

# Environmental Soil Physics- 477

Fall Semester (3 Credit hours)

## Instructors

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Office Hours:  
11:30 AM-12:30 PM on Monday and Friday  
Or by appointment

**Course Overview:** This course is designed for undergraduate and graduate students interested in learning basic soil physics and its application to environment quality. The syllabus meets the curriculum needs of students in Soil Science, Environment Science, Natural Resources, Agriculture Engineering, Horticulture and Crop Sciences and Forestry. Students will gain insight on important soil physical properties, critical physical processes involving mass transport, movement and retention of water, solutes (nutrients and contaminants) through soil profile, soil temperature regime, aeration and plant-water relations.

**Objectives:** Objectives of this courses are to: (1) identify soil physical properties and their influence on water retention and transport through soil profile; (2) methods of evaluating soil physical properties; (3) understand nature and properties of soil water; (4) understand fundamental principles of water flow, contaminant transport; (6) develop improved understanding of fundamental processes within the soil profile that control water infiltration, redistribution, evapotranspiration, and drainage; (7) understand impacts of anthropogenic contaminants on ground water quality; and (8) know effects of land use on flow and transport.

**Text Book:** Principles of Soil Physics- Lal and Shukla; ISBN: 0-8247-5324-0; Marcel Dekker Inc.

## Grading:

Midterm Examinations (2)	200 points (25% each)
Homework (5)	100 points (20%)
Final Examination	200 points (25%)
Class Discussion and Participation	25 points (5%)

A= 90-100%; B= 80-89%, C = 70-79%, D= 60-69%, F<60%

**Class Schedule: Days: Monday, Wednesday and Friday**

**Time: 10:30 AM - 11:20 PM**

**Room: Skeen Hall, Room : N120**

**CODE OF CONDUCT:** Please see the Student Code of Conduct in The Student Handbook: ([http://www.nmsu.edu/Campus\\_Life/vpsa/public\\_html/SCOC/index.html](http://www.nmsu.edu/Campus_Life/vpsa/public_html/SCOC/index.html)) Pay particular attention to III. B. Academic Misconduct. Academic misconduct will not be tolerated and will result in severe penalties including an F in the class.

**DISABILITIES:** If you have or think you may have a disability that interferes with your performance as a student in this class, you are encouraged for academic reasons to discuss this on a confidential basis with Services for Students with Disabilities at 646-6840 in Garcia Annex 102 or go to

<http://www.nmsu.edu/~ssd/>. **If you have a disability, you must make this known to me so that arrangements can be made.** If you have a condition that may affect your ability to exit from the premises in case of emergency, you are urged, for safety reasons, to notify me.

**STUDENTS WITH DISABILITIES:** If you have (or believe you have) a disability and would benefit from classroom accommodation(s), please contact the Services for Students with Disabilities (SSD) Office located at Corbett Center, Room 244 [Phone: 646-6840: TTY: 646-1918]

**Student Responsibilities:** Register with SSD and obtain accommodation documents early in the semester; Deliver the completed accommodation and testing form(s) to the instructor(s) within the first two weeks of beginning of classes (or within one week of the date services are to commence); Retrieve the signed form(s) from faculty and return to SSD within (5) days of the receipt from faculty and at least one week before any scheduled exam; and, Contact the SSD Office if the services/accommodations requested are not being provided, not meeting your needs, or if additional accommodations are needed. Do not wait until you receive a failing grade. Retroactive accommodations cannot be considered.

**OTHER HELP:** The Center for Learning Assistance is a valuable resource center for help in note taking, test taking, time-management and other useful academic skills. The website is very informative ([www.nmsu.edu/~cla/ssresources/](http://www.nmsu.edu/~cla/ssresources/)) or you can visit in person (Hardman Hall Room 210).

**GRADE DISPUTES:** If you feel that graded material (exam, assignment, lab) has been incorrectly marked or calculated, please bring it to my attention immediately. After you receive your graded material (exam, assignment, lab), **you have one week to discuss the problem with me.** I will not go back weeks after material is returned and change the grade.

**GRADE POSTING:** Grades for exams, quizzes, assignments, and your final grade will be posted on WEB-CT. I will not post your grades in a public location. Other students will not be able to see your grades unless you give somebody your logon and password identification.

