



Introduction to Soil Sciences

3 hour lecture once a week (one hour theoretical and two hours experimental)
3 credits, **Undergraduate**

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 depths. 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 choose 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. The main reading of this course will be provided by the instructor.

Grade components

- Attendance, participation, discussions 10%
- Quizzes, Assignments, Readings 10%
- Soil project 10%
- Midterm exam 10%
- Laboratory work and reports 30%
- Final exam 30%

Schedule

| Lesson # | Topics | Lab |
|--------------------------------|---|---|
| Introduction | | |
| 1. | 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. |
| Soil physical processes | | |
| 2. | - 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 |
| 3. | Particle Density, Bulk density and Porosity Soil permeability | Soil texture dry and wet method - Sieving and determination of |

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| | <ul style="list-style-type: none"> - Movement of water and solutes within the soil profile. - Shrinkage and swelling of soil aggregates and clays <p>Principles of soil physics by Rattan Lal and Manoj K.Shukla, 2004. Page 140 - 150</p> <p>Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004. page 47</p> | coarse fraction |
| Soil chemical processes | | |
| 4. | <ul style="list-style-type: none"> - 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 <p>1. Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004, page 50</p> <p>2. N.van Breemen, P.Buurman - Soil Formation. 2nd edition</p> | Definition and expression of soil acidity (Soil pH and EC) |
| 5. | <ul style="list-style-type: none"> - Cation exchange capacity (CEC) - Factors affecting CEC - Redox processes - Soil salinity <p>Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004, page 50</p> | Carbonate in soil |
| Soil biological processes | | |
| 6. | <p>Soil organisms and organic matter</p> <ul style="list-style-type: none"> - 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 <p>N.van Breemen, P.Buurman</p> <p>- Soil Formation. 2nd edition</p> | Water Drop Penetration Time (WDPT) |
| 7. | <ul style="list-style-type: none"> - 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 manure into soils and nutrient cycling within the soil profile <p>N.van Breemen, P.Buurman - Soil Formation. 2nd edition</p> | <ol style="list-style-type: none"> 1. Critical Surface Tension (CST) 2. Drop Angle Contact test |
| 8. | Organic pollutants in soil: remediation in different soil types using analytical methods | Guest lecturer – Ahmad Nasir |
| Soil Hydrology | | |
| 9. | <ul style="list-style-type: none"> - Soil Water Interaction. - Soil's Moisture Content. | 1. Soil moisture condition of a horizon (field) |

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|-------------------------------|--|---|---|
| | | <ul style="list-style-type: none"> - Soil-Moisture Potential. - Water Flow in Saturated Soils <p>Principles of soil physics by Rattan Lal and Manoj K.Shukla, 2004.page 234</p> | 2.Soil moisture (water) content (lab) |
| 10. | | <ul style="list-style-type: none"> - Water Flow in Unsaturated Soils. - Water Infiltration in Soil. - Soil Water Evaporation. - Solute Transport <p>Principles of soil physics by Rattan Lal and Manoj K.Shukla, 2004.</p> | Infiltration capacity |
| Studying soil profiles | | | |
| 11. | | <p>Studying soil profiles</p> <ul style="list-style-type: none"> - Methodologies to characterize and quantify effects of soil formation. - Humus mineral horizons - Mean residence time of organic matter in topsoils <p>N.van Breemen, P.Buurman - Soil Formation. 2nd edition</p> | <p>Standardization and calibration curve</p> <p>(Na and K minerals in soil)</p> |
| 12. | | <p>Soil profile Degradation</p> <ul style="list-style-type: none"> - 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 <p>Soil Pollution: origin, Monitoring & Remediation by Ibrahim A. Mirsal. Second edition, 2004, page 95</p> | NO3-N, NH4 |
| 13. | | Final exam | |

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.