מכון הערבה
Arava Institute
معهد وادي عربة

Introduction to Soil Sciences

3 hour lecture oce a week, 3 credits
(theoretical lecture and Laboratory)

Overview

Soils form a unique and irreplaceable essential resource for all terrestrial organisms, including man. Soils form not only the very thin outer skin of the earth's crust that is exploited by plant roots for anchorage and supply of water and nutrients. Soils are complex natural bodies formed under the influence of plants, microorganisms and soil animals, water and air from their parent material, solid rock or unconsolidated sediments. Physically, chemically and mineralogically they usually differ strongly from the parent material, and normally are far more suitable as a rooting medium for plants. In addition to serving as a substrate for plant growth, including crops and pasture, soils play a dominant role in the biogeochemical cycling of water, carbon, nitrogen and other elements, influencing the chemical composition and turnover rates of substances in the atmosphere and the hydrosphere.

Specific Goals

Students who successfully complete this course will be able to:

1. Recall and define the basic terms used for the description, study, and management of soils.
2. Describe the soil forming factors and the effect of each factor on soil development.
3. Identify and describe soil physical properties such as texture, structure, and color.
4. Explain how soil physical, chemical, and biological properties and processes affect agricultural and nonagricultural land use and management.
5. Summarize the ecological functions of soil and explain the role of soil management in maintaining and improving environmental quality.

Laboratory

The laboratory will provide hands-on experience in a variety of soil analytical skills and illustrate soil science concepts. During the lab work, two sites will be sampled in 3 depth and each group will analyze one sample from the oil spill flooded and one sample from the non-flooded site. In the field, general characteristics as color, moisture status, texture or carbonate content are estimated during sampling. The field moist samples are then homogenized, dried and sieved in the laboratory and water content (WC), pH and electrical conductivity (EC) of aqueous extracts and other results are to be determined in the laboratory. Each group will chose a project related to soil analysis

and another field (agriculture, ecology, hydrology, geology, pollution, etc) and use the knowledge required in the lab, to do a series of analysis and write a report.

Course Requirements

The course will include laboratory and field work (soil sampling and field analysis), worksheets, exercises, readings, etc. In addition to participating in the lab and class discussions, students will have a midterm exam and a final exam. The main reading of this course will be provided by the instructor.

Text Book:

1. Soil and the environment: An introduction by Alan Wild. First Edition, 1993.
2. Fundamentals of soil science by Henry D. Foth. Sixth edition, 1978.
3. Principles of soil physics by Rattan Lal and Manoj K.Shukla, 2004.
4. Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004.

Grade components

- Attendance, participation, discussions 10%
- Quizzes, Assignments, Readings 10%
- Soil project 20%
- Laboratory work and reports 15 %
- Midterm exam 5%
- Final exam 40%

Schedule

Lesson Out line

Topics	Lab
Introduction **The Earth's Crust Origin of Soil** Terminology used in describing soils What is a Soil? 1. Soil definition 2. Components of soils What is soil genesis? Why study soil genesis? How to study soil genesis? **N.van Breemen, P.Buurman - Soil Formation. 2nd edition (pages 7 – 12)**	**Safety manual** - Lab safety policy & Interpreting Soil Test Reports, Soil Sampling and management. **-** Introduction to laboratory activity and soil manual.

- **Soil physical processes** - Soil texture, Soil structure, Profile variability and Soil color - Soil Temperature. - Specific Surface Area**,** Particle Shape, Particle Size Distribution (PSD) **1. N.van Breemen, P.Buurman - Soil Formation. 2nd edition (pages 15 -26)** **2. Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004, page 47**	Soil texture - soil type by feel and appearance method
Soil chemical processes - Soil sampling and pollution - Sources of Soil Acidity - Cation & anion definitions - Soil minerals and their physico-chemical properties. - Chemical weathering and formation of secondary minerals **1. Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004, page 50** **2. N.van Breemen, P.Buurman - Soil Formation. 2nd edition**	Definition and expression of soil acidity (Soil pH and EC)
- Cation exchange capacity (CEC) - Factors affecting CEC - Redox processes - Soil salinity **Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004, page 50**	Carbonate in soil
Soil biological processes **Soil organisms and organic matter** - Soil Organisms (types, functions, processes such as nitrification, ammonification, N-fixation). - Effects of soil fauna on soil properties - Organic matter (definition, composition of plants, decomposition). - Decomposition of plant litter and formation of soil organic matter. - Environmental factors influencing decomposition and humification **N.van Breemen, P.Buurman** **- Soil Formation. 2nd edition**	Water Drop Penetration Time (WDPT)
- Formation of humus Kinetics of decomposition and of humus formation - Sources of nutrients in soils (organic matter and soil minerals). - C:N ratio of materials returned to soil. - Input of plant litter (Compost) and animal manor into soils and nutrient cycling within the soil profile **N.van Breemen, P.Buurman - Soil Formation 2nd edition**	1. Critical Surface Tension (CST) 2. Drop Angle Contact test
Soil Hydrology - Soil Water Interaction. - Soil's Moisture Content. - Soil-Moisture Potential. - Water Flow in Saturated Soils	1. Soil moisture condition of a horizon (field) 2.Soil moisture (water) content (lab)

Principles of soil physics by Rattan Lal and Manoj K.Shukla, 2004.page 234	
- Water Flow in Unsaturated Soils. - Water Infiltration in Soil. - Soil Water Evaporation. - Solute Transport **Principles of soil physics by Rattan Lal and Manoj K.Shukla, 2004.**	Infiltration capacity
Studying soil profiles - Methodologies to characterize and quantify effects of soil formation. - Humus mineral horizons - Mean residence time of organic matter in topsoils **N.van Breemen, P.Buurman - Soil Formation. 2nd edition**	Standardization and calibration carves
Soil profile Degradation - Soil Degradation and Soil Quality. - Biological Indicators of Soil Quality – Soil Respiration Rates - Physical Indicators of Soil. - Chemical Indicators of Soil Quality. - Physical Soil Degradation. - Soil Compaction **Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004, page 95**	Na and K minerals in soil
Soil profile Degradation - Soil Crusting and Sealing. - Chemical Soil Degradation. - Acidification. - Salinization and Sodification **Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004. page 95**	NO3-N, NH4
Final Exam	