



Ministry of Education
Federal University of Santa Maria
Rural Science Center
Graduate Program in Soil Science

Course: Soil Physics

Identification

Code: SOL882
Credits: 3 (3 hours lecture)
Level: Master's/Doctoral
Professor: Paulo Ivonir Gubiani
Offering: Annual (Second Semester)

Course Objectives

To identify, analyze, and discuss soil properties and processes as a three-phase, heterogeneous, and dispersed system. To provide fundamental concepts and methodologies for analyzing the solid, liquid, and gaseous phases and their interactions; and to apply this knowledge to problems related to soil use and management.

Syllabus

The course addresses soil physical properties and processes, relating them to land use and management practices in agricultural systems.

Methodology and/or Teaching Instruments

Lectures, discussion sessions, and problem-solving activities.

Assessment Methods

Written examinations and evaluation of problem-solving exercises and discussions.

Program: Title and Breakdown of the Units

Unit 1 – Introduction

- 1.1 – Soil as a multiphase, heterogeneous, and dispersed system
- 1.2 – Soil solid fraction
- 1.3 – Physicochemical properties of clays

Unit 2 – Soil Solids

- 2.1 – Particle size distribution
- 2.2 – Specific surface area
- 2.3 – Particle density
- 2.4 – Relationships with mineralogy and chemical properties

Unit 3 – Relationships among Soil Phases

- 3.1 – Density
- 3.2 – Porosity
- 3.3 – Soil water content
- 3.4 – Air-filled porosity
- 3.5 – Relationships with land use and management

Unit 4 – Soil Consistency

- 4.1 – Forms of consistency
- 4.2 – Atterberg limits
- 4.3 – Factors controlling soil consistency

Unit 5 – Formation and Degradation of Soil Structure

- 5.1 – Aggregation
- 5.2 – Methods for evaluating soil structure
- 5.3 – Soil compaction
- 5.4 – Causes and conditioning factors of compaction

5.5 – Consequences of compaction

5.6 – Soil decompaction

Unit 6 – Soil Air

6.1 – Composition of soil air

6.2 – Aeration dynamics

6.3 – Aeration processes

Unit 7 – Soil Thermal Energy

7.1 – Surface energy balance

7.2 – Thermal properties

7.3 – Modification of the soil thermal regime

Unit 8 – Soil Water

8.1 – Water properties and processes at the solid–liquid–air interface

8.2 – Soil water potential

8.3 – Soil water retention curves

8.4 – Water flow in soil

8.5 – Water availability to plants

8.6 – Pedotransfer functions for water retention

Unit 9 – Indicators of Soil Physical Quality

9.1 – Mechanical constraints

9.2 – Water-related constraints

9.3 – Aeration constraints

Recommended Literature

ALBUQUERQUE, J. A.; GUBIANI, P. I. Física do Solo. Santa Maria, RS: Palotti, 2023.

BAVER, L.D; GARDNER, W.H.; GARNER, W.R. Soil physics. 4 ed. Ney York: John Wiley & Sons, 1972. 498p.

DANE, J.H.; TOPP, G.C. Methods of soil analysis. Part 4. Physical methods. 2 ed. Madison: ASA, 2002. 1692p.

HILLEL, D. Fundamentals of soil physics. London: Academic Press, 1980. 413p.

HILLEL, D. Applications of soil physics. London: Academic Press, 1980. 385p.

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JURY, W.A.; GARDNER, W.R., GARDNER, W.H. Soil physics. 5 ed. Ney York: John Wiley & Sons, 1991. 328p.

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LIBARDI, P. L. Dinâmica da água no sistema solo-planta-atmosfera. Piracicaba: O autor, 1999. 491p.

REICHARDT, K. Dinâmica da matéria e da energia em ecossistemas. São Paulo: USP/ESALQ, 1996. 513p.

REICHARDT, K.; TIMM, L. C. Solo, planta e atmosfera: conceitos, processos e aplicações. Barueri, SP: Manole, 2012.

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WARRICK, A.W. Soil physics companion. Boca Raton: CRC, 2002. 389p.