthesis: Pigments, Photosynthetic apparatus, Light reaction, PSI, PSII, Cyclic and Non-cyclic Photo-phosphorylation, Calvin cycle, C4 and CAM Pathway, Photorespiration, Factors affecting Photosynthesis.

Respiration: Aerobic and Anaerobic respiration, Glycolysis, Tricarboxylic Acid Cycle,Electron Transport System (ETS) and Oxidative Phosphorylation, Pentose Phosphate Pathway, Respiratory Quotient (RQ).

(15 lectures)

Unit-IV

Growth and Development: Phases of Growth, Differentiation, Dedifferentiation and Redifferentiation, Characteristics, discovery and Physiological effects of Plant Growth Regulators: Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic Acid. Concept, Physiology and mechanism of Photoperiodism and Vernalisation. Florigen concept, Seed Dormancy.

(15 lectures)

Suggested Books and References –

1. Cox, M.M. and Nelson DL (2004) Lehniger Principle of Biochemistry (Third Edition) MacMillan Worth Publishers.
2. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons.U.S.A. 4th edition.
3. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
4. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
5. Srivastava, L. M. 2002. Plant Growth and Development: Hormones and Environment (1st edition). Academic Press, USA.
6. Verma,S. K., Textbook of Plant Physiology, S.Chand & Company.

Suggested E-resources:

1. https://docs.google.com/file/d/0B_FBtJyzk2ZNLVNuZFp6S3E2YU0/edit?resourcekey=0-_NxnSCZjwDIn3VDCh0rfgSQ
2. https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
3. https://archive.org/details/plant-physiology-and-bio-chemistry/page/18/mode/2up

Course Learning Outcomes:

At the completion of the course, the student would be able to:

1. Identify and classify major biomolecules such as carbohydrates, proteins, lipids, and nucleic acids, and explain their structure and function in biological systems.
2. Explain the nature and significance of biochemical bonds (glycosidic, peptide, phosphodiester) and key metabolic processes like alpha and beta oxidation.
3. Demonstrate an understanding of enzymes, including their classification, structure, mechanism of action, and the factors influencing their activity.
4. Describe the mechanisms of water and nutrient transport in plants and relate them to physiological processes like osmosis, transpiration, and root pressure.
5. Interpret the role of macro- and micronutrients in plant growth and diagnose common nutrient deficiency symptoms.
6. Explain the processes of nitrogen metabolism and biological nitrogen fixation, and evaluate their importance in plant productivity and sustainable agriculture.
7. Illustrate the light and dark reactions of photosynthesis and compare cyclic and non-cyclic photophosphorylation, including factors affecting the process.
8. Describe the pathways of respiration (aerobic and anaerobic), glycolysis, TCA cycle, ETS, and pentose phosphate pathway, and assess their role in energy production.
9. Apply the concepts of photoperiodism and vernalization in understanding flowering responses and seasonal adaptations in plants.

Syllabus
BOT-75P-302- Botany Lab-V

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	BOT-75P-302	Botany Lab-V			7	2
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	0	2	2	Practical	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	BOT-75P-302 Botany Lab-V	CA- 1Hrs EoSE -4Hrs	CA- 10 Marks EoSE- 40 Marks	CA- 04 Marks EoSE-16 Marks

Objectives of the Course:	To provide students with hands-on understanding of fundamental plant biochemical and physiological processes. The course focuses on experiments related to membrane permeability, osmosis, transpiration, photosynthesis, respiration, enzyme activity, pigment and amino acid separation, and seed germination. Through practical exercises, students will develop skills to analyze plant responses to environmental factors and gain insights into the functional mechanisms underlying plant growth and metabolism.

1. To study the effect of temperature on permeability of Plasma Membrane
2. To determine osmotic potential of Vascular Sap using Plasmolytic method.
3. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
4. To separate chlorophyll pigments using paper chromatography.
5. To separate chlorophyll pigments using solvent method.
6. Separation of amino acids by paper chromatography.
7. To demonstrate enzyme activity- Catalase, amylase.
8. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
9. Mohl's Half Leaf experiment
10. To study the effect of light intensity and bicarbonate on O2 evolution in photosynthesis.
11. Calculate Respiration Quotient (RQ) of different substrates by Ganong's Respirometer.
12. To study the phenomenon of seed germination (effect of light).
13. Demonstration of Potato osmoscope, Aerobic and Anaerobic respiration, Rate of Transpiration, Arc Auxanometer.

