

<b>Program</b>	B.Sc. (Hons) Agriculture (Major: Soil Science)	<b>Course Code</b>	SS-305	<b>Credit Hours</b>	3(1-2)
<b>Course Title</b>	<b>INSTRUMENTATION AND LABORATORY TECHNIQUES</b>				
<b>Course Introduction</b>					
This course covers the principles and use of common laboratory equipment and analytical techniques for soil and plant analysis. Students will learn to use laboratory instruments and collect, handle, and analyze soil and plant samples effectively.					
<b>Learning Outcomes</b>					
Upon completion of the course, students will:					
<ol style="list-style-type: none"> <li>1. Understand quality assurance and safety measures in the laboratory.</li> <li>2. Properly store and dispose of chemicals.</li> <li>3. Apply S.I. and derived S.I. units in laboratory settings.</li> <li>4. Perform extraction, digestion, and dry ashing techniques.</li> <li>5. Operate specialized laboratory equipment such as conductivity meters, potentiometers, spectrophotometers, and emission and absorption spectrometers.</li> </ol>					
<b>Course Content (Theory)</b>					
<b>Week</b>	<b>Unit</b>	<b>Topics</b>		<b>Assignments/Readings</b>	
<b>1</b>	Unit 1	Quality assurance in laboratory practices		Review on quality assurance protocols.	
<b>2</b>	Unit 2	Safety measures in the laboratory		Assignment on laboratory safety rules and regulations.	
<b>3</b>	Unit 3	Storage and disposal of chemicals		Case studies on chemical storage and disposal.	
<b>4</b>	Unit 4	S.I. and derived S.I. units		Exercises on unit conversion and application.	
<b>5</b>	Unit 5	Extraction techniques: principles and methods		Review of extraction methods in soil and plant analysis.	

6		Digestion techniques: principles and methods	
7		Dry ashing techniques: principles and methods	Practical assignment on digestion and ashing.
8	Unit 6	Conductivitymetry: principle and operation	Hands-on demonstration of conductivity meters.
9		Potentiometry: principle and operation	
10		Spectrophotometry: principle and operation	Assignment on spectrophotometric analysis.
11		Emission spectroscopy: principle and operation	
12		Absorption spectroscopy: principle and operation	Practical session on spectroscopic techniques.
13		Instrument calibration and maintenance	Exercises on instrument calibration procedures.
14		Data interpretation and analysis	
15		Practical applications in soil and plant analysis	Group discussion on analytical techniques.
16		Final review and summary	Comprehensive review of course content.

**Course Content (Practical)**

Week	Unit	Topics	Assignments/Readings
1	Unit 1	Soil and plant sampling and preparation	Practical notebook completion.
2		Preparation of standard solutions	
3	Unit 2	Introduction to soil analytical techniques for nitrate determination	
4		Practical session on nitrate analysis	

5		Phosphorus (P) analysis in soil samples	
6		Potassium (K) analysis in soil samples	
7	Unit 3	Micronutrient analysis in soil samples	
8		Interpretation of analytical results	Practical report writing.
9	Unit 4	Calibration of laboratory equipment	
10		Maintenance of laboratory instruments	
11		Practical demonstration of potentiometry	
12		Practical demonstration of spectrophotometry	Practical session on data collection and analysis.
13		Emission spectroscopy demonstration	
14		Absorption spectroscopy demonstration	
15		Practical applications in soil and plant analysis	
16		Final practical examination and project presentation	

### **Textbooks and Reading Material**

1. Carter, M.R. and E.G. Gregorich (eds.). 2008. *Soil Sampling and Methods of Analysis*. 2nd Ed. Taylor & Francis Group, Boca Raton, FL, USA.
2. Jones, J.B. Jr. 2001. *Laboratory Guide for Conducting Soil Tests and Plant Analysis*. CRC Press, Boca Raton, FL, USA.
3. Ryan, J., G. Estefan, and A. Rashid. 2001. *Soil and Plant Analysis. Laboratory Manual*. International Centre for Agricultural Research in the Dry Areas. Aleppo, Syria.

4. Smith, K.A. and M.S. Cresser. 2003. *Soil and Environmental Analysis: Modern Instrumental Techniques*. CRC Press, Boca Raton, FL, USA.
5. Sparks, D.L. et al. (eds.). 1996. *Methods of Soil Analysis. Part III. Chemical Methods*. SSSA, ASA Series No.5, Madison, WI, USA.
6. Tandon, H.L.S. 2005. *Methods of Analysis of Soils, Plants, Waters, Fertilizers and Organic Manures*. Fertilizer Development and Consultation Organization, New Delhi, India.

### **Teaching Learning Strategies**

- Multimedia presentations
- Whiteboard explanations
- Group discussions
- Quizzes and assignments
- Practical demonstrations and hands-on activities

### **Assignments: Types and Number with Calendar**

1. Quality assurance and laboratory safety exercises.
2. Chemical storage and disposal case studies.
3. Unit conversion and application assignments.
4. Practical exercises on extraction, digestion, and dry ashing techniques.
5. Calibration and maintenance of laboratory instruments.
6. Practical sessions on soil and plant sampling and preparation.
7. Analytical techniques for nitrate, P, K, and micronutrients.
8. Interpretation of analytical results and practical report writing.