The Hashemite University
Faculty of Natural Res. & Eniron.
Dept. Land Management & Environ.
2nd Semester, 2010/2011

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Soil Physics (1202318)
3 Credit Hours

Course Description:
This course talk about soil physical properties, water infiltration into soil, components of the soil water, as in matric, osmotic, gravitational and hydraulic potentials. It also concentrates on soil water movement under saturated and unsaturated conditions, Darcy's law and continuity equation, soil and water equilibrium and water tables. The course ends with a look at the gas diffusion and heat flow in soil, solar energy, budget and aerodynamic effects on evaporation.

Course Objectives:
- Introduce the students to basic soil physical properties and its interaction with the environment.
- Introduce the students to the main principles of water, gas, heat, and solute movement in soils with selected examples related to soil and water management and the influence of soil physical properties on transfer processes.
- Allow the students to practice the major determination and/or estimation principles and methods for the most common soil physical properties either at the field or at the laboratory.

Course Outline	Week
Soil Physics in Perspective Introduction, definitions of soil physics, soil physical properties, spatial influences, scale of observation, areas of importance, relation of soil physics to other sciences, history of soil physics.	1
Calculations and Dimensions of Physical Quantities Physical dimensions, dimensional quantities, volume and mass relationships in soils (solid, liquid, and gaseous phases), volume/mass relationships of soil physical quantities (water density, dry bulk density, particle density, total porosity, aeration porosity, void ratio, water content, equivalent depth of water, relative saturation ratio), relations among soil physical quantities.	2
Soil Texture Amount of solid phase, soil separates, textural classes of soil particles, particle composition, summation curves and uniformity index, determination of particle size distribution (preparation and fractionation of the sample, derivation of sedimentation equation, techniques of mechanical analysis), specific surface (relation of surface area to particle size, relation of specific surface to shape and surface activity, methods of determining specific surface), soil texture profile.	3+4
Soil Structure Definition of soil structure, components of soil structure (soil peds and soil pores), genesis of soil structure (physical, chemical and biological processes), characterization of soil structure (soil physical and morphological techniques), manifestations of soil structure, Effect of cultivation on soil organic-matter dynamics, managing of soil structure.	5+6
Soil Water Principles Introduction, forms of energy (kinetic and potential energies), total soil water potential, component water potentials (gravitational, pressure, matirc, and osmotic potential energies), hydrological horizons (groundwater, vadose, and root zones), methods of soil water determination (water content methods and potential energy methods), soil water retention curve, hysteresis, water terms in soil classification system.	7+8

Soil Water Flow Introduction, flow of water in tubes and pipes, Darcy's law, transport of soil water under saturated conditions, transport of soil water under unsaturated conditions (Darcy's law for unsaturated flow, unsaturated hydraulic conductivity, soil water diffusivity, and transient state unsaturated flow equations), characteristic flow conditions of water in bare soil, determination of hydraulic conductivity.	9+10
Fate and Transport of Mass and Energy Conservation of mass and energy (system, balance equation, water balance, energy balance, derivation of continuity equation), general transport mechanisms (flux density, mass transport, heat transport).	11+12
Soil Temperature Soil temperature classes, thermal concepts (heat, temperature, heat capacity, amount of heat, heat flux, heat flux density, thermal conductivity, thermal diffusivity), factors affecting soil temperature (environmental and soil factors), heat conductance in soil (heat transport mechanisms, Fourier's Law, steady-state heart conductance, methods of calculation soil heat flux density), Continuity equation, heat transport equation (conductive, convective, heat storage, and derivation of soil heat transport equation), predictions of soil thermal regimes, experimental estimation of soil temperature.	13+14
Soil Aeration Gaseous composition of the cosmos and soil atmosphere, mechanism of soil gas exchange (convective and diffusion flow), gas balance equation, diffusion of gas in soil, steady-state concentration profiles, soil air pressure, characterization of soil aeration (aeration porosity, composition of soil atmosphere, oxygen diffusion rate, oxidation-reduction potential, respiration rate).	15+16

Textbook:

- Scott, H.D. 2000. Soil Physics: Agricultural and Environmental Applications. Iowa State University Press, Ames, Iowa.

Additional References:

- Baver, L.D., W.H. Gardner, and W.R. Gardner. 1976. Soil Physics. Wiley Eastern Limited, New Delhi.
- Hillel, D. 1980. Fundamentals of soil physics. Academic Press, New York, USA.
- Hillel, D., 1998. Environmental Soil Physics. Academic Press, London.
- Iwata, S., T. Tabuchi, and B.P. Warkentin. 1995. Soil Water Interactions: Mechanisms and Applications. Second ed. Marcel Dekker, Inc., New York.
- Kohnke, H. 1980. Soil Physics. New York, McGraw-Hill.
- Marshall, T.J. and J.W. Holmes. 1996. Soil Physics. Cambridge University Press.

Evaluation:

First Hour Exam	15%
Second Hour Exam	15%
Assignments & Quizzes	5%
Laboratory	25%
Final Hour Exam	40%

Homeworks:

Homework will be assigned week ahead from the due time. Penalties are restrictedly considered.

Drop Quizzes:

There will be a short quiz at the beginning of some lectures consisting of 1 to 3 brief questions.

Homework

Homework assignments can be handwritten. However, neatness and good organization are required. All intermediate calculations must be shown. All source code (or formulas for spreadsheets) must be submitted in with all computer programming assignments. Please note that homework assignments will not receive full credit unless presented neatly and in an organized format, even if the calculations and content are completely correct. If you submit homework by email, the name of the file(s) *must be like this*: BIE 5110, 2004, HW01, YourName where "YourName" is your name (could be just your last name), and HW01 means "Homework assignment #1." The extension on the filename will depend on what kind of file it is. If you don't follow this file-naming convention, *you will have to resubmit it.*

Quizzes

Several unannounced quizzes will be given during the first five minutes of class time on random days of scheduled class. These are designed to encourage you to stay up-to-date on the reading assignments in the textbook, lecture notes, and other references.

Late Work

All assignments are due at the beginning of class on the date assigned by the Instructor. Late work will be penalized 10% per day.

Group Work

Students are encouraged to discuss concepts and problems with one another or in groups. However, when it comes time to solve a homework problem, or to write a computer program, each student must work independently.

Plagarism

All work, including homework, computer programs, and examinations are to be the student's own original work. No plagiarism of published material or other student's (former or current) work will be allowed. Cheating, falsification, plagiarism and other forms of academic dishonesty are violations of USU policy and can result in grade adjustment, probation, suspension, or expulsion from the university. Please read USU's policy Academic Honesty.

Etiquette

Please arrive in class on time and turn off all cell phones and beepers during class.