Syllabus

BOT-76T- 303 - Plant Morphology, Anatomy and Embryology

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	BOT-76T- 303	Plant Morphology, Anatomy and Embryology			7	4
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	4	0	4	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	BOT-76T- 303 Plant Morphology, Anatomy and Embryology	CA- 1Hrs EoSE -3Hrs	CA- 20 Marks EoSE- 80 Marks	CA- 08 Marks EoSE-32 Marks

Objectives of the Course:	1. To understand morphology and anatomy of flowering plants and its practical and experimental aspects. 2. To understand the modifications of root, stem, leaves and their significance in plant life. 3. To make the students learn about the concepts of secondary growth, abnormal secondary growth and wood formation. 4. To provide knowledge of the internal structure and functional organization of higher plants 5. To provide basic knowledge of male and female plant reproductive structures To provide detailed understanding of plant embryology and seed structure

Unit 1

Morphology and the Tissue System

Basic body plan of a typical dicot and a monocot plant; diversity of plants on the basis of habit, habitat, longevity, and body forms

Tissues: Structure and function- Meristematic Tissues, Permanent Tissues: Simple Tissues and Complex Tissues; Tissue systems: Epidermal Tissue System, Ground Tissue System and Vascular Tissue System Organizational theories of Shoot apical meristem (SAM) and Root apical meristem (RAM)

(15 hours)

Unit 2

Growth in plants

Anatomy of primary structures of root, stem and leaf of dicot and monocot plants.
Secondary Growth: Structure and function of vascular cambium, secondary growth in stem and roots; Annual Rings: Spring wood and autumn wood, Heartwood and sapwood, tyloses, Porous and non-porous wood Structure and function of cork cambium, Periderm Anomalous growth in *Nyctanthus*, *Boerhaavia*, *Bignonia,Salvadora, Dracaena* and *Leptadenia*

(15 hours)

Unit 3

Embryology I

Angiosperm flower, Structure of anther, microsporogenesis, development of male gametophyte, Structure of pistil, structure of ovule and its types, megasporogenesis, development and types of female gametophyte

(15 hours)

Unit 4

Embryology II

Pollination and double fertilization. Endosperm: structure and types, embryo development in dicotyledons and monocotyledons,Seed structure (monocot and dicot), specialized structures related to seed, seed dispersal mechanisms.Polyembryony, apomixes **(15 hours)**

Suggested Books and References –

1. Cutter E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part II Organs. Edward Arnold, London.
2. Esau K. 1977. Anatomy of seed plants, 2nd edition, John Wiley and Sons New York.
3. Fahn, A. 1974. Plant anatomy 2nd edition. Pergamon press. Oxford.
4. Crang, R. et al, 2018. Plant anatomy: a concept-based approach to the structure of seed plants.
5. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
7. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
8. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
9. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
10. Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands

Suggested E-resources:

1. https://nptel.ac.in/courses/102107075

Course Learning Outcomes:

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

- Apply knowledge of plant anatomy to identify plant samples and interpret their adaptive significance
- Understand on the organization of tissues and tissue systems in plants.
- Analyze and compare vascular bundles and secondary growth in monocot and dicot plants
- Identify and analyze anomalous patterns of secondary growth in various plants.
- Understand, evaluate and analyze the wood anatomy and climate studies
- Identify and compare the different reproductive organs of angiosperms and analyze the diversity of their structures.
- Understand the process of double fertilization and its significance in flowering plants
- Illustrate and interpret various aspects of embryology.

Syllabus

BOT-76P-304 - Botany Lab-VI

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	BOT-76P-304	Botany Lab-VI			7	2
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	0	2	2	Practical	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	BOT-76P-304 Botany Lab-VI	CA- 1Hrs EoSE -4Hrs	CA- 10 Marks EoSE- 40 Marks	CA- 04 Marks EoSE-16 Marks

Objectives of the Course:	To provide students with practical knowledge and skills in understanding the structural organization, internal anatomy, and developmental processes of plants. The course aims to familiarize students with root, stem, leaf, and reproductive structures of dicots and monocots, anomalous secondary growth, pollen biology, ovule and embryo development, endosperm formation, and seed dispersal mechanisms. Through microscopic studies, slide observations, and specimen analysis, students will develop the ability to correlate plant form, function, and reproduction.

1. Study of Tissue organization in root and shoot apices using permanent slides
2. Study of Anatomy of dicot and monocot root
3. Study of Anatomy of dicot and monocot stem
4. Study of Anatomy of dicot and monocot leaf
5. Study of Anomalous secondary growth in stems of *Nyctanthus, Boerhaavia, Bignonia, Salvadora, Dracaena*and *Leptadenia*
6. Study of ovule using temporary/ permanent slides/photographs
7. Study of T. S. of anther, to study the wall layers and pollen sac with pollen grains
8. Study of pollen germination and pollen viability
9. Measurement of pollen size using micrometry
10. Study of types of placentation in angiosperms
11. Study of structure of endosperm (nuclear and cellular) using permanent slides / Photographs.
12. Study of developmental stages of dicot and monocot embryos using permanent slides / photographs
13. Study of seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens)
14. Any other exercise related to syllabus