



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

## **Course: Soil Genesis, Morphology and Classification**

### **Identification**

Code: SOL881

Credits: 4 (2 hours lecture – 2 hours practical)

Level: Master's/Doctoral

Instructors: Fabricio de Araujo Pedron and Ricardo Simão Diniz Dalmolin

Offering: Annual (First Semester)

### **Course Objectives**

To understand soil genesis through the weathering processes of rocks and sediments, influenced by soil-forming factors and processes; to recognize primary and secondary minerals involved in pedogenesis and their mineralogical evolution, as well as their morphological, chemical, and physical implications; to identify and determine soil morphological characteristics and diagnostic properties, and establish relationships with other soil attributes, especially soil–environment interactions; to identify soil classes in the field and their distribution in the landscape; to understand the main taxonomic classification systems used in Brazil and worldwide, and apply them to the classification of Brazilian soils; to recognize the soils of Rio Grande do Sul and the main soils of Brazil, including their genesis, morphological, physical, and chemical characteristics, and their taxonomic classification.

### **Syllabus**

The course on Soil Genesis, Morphology and Classification initially addresses the definition of soil and the fundamentals of petrography applied to soil science. Subsequently, soil-forming factors and processes are discussed, as well as weathering processes and basic concepts of mineralogy and soil organic composition. Soil morphology is extensively discussed in both theoretical and practical classes. Taxonomic classification systems are presented and widely applied through practical exercises. Soils and their relationships with the landscapes of Rio Grande do Sul and Brazil are also addressed through both theoretical and practical approaches, with emphasis on field activities conducted on the UFSM campus and during technical field excursions.

### **Methodology and/or Teaching Instruments**

Lectures, discussion groups, seminars, field practices, laboratory activities, study excursions, and a repository of texts and scientific articles related to the course content are the main teaching tools used.

### **Assessment Methods**

Written evaluations (theoretical and practical), seminars, discussion of results, and reports from laboratory classes and field excursions.

### **Program: Title and Breakdown of the Units**

#### **Unit 1 – Soil Definition**

- 1.1 – Brief history of soil science
- 1.2 – Soil definitions
- 1.3 – Soil as a natural body
- 1.4 – Soil as an anthropogenic body
- 1.5 – Soil characteristics and properties
- 1.6 – Environmental functions of soils

#### **Unit 2 – Soil Morphology**

- 2.1 – Soil profile
- 2.2 – Pedogenetic horizons
- 2.3 – Soil morphological characteristics
- 2.4 – Field description of soil morphology
- 2.5 – Study of soil morphology

- 2.6 – Technical interpretation of soil morphological evaluation
- 2.7 – Relationship between soil morphology and landscape (environmental elements)

### **Unit 3 – Petrography Applied to Soil Science**

- 3.1 – Composition and dynamics of the Earth's crust
- 3.2 – Continental drift theory
- 3.3 – Types of rocks, genesis, and characteristics
- 3.4 – Geological evolution of Rio Grande do Sul
- 3.5 – Effects of rocks on soil formation and composition
- 3.6 – Effects of rocks on landscape morphology

### **Unit 4 – Weathering of Rocks and Minerals**

- 4.1 – Physical and biophysical weathering
- 4.2 – Chemical and biochemical weathering
- 4.3 – Mechanisms of mineral alteration
- 4.4 – Weathering mantles in Rio Grande do Sul

### **Unit 5 – Mineral and Organic Composition of Soil**

- 5.1 – Primary mineralogy and its effects on soil
- 5.2 – Secondary mineralogy and its effects on soil
- 5.3 – 2:1 clay minerals
- 5.4 – 1:1 clay minerals
- 5.5 – Oxides, oxyhydroxides, and hydroxides
- 5.6 – Soil organic composition
- 5.7 – Pedological aspects of soil organic matter

### **Unit 6 – Soil-Forming Factors**

- 6.1 – Theory of soil-forming factors
- 6.2 – Parent material
- 6.3 – Climate
- 6.4 – Relief (topography)
- 6.5 – Organisms
- 6.6 – Time
- 6.7 – Soil–landscape relationship in Rio Grande do Sul

### **Unit 7 – Soil-Forming Processes**

- 7.1 – General soil-forming processes
- 7.2 – Specific soil-forming processes
  - 7.2.1 – Clay illuviation
  - 7.2.2 – Laterization
  - 7.2.3 – Gleying
  - 7.2.4 – Podzolization
  - 7.2.5 – Plinthization
  - 7.2.6 – Pedoturbation
  - 7.2.7 – Vertization
  - 7.2.8 – Carbonation
  - 7.2.9 – Salinization
  - 7.2.10 – Sodification
  - 7.2.11 – Solodization
  - 7.2.12 – Paludization
  - 7.2.13 – Melanization
  - 7.2.14 – Leucinization
  - 7.2.15 – Silicification
  - 7.2.16 – Anthrosoilization

### **Unit 8 – Soil Classification**

- 8.1 – Basic principles, evolution, and importance
- 8.2 – Diagnostic soil characteristics and properties for classification purposes
- 8.3 – Pedons and polypedons
- 8.4 – Diagnostic horizons
- 8.5 – Brazilian Soil Classification System (SiBCS)
- 8.6 – U.S. Soil Taxonomy
- 8.7 – FAO/IUSS World Reference Base for Soil Resources (WRB)
- 8.8 – Exercises in taxonomic soil classification

## **Unit 9 – Soils of Brazil and Rio Grande do Sul**

9.1 – Occurrence and distribution

9.2 – Morphology and classification

9.3 – Limitations and potential for agricultural and non-agricultural use

9.4 – Exercises, seminars, and field trips to different regions of the state of Rio Grande do Sul

### **Recommended Literature**

GIASSON E. et al. Pedologia: Estudo dos Solos do Rio Grande do Sul e Santa Catarina. Santa Maria: SBCS-NRS, 2024. 298 p.

IBGE. Manual técnico de Pedologia. 3 ed. Rio de Janeiro: IBGE, 2015. 430p.

KER J. C. et al. Pedologia: fundamentos. Viçosa: SBCS. 2012. 343p.

CURI N. et al. Pedologia: solos dos biomas brasileiros. Viçosa: SBCS. 2017. 597p.

PEDRON F. A.; DALMOLIN R. S. D. Solos arenosos do bioma Pampa brasileiro. Santa Maria: Editora UFSM, 2019. 280p.

SANTOS H. G. et al. Sistema brasileiro de classificação de solos. 5ª ed., Brasília: EMBRAPA, 2018. 356p.

STRECK, E. V. et al. Solos do Rio Grande do Sul. 3 ed., Porto Alegre: Emater/RS, 2018. 252p.

PEDRON et al. Compêndio de Solos do Brasil. Volume 1 e 2. Santa Maria: SBCSNRS, 2024 e 2025.