



**DEPARTMENT OF AGRONOMY**  
**Faculty of Agricultural Sciences**  
**University of the Punjab, Lahore**



**Course Outline**

<b>Programme</b>	B.Sc. (Hons) Agriculture (Agronomy)	<b>Course Code</b>	AGR-409	<b>Credit Hours</b>	3 (2-1)
<b>Course Title</b>	<b>PLANT NUTRIENTS AND GROWTH REGULATORS</b>				
<b>Course Introduction</b>					
<p>This course offers an in-depth exploration of mineral nutrients and growth regulators essential for plant development. Students will study the classification of mineral nutrients, their functions, and the symptoms associated with their deficiencies. The course will cover the criteria for determining the essentiality of mineral nutrients and the factors that influence nutrient availability in the soil. In addition, the course delves into the biosynthesis, translocation, and functions of major plant growth regulators.</p>					
<b>Learning Outcomes</b>					
<p>On the completion of the course, the students will:</p> <ol style="list-style-type: none"> <li>1. Develop a comprehensive understanding of the classification, functions, and deficiency symptoms of essential mineral nutrients.</li> <li>2. Be able to diagnose and address nutrient-related issues in plants effectively.</li> <li>3. Become knowledgeable about the composition and types of fertilizers and make informed decisions regarding fertilizer application to meet the nutritional needs of various crops.</li> <li>4. Acquire a thorough understanding of key growth regulators, enabling them to manipulate these hormones to improve plant growth, development, and yield.</li> </ol>					
<b>Course Content</b>				<b>Assignments/Readings</b>	
<b>Week 1</b>	<p style="text-align: center;"><b>Theory</b>  <b>Unit-I</b></p> <p>1.1 Overview of mineral nutrients in plants            1.2 Importance of mineral nutrients in plant growth and development</p>			<p>Read Chapter 1            Principles of Plant Nutrition (Mengel et al.)</p>	
<b>Week 2</b>	<p style="text-align: center;"><b>Unit-II</b></p> <p>2.1 Classification of Mineral Nutrients            2.2 Macro and micronutrients</p>			<p>Read Chapter 1            Principles of Plant Nutrition (Mengel et al.)</p>	

<b>Week 3</b>	<p align="center"><b>Unit-III</b></p> <p>3.1 Detailed functions of mineral nutrients 3.2 How each nutrient supports plant physiological processes</p>	<p>Read Page No. 261-262, 291-292, 317-319, Chapter 12 Soil Science (Rashid, A. and K.S. Memon) Internet source</p>
<b>Week 4</b>	<p align="center"><b>Unit-IV</b></p> <p>4.1 Identifying nutrient deficiency symptoms in plants 4.2 Visual diagnosis and corrective measures</p>	<p>Chapter 5 Plant Physiology (Taize, L. and E., Zeiger) Internet source</p>
<b>Week 5</b>	<p align="center"><b>Unit-V</b></p> <p>5.1 Criteria for essentiality of mineral nutrients 5.2 Understanding why certain nutrients are essential for plant life</p>	<p>Read Chapter 1 Principles of Plant Nutrition (Mengel et al.)</p>
<b>Week 6</b>	<p align="center"><b>Unit-VI</b></p> <p>6.1 Factors Affecting Nutrient Availability 6.1.1 Soil pH, texture, and organic matter 6.1.2 Environmental factors influencing nutrient availability</p>	<p>Chapter 4, 6, 8 Soil Science (Rashid, A. and K.S. Memon) Internet source</p>
<b>Week 7</b>	<p align="center"><b>Unit-VII</b></p> <p>7.1 Mechanisms of Nutrient Uptake 7.2 Root absorption processes 7.3 Active and passive transport mechanisms</p>	<p>Chapter 2 Soil Fertility and Fertilizers (Havlin et al)</p>
<b>Week 8</b>	<p align="center"><b>Unit-VIII</b></p> <p>8.1 Nutrient Translocation in Plants 8.2 Movement of nutrients from roots to other plant parts 8.3 Role of xylem and phloem in nutrient translocation</p>	<p>Chapter 3 Principles of Plant Nutrition (Mengel et al.)</p>
<b>Mid Term Exam</b>		
<b>Week 9</b>	<p align="center"><b>Unit-IX</b></p> <p>9.1 Composition of Fertilizers 9.2 Key components of fertilizers (NPK, micronutrients) 9.3 Organic vs. inorganic fertilizers</p>	<p>Chapter 6 Principles of Plant Nutrition (Mengel et al.) Internet source</p>

