

THEORY:**Introduction of the Course:**

The course is organized to cover physiological processes involved in plant interaction with the environment, including water relations, gas exchange, photosynthesis, respiration, energy balance, mineral nutrition, responses to the environment and plant hormones. It is generally aimed to familiarize students with the ecological concepts focusing on biotic and abiotic factors involved in establishing plant communities.

Course Objectives:

The course is designed:

1. To provide an adequate knowledge about basic concepts of plant physiology.
2. To understand abiotic and biotic factors of the environment and interactions of plants with these factors

Contents:**1. Plant Physiology:**

1.1. Water Relations: Water Potential, Osmotic Potential, Pressure Potential, Matric Potential; Absorption and Translocation of Water.

1.2. Mineral Nutrition: Soil as a Source of Minerals, Passive and Active Transport of Nutrients, Essential Mineral Elements, Role and Deficiency Symptoms of Macronutrients.

1.3. Photosynthesis: Introduction, Mechanism of Oxygenic and Non-Oxygenic Photosynthesis: Light Reactions (Electron Transport and Photophosphorylation) and Dark Reactions (Calvin Cycle), Differences between C₂ and C₃ Plants, Factors affecting Photosynthesis.

1.4. Respiration: Definition and Respiratory Substrates, Mechanism of Glycolysis, Krebs Cycle, Electron Transport and Oxidative Phosphorylation, Anaerobic Respiration, Energy Balance in Aerobic and Anaerobic Respiration.

1.5. Growth: Definition; Role of Auxins, Cytokinins, Gibberellins, Abscisic Acid and Ethylene in controlling Growth.

1.6. Photoperiodism: Definition, Historical Background, Classification of Plants based on Photoperiodic Response, Role of Phytochromes, and Hormones and Metabolites in photoperiodism.

1.7. Dormancy: Definition and Causes of Seed and Bud Dormancy; Methods of breaking Seed Dormancy, Physiological processes during Seed Germination.

1.8. Plant Movements: Classification, Phototropism, Nastic Movements, Gravitropism and their Mechanisms

2. Plant Ecology:

2.1. Introduction: Aims and applications of Ecology. Branches of Ecology

2.2 Soil: Physical and chemical properties of soil (soil Formation, soil texture, pH, EC, soil organic matter, soil organisms) and their relationships to plants. Fields and water holding capacity.

2.3. Light and Temperature: Quality, diurnal and seasonal fluctuations. Factors affecting variations in light and temperature. Ecophysiological responses of plants to light and temperature.

2.4. Water: Water as an ecological factor, distribution and significance. Adaptations of plants in relation to water i.e. Characteristics of Hydrophytes and xerophytes.

2.5. Wind, fire and Biotic Factors: Impact and importance as ecological factors.

2.6. Population Ecosystem

2.7. Ecological hierarchy: Introduction to population Ecology

2.8 Community Ecology: Ecological characteristic plant community, method of sampling of vegetation (Quadrat of line Transect)

2.9. Plant succession: Major vegetation types of Pakistan

2.10 Ecosystem Ecology: Definition and components of Ecosystem, food chain and food Web. Biogeochemical cycles; definition type with emphasis on Nitrogen and Hydrological cycles

2.11. Applied Ecology:

a) Drought, Salinity and water-logging: Brief overview of causes & Effects.

b) Agro ecology: Invasive species, Climatic change.

Practicals:

a) Plant Physiology:

1. Determination of Uptake of Water by Swelling Seeds when placed in Sodium Chloride Solution of Different Concentrations.
2. Determination of the Temperature at which Beet Root Cells lose their permeability.
3. Determination of the effects of environmental factors on the rate of transpiration of a Leafy shoot by means of a photometer by Cobalt Chloride Paper Method.
4. Extraction of Chlorophyll from the leaves and Separation of Component Pigments on a Paper Chromatogram.
5. Study of Absorption Spectra using Spectrophotometer.
6. Extraction of Amylase from Germinating Wheat Seeds and study of its effect on Starch Break Down.
7. Effect of Light and Temperature on Seed Germination.

b) Ecology:

1. Determination of Physical and Chemical Characteristics of Soil
2. Measurement of Light and Temperature
3. Measurement of Vegetation by Quadrat and Line Intercept Methods
4. Measurements of Wind Velocity
5. Field Trips to Ecologically Diverse Habitats.

