

DISCIPLINE SPECIFIC ELECTIVE COURSE –DSE-17

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant Signaling and Behaviour (BS-DSE-17)	4	2		2	Class XII pass with Biology	NA

Learning Objectives:

Plant physiology is a fascinating field of plant sciences and gives the students an insight into the structure - function integration in plants. The complex interactions of the plant with the environmental and edaphic factors form a major portion of plant physiological studies. How plants respond to maintain their homeostasis in the changing environmental conditions is one of the most recent fields of investigation in plant stress physiology. The course aims to familiarize the students with this important subject alongwith the signaling pathways associated with physiological phenomena.

Course Learning Outcomes:

On successful completion of the course, a student will:

- Understand the complex regulation of phenomena of signal transduction in combating stress etc.
- Learn to design experiments dealing with signal transduction in the plant cell and analyse papers on signaling pathways.
- Understand various aspects of stress physiology such as physiological and molecular basis of abiotic stress tolerance in plants
- Gain the knowledge in stress physiology that will be useful for developing climate resilient genotypes for sustainable crop production.

3. Course Contents

3.1 THEORY

Credits: 2

Total Hours: 30

Unit 1: Signal transduction

No. of Hours: 6

Brief historical account of signaling in plants; Concept of signal transduction; Signal perception at plasma membrane (characteristic features of membrane receptors, receptor kinases), stress sensing mechanism: concept of second messengers like calcium, calmodulin, lipid signaling molecules, mitogen-activated protein (MAP) kinase cascade, cyclic nucleotides.

Unit-2: Abiotic stress

No. of Hours: 6

Introduction to stress: definition; acclimation and adaptation; Factors causing plant stress- abiotic and biotic; Abiotic stress- strategies and mechanisms, Physiological and cellular responses to drought stress, salinity stress, temperature stress (freezing and heat); developmental and physiological mechanisms that protect plants against environmental stress

Unit 3: Lipid Metabolism and Nitrogen metabolism

No. of Hours: 13

Introduction to Plant Lipids; Biosynthesis and breakdown of Triglycerides; Oxidation of Fatty acids; Glyoxylate cycle; Gluconeogenesis and its role in mobilisation of lipids during seed germination; Biological Nitrogen fixation by free living organisms and in symbiotic association (nodulation, signals between host and symbiont, genetics of fixation); structure and function of enzyme Nitrogenase; Nitrate assimilation: Nitrate and Nitrite reductase; ammonia assimilation GS, GOGAT, GDH; reductive amination and transamination.

Unit 4: Plant Movements

No. of Hours: 5

Tropic Movements (Phototropism, Gravitropism, Chemotropism); Nastic Movements (Epinasty, Hyponasty, Nyctinasty, Thigmonasty); Circadian rhythms; Turgor and growth mediated movement; prey- driven movements (Insectivorous plants)

3.2 PRACTICAL

Credit: 2

Total Hours: 60

1. To study the activity of nitrate reductase in leaves of two plant sources.
2. To study the activity of enzyme urease and the effect of substrate concentration on its activity.
3. To estimate the peroxidase activity in seedlings in the presence and absence of salt stress.
4. To study the activity of enzyme catalase in two or more plant sources.
5. To study the effect of pH/enzyme concentration on the activity of enzyme catalase.
6. To study the activity of enzyme superoxide dismutase in the absence and presence of salt stress.
7. To study the effect of stress (salt/water/heavy metal) on seed germination and seedling growth.
8. To study the activity of Lipase and its role in mobilisation of lipids during seed germination.
9. To estimate proline content in the seeds germinated in the presence and absence of salt/heavy metal.

3.3 Essential readings:

1. Hopkins, W.G. and Huner, A. (2008) *Introduction to Plant Physiology*. John Wiley and Sons. U.S.A. 4th edition.
2. Kochhar, S.L. and Gujral, S.K. (2011) *Comprehensive Practical Plant Physiology*. Macmillan India Ltd, New Delhi.
3. Noggle, G.R. and Fritz, G.J. (1986) *Introduction to Plant Physiology*, 2nd Ed. Prentice-Hall of India Ltd., New Delhi.
4. Salisbury, F.B. and Ross, C.W. (2005) *Plant Physiology*, Thomson Wadsworth, 4th edition.
5. Taiz, L., Zeiger, E. Moller, I.M. and Murphy, A (2015). *Plant Physiology and Development*, Sinauer Associates Inc. U.S.A 6th edition.

Additional readings

1. Bhatla, S.C. and Lal M.A. (2018). *Plant Physiology, Development and Metabolism*, Springer Nature, 1st edition.
2. Lodish (2021) *Molecular Cell Biology*.

4. Teaching Learning Process and Assessment Methods

Facilitating the achievement of Course Learning Outcomes**

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1	Students will learn about the concept of signal perception and transduction. Students will also learn about the various kinds of second messengers.	Teaching using chalk and board; Assignments given to the students followed by discussions in the class; Appropriate videos to supplement the theoretical concepts.	Problems will be assigned to students for understanding various important concepts.
2	Students will gain insights into various abiotic stresses affecting plant growth and the physiological and developmental mechanisms to protect plants.	Chalk and board teaching method; illustrations and flow charts through e-presentations; understanding the plant signaling pathways through latest research and review articles.	Group discussions in the class. Class tests will be conducted for internal assessment. Practicals designed in such a way so as to reinforce the concepts learnt in theory.
3	Students will be familiarized with different types of lipids and its biosynthesis and breakdown in plants.	Teaching using chalk and board; Oral discussion sessions in the class; Theoretical concepts to be supplemented with projects; computer animations of physiological phenomena.	Assessment on the basis of practicals performed; Questions will be asked in the class
4	Students will learn about the mechanism and the genetics of nitrogen metabolism and assimilation of ammonia.	Teaching using chalk and board; Oral discussion sessions in the class. Powerpoint presentations may be used for explaining certain topics.	Class tests will be conducted for internal assessment. Oral questions will be asked in the class.

5	Students will gain insight into the different tropic and nastic movement in plants. They will also learn about the growth and turgor-mediated movements.	Teaching using chalk and board; Assignments given to the students followed by discussions in the class; Appropriate videos to supplement the theoretical concepts.	Group discussions in the class. Class tests will be conducted for internal assessment.
---	--	--	--

(Assessment tasks enlisted here are indicative in nature)**

5. Keywords:

Signal transduction, abiotic stress, nitrogen fixation, fatty acid oxidation, tropism, nastic movement.