<b>Week 10</b>	<p align="center"><b>Unit-X</b></p> 10.1 Types of Fertilizers 10.2 Classification of fertilizers (straight, compound, slow-release) 10.3 Selecting the right fertilizer for different crops	Chapter 6 Principles of Plant Nutrition (Mengel et al.) Internet source
<b>Week 11</b>	<p align="center"><b>Unit-XI</b></p> 11.1 Introduction to Plant Growth Regulators 11.2 Importance of growth regulators in plant development	Chapter 19 Plant Physiology (Taize, L. and E., Zeiger) Internet source
<b>Week 12</b>	<p align="center"><b>Unit-XII</b></p> 12.1 Biosynthesis of Auxin 12.2 Translocation of Auxin within the plant 12.3 Functions of Auxin	Chapter 19 Plant Physiology (Taize, L. and E., Zeiger)
<b>Week 13</b>	<p align="center"><b>Unit-XIII</b></p> 13.1 Biosynthesis of gibberellins 13.2 Translocation of gibberellins within the plant 13.3 Functions of gibberellins	Chapter 20 Plant Physiology (Taize, L. and E., Zeiger)
<b>Week 14</b>	<p align="center"><b>Unit-XIV</b></p> 14.1 Biosynthesis of cytokinins 14.2 Translocation of cytokinins within the plant 14.3 Functions of cytokinins	Chapter 21 Plant Physiology (Taize, L. and E., Zeiger)
<b>Week 15</b>	<p align="center"><b>Unit-XV</b></p> 15.1 Biosynthesis of abscisic acid 15.2 Translocation of abscisic acid within the plant 15.3 Functions of abscisic acid	Chapter 22 Plant Physiology (Taize, L. and E., Zeiger)
<b>Week 16</b>	<p align="center"><b>Unit-XVI</b></p> 16.1 Biosynthesis of ethylene 16.2 Translocation of ethylene within the plant 16.3 Functions of ethylene	Chapter 23 Plant Physiology (Taize, L. and E., Zeiger)
	<p align="center"><b>Practical Course Contents</b></p> <ol style="list-style-type: none"> <li>1. Raising plants in different growth media with various nutrients</li> <li>2. Identification of deficiency symptoms</li> <li>3. Demonstration of nutrient uptake</li> <li>4. Demonstration of plant responses to growth regulators.</li> </ol>	

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**Textbooks and Reading Material**

1. Epstein, E. and A. J. Bloom. 2004 Mineral Nutrition of Plants: Principles and Perspectives. John Wiley and Sons Inc., USA.
2. Havlin, J.L., Tisdale, S.L., J.D. Beaton and W.L. Nelson. 2005. Soil Fertility and Fertilizers. 7<sup>th</sup> Ed. Macmillan Publishing Co., NY, USA.
3. Mengel, K., E. A. Kirkby, H. Kosegarten and T. Appel. 2001. Principles of Plant Nutrition. 5<sup>th</sup> Ed. International Potash Institute, Bern, Switzerland.
4. Rashid, A. and K.S. Memon. 2005. Soil Science. Ed. E. Bashir and R. Bantel. National Book Foundation, Islamabad.
5. Taize, L. and E., Zeiger. 2006. Plant Physiology 4<sup>th</sup> Ed. Sinauers Associate, Inc. Sunderland, Massachusetts, USA

**Teaching Learning Strategies**

1. Lectures
2. Class Discussions
3. Presentations
4. Quiz
5. Assignments

**Assignments: Types and Number with Calendar**

1. Written Assignments
2. Presentations

**Assessment**

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.