Teaching-learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop
5. Field Tours

Learning Outcome:

1. Students will be familiarized with the basic functioning of plants.
2. They will be able to conduct and interpret measurements using a variety of instruments and methods
3. They will be able to analyze and present quantitative results in graphs and tables.

4. This will enable them qualify for basic to moderate level jobs involving knowledge of plants and their environment.
5. The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving environment.

Assessment Strategies:

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

Recommended Readings for Plant Physiology:

1. Annual Review of Plant Biology (<http://www.annualreviews.org/journal/arplant>).
2. Buchanan, B. B., Gruissem, W. and Jones, R. L. (2015). *Biochemistry and Molecular Biology of Plants*. Wiley-Blackwell. ISBN: 978-0-470- 71421-8 1280pp
3. Current protocols in Plant Biology (<http://www.currentprotocols.com/WileyCDA/Section/id-810246.html>).
4. Grotewold, E., Chappell, J. and Kellogg, E. A. (2015). *Plant Genes, Genomes, and Genetics*. Wiley-Blackwell ISBN: 978-1-119-99888
5. Jones, R. L., Ougham, H., Thomas, H. and Waaland, S. (2012). *The Molecular Life of Plants*. Wiley Blackwell. ISBN: 978-0-470-87011-2012 766pp
6. Plant Physiology and Development (<http://6e.plantphys.net/>)
7. Plant Physiology (<http://www.plantphysiol.org/>).
8. Taiz, L., Zeiger, E., Møller, I.M. and Murphy A. (2015). *Plant Physiology and Development*, 6th Edition. Sinauer Associates Inc., Sunderland MA. ISBN: 0-87893-831-1,700pp
9. Teaching tools in Plant Biology (<http://www.plantcell.org/content/teaching-tools-plant-biology>).
10. The Arabidopsis Book (<https://aspb.org/publications/other-aspb-publications/the-arabidopsis-book/>).
11. The Plant Cell (<http://www.plantcell.org/site/teachingtools/>).

Recommended Readings for Plant Ecology:

1. Barbour, M.O., Burke, H.J. and Pitts, D.W. (1999). *Terrestrial Plant Ecology*. The Benjamin, Cumming Publishing Co. California, USA.
2. Chapman, J. L. and Reiss, M. J. (1995). *Ecology; Principles and Applications*. Cambridge University Press. U.K.
3. Hussain, F. (1999). *Field and Laboratory Manual of Plant Ecology*. National Academy of Higher Education, Islamabad.
4. Krebs, C. J. (1997). *Ecology and Field Biology*. Addison Wesley Longman Inc, New York.
5. Odum, E.P. (1970). *Basic Ecology*. V/B. Saunders. Philadelphia.
6. Rick, R. E. (2000). *Ecology*. (1st Ed.). W.H. Freeman and Company, U.K.
7. Schultz, E. (2005). *Plant Ecology*. 2nd Ed. Springer-Verlag, Berlin.
8. Smith, R. L. (2002). *Ecology and Field Biology*. Harper and Row Publishers, New York.
9. Smith, R. L. (2000). *Elements of Ecology*. Harper and Row Publishers, New York.
10. Subrahmanyam, N.S. and Sambamurthy. A.V.S.S. (2000). *Ecology*. Narosa Publishing House, New Delhi.
11. Townsend, C.R., Harper, J.L. and Begon, M.E. (2000). *Essentials of Ecology*. Blackwell Scientific Publications, U.K.
