



**Institute of Botany**  
**Faculty of Life Sciences**  
**University of the Punjab, Lahore**  
**Course Outline**  
**Semester – IV**



Programme	BS/BS-ADP	Course Code	Bot-213	Credit Hours	2
Course Title	<b>Principles of Plant Physiology (Theory)</b>				
<b>Introduction</b>					
<p>This course delves into the fundamental biochemical and physiological processes that underpin plant life. This course provides an in-depth examination of how plants harness light energy through photosynthesis, converting it into chemical energy vital for their growth and development. It also covers the intricacies of plant respiration, where glucose is metabolized to produce ATP, the energy currency of cells. Additionally, the course addresses the mechanisms behind the translocation of photosynthates, the process by which the products of photosynthesis, such as sugars, are distributed throughout the plant to support various functions. Mastery of these topics is essential for a thorough understanding of plant nutrition, transpiration, plant growth, development, and adaptation to environmental conditions. This course integrates molecular, cellular, and whole-plant perspectives to give students a comprehensive understanding of plant physiology.</p>					
<b>Learning Outcomes</b>					
<p>On the completion of the course, the students will:</p> <ul style="list-style-type: none"> <li>• equipped with the following technical competencies</li> <li>• comprehend and apply the concept of water potential, including its components and its role in plant water relations.</li> </ul>					
<ul style="list-style-type: none"> <li>• Analyze the factors influencing transpiration rates in plants, including environmental and physiological variables.</li> <li>• Understand the principles of mineral nutrition in plants, including the roles and uptake mechanisms of essential macro- and micronutrients.</li> <li>• Explain the fundamental principles and mechanisms of photosynthesis, detailing the structures and functions of the photosynthetic apparatus and the pathways of CO<sub>2</sub> fixation.</li> <li>• Describe the biochemical processes of respiration, including Glycolysis, the Citric Acid Cycle, and the mitochondrial electron transport chain, and distinguish between aerobic and anaerobic respiration.</li> <li>• Understand the mechanisms of phloem transport and the allocation of photosynthates within plants, and elucidate how these processes support plant growth and development.</li> </ul>					
<b>Course Contents</b>					
<ul style="list-style-type: none"> <li>• <b>Plant Water Relations:</b> Water potential, Osmotic potential, Pressure potential, Matric potential, Relation of osmotic quantities, Water Absorption (Root structure and function, Mechanisms of water uptake by roots, pathways of water absorption in plants).</li> <li>• <b>Water Translocation:</b> Movement of water through xylem, Cohesion tension theory of ascent of sap, Transpiration and its significance</li> <li>• <b>Essential Mineral Elements:</b> Macronutrients and micronutrients, Functions and deficiency symptoms of macronutrients (Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulfur).</li> <li>• <b>Photosynthesis:</b> General Concepts, Ultrastructure of chloroplast, Organization of the photosynthetic apparatus, Ultra structure and composition of photosystem-I and II, ATP synthase, Mechanism of photosynthesis, light absorption, charge separation and oxidation of water (water oxidizing clock), electron and proton transport through, thylakoid protein-pigment complexes. CO<sub>2</sub> fixation mechanism (C<sub>3</sub>, C<sub>4</sub> and CAM plants).</li> <li>• <b>Respiration:</b> Glycolysis, Anaerobic and aerobic respiration, The Citric Acid Cycle, Mitochondrial Electron Transport and ATP synthesis, Energetics of Respiration, Glyoxylate cycle.</li> </ul>					

- **Translocation of photosynthates:** Pathway of Translocation, Mechanism of phloem transport; materials translocated through phloem, Phloem loading and unloading, Photosynthate allocation and partitioning.

Programme	BS/BS-ADP	Course Code	Bot-214	Credit Hours	1
Course Title	<b>Principles of Plant Physiology (Lab)</b>				
<b>Lab Course Contents</b>					
<ul style="list-style-type: none"> <li>• Preparation of percent, molar and normal solutions</li> <li>• Measurement of Transpiration Rate in Plants by Ganong's potometer.</li> <li>• Extraction and quantification of photosynthetic pigments.</li> <li>• Measurement of Carbon Dioxide Evolution by respiring seeds by titration method.</li> <li>• To Categorize C3 and C4 plants through their anatomical and physiological characters.</li> <li>• To regulate stomatal opening by light of different colors and pH</li> </ul>					
<b>Textbooks and Reading Material</b>					
<ol style="list-style-type: none"> <li>1. Taiz, L., Zeiger, E., Møller, I. M., &amp; Murphy A. (2015). <i>Plant physiology and Development</i>, (6<sup>th</sup> ed). Sinauer Associates Inc., Sunderland MA. ISBN: 0-87893-831-1, pp. 700</li> <li>2. Jain, V. K. (2018). <i>Fundamentals of plant physiology</i>. S. Chand Publishing. ISBN: 9-78935-253-3, 343pp.</li> <li>3. Jones, L. L., Ougum, H., Thomas, H., &amp; Waaland, S. (2012). <i>The Molecular Life of Plants</i>. Wiley-Blackwell, ISBN: 978-0-470-80711-2013, pp. 766</li> <li>4. Hopkins, W. G., Norman, P. A., &amp; Hüner. (2008). <i>Introduction to Plant Physiology</i>. 4<sup>th</sup> Ed. Wiley.</li> </ol>					
<b>Suggested Readings</b>					
<ol style="list-style-type: none"> <li>5. Plant physiology and development (<a href="http://6e.plantphys.net/">http://6e.plantphys.net/</a>).</li> <li>6. The Arabidopsis Book (<a href="http://aspb.org/publications/other-aspb-publications/the-arabidopsis-book/">http://aspb.org/publications/other-aspb-publications/the-arabidopsis-book/</a>).</li> <li>7. Plant Physiology (<a href="http://www.plantphysiol.org/">http://www.plantphysiol.org/</a>).</li> <li>8. Annual Review of Plant Biology (<a href="http://www.annualreviews.org/journal.arplant">http://www.annualreviews.org/journal.arplant</a>)</li> </ol>					
<b>Teaching Learning Strategies</b>					
<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Group Discussion</li> <li>• Lab work</li> <li>• Seminars/ Workshop</li> <li>• Assignments</li> </ul>					
<b>Assignments: Types and Number with Calendar</b>					
<ul style="list-style-type: none"> <li>• Lecture Based Examination (Objective and Subjective)</li> <li>• Assignments</li> <li>• Classroom discussion</li> <li>• Quizzes and Tests</li> <li>• Self-assessments</li> </ul>					

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