SOIL PHYSICS, SWS 4602C
SYLLABUS

I. COURSE INSTRUCTORS:

Dr. Peter Nkedi-Kizza (Kizza): McC- G-155E (Office) or McC-1196 (Lab).
Tel. 352-294-3106, Office (8-5); Cell 352-219-5937 (10 am – 10 pm)
Office hours: Wednesday (1-2 pm), Friday (10-11 am)
TA: McC-1196 (Lab). Tel: 352-294-3129

II. COURSE DESCRIPTION :

Soil is a naturally occurring porous medium that supports the growth of plant roots by retaining air, heat, water, and nutrients; and provides mechanical support for the plant. The course treats the interaction of physical, chemical, and microbiological processes and properties of soils which influence the optimum growth of plants as well as the potential for groundwater and surface water contamination from agrochemicals (fertilizers and pesticides) applied to a variety of crops, turf grass, and golf greens. Primary emphasis will be given to basic concepts of transport and retention for water and solutes, and secondary emphasis will be given to air and heat flow in the root zone of the soil profile.

III. GENERAL COURSE OBJECTIVES:

1. Gain basic understanding of mechanical properties of soils which influence root penetration and growth.

2. Comprehend transfer processes for water, air, solutes, and heat in soils that influence the physical environment of the root zone for plant growth.

3. Perform laboratory and field experiments to measure selected physical properties (parameters) of soils and appropriate fate and transport parameters of agrochemicals in soils.

4. Use mathematical models (where possible) to quantify transfer processes for air, water, and solutes in water saturated and unsaturated soils.

5. Upon completion of the course, students should be able to apply the principles governing the flow and retention of water and solutes in the root zone, solve simple problems involving general water management of soil-water-systems used in agriculture, and agroforestry.

Format:

Two lectures per week, and one laboratory session per week.
Lectures: Tuesdays (11:45-12.35): Thursdays (11:45-12:35); McC-D-G001
Laboratory: Tuesdays (12:50-3:50) in McCarty A, Room 1196
Office hours: Mondays and Fridays and by appointment any time

Textbooks:

1. Environmental Soil Physics, by Daniel Hillel, 1998. Academic Press, Inc. San Diego, California.
2. Syllabus and lecture notes/slides, examples of problem sets similar to examination problems Lab manual and handouts will be provided at the course Website.

LECTURE TOPICS:

I. Introduction: Lectures 1 and 2

A. i. Soil Physics before the 70s (Hillel xix-xxv)
ii. Soil Physics in relation to Natural Sciences and Soil Science.

B. Practical Application of Soil Physics (slides)
i. Transfer processes in soils
ii. Use of transfer processes to manage soils for plant growth.
iii. Mismanagement of transfer processes in soils

C. Application of Physics in Soil Physics (slides)
1. How to acquire Physics knowledge by Scientific Methods
2. Application of Physics laws in Soil Physics
3. Fundamental and derived physical quantities and System of units

II. Basic Physical Properties of Soils (Hillel pages 3-18; 59-72; 101-123)

a. Soil as a porous medium, volume and mass relationships
b. Soil texture, specific surface area, soil structure and aggregation
c. Pore size and distribution, and pore geometry

III. Soil Water (Hillel pages 19-50; 129-198; Lectures 3-6)

a. General properties of water
b. Water rise in a capillary tube
c. Soil water content
d. Measurement of soil water content
e. Energy status of soil water
f. Soil moisture release curves
g. Measurement of soil water potential

IV. Water Flow in Saturated Soils (Hillel pages 173-198 and Lectures 4-6 and 7-10)

a. Driving force for water flow
b. Darcy flux and pore water velocity
c. Darcy's law and Poiseuille's Law
d. Saturated hydraulic conductivity, permeability, and fluidity
e. Vertical and horizontal water flow
f. Water flow in layered soils

V. Water Flow in Unsaturated Soils (Hillel pages 203-233, Lectures 10-14)

a. Darcy's Law in unsaturated soils
b. Hydraulic conductivity as function of water content and potential
c. Estimation of hydraulic functions and diffusivity from soil moisture release curves, and from particle-and pore size distribution.
d. Equation of continuity and Richard's equation
e. Steady and unsteady water flow
f. Infiltration, redistribution and evaporation

VI. Solute Transport and Retention in Soils (Hillel pages 243-268; Lectures 15-18)

a. Types of solutes, sorption kinetics and equilibria (isotherms) in aqueous and mixed solvent systems
b. Molecular diffusion and mass flow
c. Miscible displacement and hydrodynamic dispersion in aqueous and mixed solvent systems
d. Solute transport during unsaturated unsteady water flow

LABORATORY SCHEDULE/EXPERIMENTS

I. Soil Texture/Volume Mass Relationships

1. Soil bulk density and particle density (Lab and Field)
2. Volumetric water content (Gravimetric and Volumetric, Lab and Field)
3. Particle-density (Lab)

II. Water Flow in Soils

1. Mariotte Device
1. Saturated hydraulic conductivity, permeability and fluidity (Lab)
2. One-dimensional infiltration in homogeneous and layered soils (Lab-simulation models)
3. Estimation of hydraulic conductivity and diffusivity functions (Lab-simulation models)
4. Instantaneous profile method for infiltration, redistribution of water and tracers, and measurement of soil hydraulic conductivity functions (Field-simulation models).

III. Convective-Dispersive Solute Transport in Soils

1. Sorption isotherms for pesticides in aqueous and mixed solvent systems (Lab-simulation models)

2. One-dimensional miscible displacement of tracers and pesticides in aqueous and mixed solvent systems (Lab-simulation models)

Grading System:

Two tests at 30% each	60%	
*Comprehensive final exam (optional)		30%
Homework and Lab reports	35%	
Class participation♥	3%	
Class attendance	2%	
Total	100%	

*** = The final will be used to substitute for the lower of the two exams**

♥ = Each student will participate in reviewing the course material before the examination

Grading scale:

A ≥ 90%; A- = 86-89%; B+ =84-85%; B = 82-83%; B - = 80-81%; C+ = 76-79%; C = 74-75% C-= 70-73%

Type of examination questions: Questions will be answered with short-answers, calculations, essays, and at times multiple-choices.

Academic Honesty:

As a result of completing the registration form at the University of Florida, every student has signed the following statement; AI understand that the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University.

Accommodations for Students with Disabilities

Students requesting classroom or laboratory accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

UF Counseling Services

Resources are available on-campus for students having personal problems or lacking clear career and academic goals which interfere with their academic performance. These resources include:

University Counseling Center, 301 Peabody Hall. Personal and career counseling (392-1575).

Student Mental Health, Student Health Care Center. Personal counseling (392-1171).
Sexual Assault Recovery Service, Student Health Care Center. Sexual assault counseling (392-1161).
Career Resources Center, Reitz Union. Career development assistance and counseling (291-1601

Software Use

All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

We, the members of the University of Florida, pledge to hold ourselves and our peers to the highest standard of honesty and integrity.