

**UNIVERSITY OF SARGODHA**

**DEPARTMENT OF SOIL & ENVIRONMENTAL SCIENCES, COLLEGE OF AGRICULTURE**

**COURSE OUTLINE**

**Spring-2020**

Course Title:           **Physical Properties of Soil**  
Course Code:           **SES-301**  
Credit Hours:         **3(2-1)**  
Instructor:             **Prof. Dr. Ghulam Sarwar**  
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**DESCRIPTION AND OBJECTIVES**

**Aims of the course:** The aim of this course is basically to develop understanding of the students about physical properties of soils and apply their knowledge for solving physical degradation problems. This course will also help in understanding the behaviour of soil physical properties in supporting the crop growth and engineering uses.

**Objectives of the course:** At the completion of the course, the students will become able to:

1. Understanding the importance of physical properties of soil in crop growth and its use for engineering purposes.
2. Understand the role of different tillage practices in crop growth and in management of water and soil.
3. Identify important problems regarding different soil physical properties.
4. Identify the management practices regarding physical degradation of soil.

**INTENDED LEARNING OUTCOMES**

Physical properties of soil and their role in water and nutrient holding and soil conditions in relation to plant growth will be covered. The students should be able to measure and interpret the soil physical properties and their significance in crop growth.

**COURSE CONTENTS**

**Theory**

1. Soil physical condition and plant growth
2. Soil texture, specific surface area and importance
3. Soil structure: genesis and description
4. Soil crusting and surface sealing with their role in seedling emergence
5. Particle and bulk density: description and significance
6. Total porosity and pore-size distribution and root development
7. Soil air composition and aeration
8. Soil temperature and its management
9. Soil color: causes and significance
10. Soil consistency and strength and interpretation for soil mechanics
11. Soil water and water potential and plant available water.
12. Water and solute movement through soil
13. Soil compaction: causes and remedies

14. Soil tillage systems and tith
15. Soil physical environment and root architecture

**Practical**

1. Textural analysis: sieve, hydrometer, pipette and feel methods
2. Determination of bulk and particle density
3. Total soil porosity estimation
4. Aggregate stability estimation
5. Measurement of soil water contents
6. Measurement of soil temperature
7. Soil color and its interpretation
8. Determination of soil strength/soil penetrometer resistance

**READINGS**

1. Brady, N.C. and R.R. Weil. 2005. The nature and properties of soils. 13th ed., Prentice-Hall, Inc., Upper Saddle River, NJ, USA.
2. Saha, A.K. 2004. Text book of Soil Physics. Kalyani Publishers. India.
3. Singer, M.J. and D.N. Munns. 2002. Soils -- An introduction. 5th ed. Prentice-Hall, Inc., Upper Saddle River, NJ, USA.
4. Jury, W.A. and R. Horton. 2004. Soil physics 6th ed. John Wiley and Sons, Inc., New Jersey, USA.
5. Miller, R.W., and R.L. Donahue. 2005. Soils in Our Environment, 11<sup>th</sup> Edition. Web link: <https://www.amazon.com/Soils-Our-Environment-Raymond-Miller/dp/0130958034>
6. Brady, N.C. and R.R. Weil. 2009. Elements of the Nature and Properties of Soils. 3<sup>rd</sup> Ed. Pearson Education, Upper Saddle River, NJ, USA.
7. Hillel, D. 2004. Introduction to Environmental Soil Physics. Elsevier, San Diego, CA, USA.
8. Hillel, D. 2008. Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.
9. Jury, W. A. and R. Horton. 2004. Soil Physics. 6<sup>th</sup> Ed. John Wiley & Sons. Inc., NY, USA.

**COURSE SCHEDULE**

<b>Week</b>	<b>Lecture / Practical</b>	<b>Topics and Readings</b>	<b>Books with Page No.</b>
1	Lecture # 1	Introduction importance and objectives of the course	-
	Lecture # 2	Diameter ranges of soil separates; derivation and application of Stoke's Law, particle size distribution	The nature and properties of soils, 4/123 and Text book of Soil Physics, 2/7-47
	Practical # 1	Introduction and Importance of the practical's and laboratory protocol	Notes will be given
2	Lecture # 1	Soil textural classes and their determination	Text book of Soil Physics, 2/7-47

	Lecture # 2	Rock fragments and its use as the adjective, Specific surface area of the particle and principles of measurements	Text book of Soil Physics, Environmental soil physics, 2/7-47 and 3/34-35
	Practical # 2	Methods of soil sampling; Soil sampling plans	Notes will be given
3	Lecture # 1	Description and importance of soil structure	The nature and properties of soils, 4/133 and Text book of Soil Physics, 3/48-90
	Lecture # 2	Factors affecting genesis of soil structure, Class, type and grade of soil structure	The nature and properties of soils, 4/152-158 and Text book of Soil Physics, 3/48-90
	Practical # 3	Soil handling, preparation, storage and labeling	Notes will be given
4	Lecture # 1	Tillage and management of soil structure	The nature and properties of soils, 4/160-162
	Lecture # 2	Mechanisms and significance of soil crusting, Utilization of poor structured soils; Description and significance of soil particle density	Soils -An introduction, 15/403-418 and Text book of Soil Physics, 3/48-90
	Practical # 4	Soil texture analysis	Notes will be given
5	Lecture # 1	Description, factors affecting and significance of soil bulk density	Text book of Soil Physics, 4/91-119 and The nature and properties of soils, 4/136-143
	Lecture # 2	Influence of bulk density on root growth; Measurement of soil bulk density, Soil porosity, size-classification and permeability	The nature and properties of soils, 4/144-147 and Text book of Soil Physics, 4/91-119
	Practical # 5	Hydrometer method for textural analysis	Notes will be given
6	Lecture # 1	Significance and factors affecting pore space	The nature and properties of soils, 4/147-148
	Lecture # 2	Calculation of porosity; Difference between soil air and aeration, Composition of gases; Renewal of gases in soil	Text book of Soil Physics, 4/91-119
	Practical # 6	Pipette method for textural analysis	Notes will be given

7	Lecture # 1	Measurement in characterization of soil aeration	Environmental soil physics, 8/147-150
	Lecture # 2	Basic concepts of soil temperature, Factors affecting soil temperature	Text book of Soil Physics, 10/426-470
	Practical # 7	Bulk density by Clod method	Notes will be given
8	Lecture # 1	Modification of soil temperature	Text book of Soil Physics, 10/426-470
	Lecture # 2	Description, significance and notation & causes of soil colour	Text book of Soil Physics, 11/471-480
	Practical # 8	Bulk density by core method	Notes will be given
9	Lecture # 1	Soil consistence and consistency	The nature and properties of soils, 4/165-167
	Lecture # 2	Air-dry, moist and wet consistency, Atterberg's limits	Text book of Soil Physics, 5/120-159 and The nature and properties of soils, 4/170-171
	Practical # 9	Bulk density by Excavation method	Notes will be given
10	Lecture # 1	Structure and properties of soil water	The nature and properties of soils, 5/177-181
	Lecture # 2	Soil water energy concepts; Soil water potential and its components, Measurement of soil water	The nature and properties of soils, 5/183-194
	Practical # 10	Measurement of soil porosity	Notes will be given
11	Lecture # 1	Classification of soil water	Text book of Soil Physics, 6/160-212
	Lecture # 2	The importance of soil water; Water retention forces, Soil water movement	Text book of Soil Physics, 6/160-212 and Nature and properties of soils, 5/195-204
	Practical # 11	Measurement of water infiltration rate	Notes will be given
12	Lecture # 1	Soil water characteristics curves and hysteresis	The nature and properties of soils, 5/187-189
	Lecture # 2	Darcy's law, hydraulic conductivity and intrinsic permeability, Water infiltration and percolation in soil	The nature and properties of soils, 5/195-202
	Practical # 12	Measurement of hydraulic conductivity	Notes will be given

13	Lecture # 1	Tillage terminology and purposes of tillage	An Introduction to Soils and Plant Growth, 14/418-420
	Lecture # 2	Conventional versus no-till farming; Reasons and disadvantages of reduced and no-till	An Introduction to Soils and Plant Growth, 14/421-424
	Practical # 13	Measurement of soil penetrability/strength	Notes will be given
14	Lecture # 1	Soil compaction; definition and impact on soil and plant growth	Soils -- An introduction, 15/403-418
	Lecture # 2	Soil compaction; causes and types, management and remedies	Soil physics, 7/218-222
	Practical # 14	Field capacity water measurement	Notes will be given
15	Lecture # 1	Solute movement and transport processes in soil	Soil physics, 7/218-222
	Lecture # 2	Fick`s Law and Transport Equations	Soil physics, 7/218-222
	Practical # 15	Students presentations/Field visits and demonstrations	-
16	Lecture # 1	Miscible displacement of solutes	Soil physics, 7/218-222
	Lecture # 2	Dispersion Process of different solutes in the soil, Land use effects on flow and transport of solutes in the soil	Soil physics, 7/218-222
	Practical # 16	Students presentations/Field visits and demonstrations	-

### **RESEARCH PROJECT/PRACTICAL/LABS/ASSIGNMENTS**

#### **ASSIGNMENTS**

Following assignments will be given to the students

1. Describe physical property important from engineering point of view. Also write its significance with respect to agriculture
2. Describe four most important physical properties and their significance with respect to crop production.
3. Describe role of soil physics in management of environment.

### **ASSESSMENT CRITERIA**

Sessional:	20 % of the total theory marks (Project, Presentation, Participation and Assignment)
Project:	-
Presentation:	-
Participation:	-
Mid Exam:	30 % of the total theory marks
Final Exam:	50 % of the total theory marks
Practical Exam:	100 % of the total practical marks