**Note:** (1) Homework set may be discussed on Mondays, if needed.

(2) Homework must be turned in on and before the due date. Late submissions may be accepted with prior permission.

(3) Final grading is based on the cumulative grade or curve rating for the entire class.

**SCHEDULE FOR ENVIRONMENTAL SOIL PHYSICS: 477**

Lecture	Day	Lecture Contents
1		Introduction, Overview and Rationale of the Course
		- Some remarks on soil genesis, soil classification
		- Definitions of soil physical properties
		<b>READING ASSIGNMENT: CHAPTER 1&amp;2 (P. 1-15 of text-book)</b>
		Soil System
		- Interrelationship among soil properties
		- Particle size distribution
		- Systems of particle size classification
		- Stokes law
		- Uniformity Coefficient
		<b>READING ASSIGNMENT: CHAPTER 3 (P. 44-63)</b>
		- Soil Specific Surface
		- Particle shape
		- Packing Arrangement
		- Properties of clay fraction
		- Surface charge, Zeta potential
		<b><u>Home-Work 1: Probs. 1 and 4 pages 11-12; Probs. 1-7 pages 29-30</u></b>
		<b><u>Due on: September 18th</u></b>
		- Surface tension
		- Viscosity
		- Contact angle
		- Capillarity
		<b>READING ASSIGNMENT: CHAPTER 4 (P. 92-140)</b>
		Soil Structure
		- Aggregation
		- Formation of organo-mineral complexes
		- Assessment of soil structure
		- Crusting, surface seal formation
		- Consistency, Plasticity, Atterberg's limit
		Soil water
		- Hydrologic cycle
		- Soil Water Content
		- Methods of measurement
		- Soil Water Potential and its assessment
		- Soil Moisture retention curve
		<b>READING ASSIGNMENT: CHAPTER 3 (P. 52-63)</b>
		<b><u>Home-Work 2: Probs. 1, 2, 4 pages 86-87; probs. 1,3,4 page 161</u></b>
		<b><u>Due on: October 2</u></b>
		Hydrodynamics of Soil Water
		- Darcian, non-Darcian flow

		- Saturated Hydraulic Conductivity, methods of measurement
		- Different forms of Darcy's law
		- Permeability
		- Limitations of Darcy's law
<b>September</b>	<b>7</b>	<b>Labor day holiday</b>
<b>September</b>	<b>25 th</b>	<b>----- Midterm I Exam: -----</b>
		Water movement in unsaturated soil
		- Infiltration
		- Models of infiltration
		- Calculation of infiltration and depth of wetting front
		<b>Home-Work 3: Probs. 1, 4 and 6 page377; Probs. 1 and 2 page 434-435</b> <b>Due on October 30</b>
		<b>READING ASSIGNMENT: CHAPTER 15 (P. 439-463)</b>
		Soil evaporation
		- Evapotranspiration
		- Transport of water in Plants
		- Water use efficiency
		- Management of Evaporation
		- Mulching
		Soil Aeration
		- Gaseous exchange: mass flow, diffusion
		- Green house effect
		- Calculation of fluxes
		- Air permeability
		- Mechanisms of transport of airborne particles
		Thermal properties of soil
		- Heat Capacity
		- Thermal conductivity
		Soil temperature
		-Diurnal, annual cycle
		Heat transport in soil
		- Soil temperature modeling
		<b>READING ASSIGNMENT: CHAPTER 16 (P.465-508)</b>
		<b>Home-Work 4: Probs. 1 and 5 pages 462-3; probs. 1, 2 and 7 page 554</b> <b>Due on: November 18</b>
<b>November</b>	<b>6th</b>	<b>----- Midterm II Exam -----</b>
		Solute Transport
		- Introduction
		- Types of Solutes
		- Miscible-Immiscible displacement
		- Application of Solute Transport

		Solute Transport Processes
		- Introduction to transport processes
		- Tortuosity, representative elementary volume
		- Solute phases in soil matrix
		Solute Mixing and Transport
		- Miscible displacement in a single capillary, network of capillaries
		- Microscopic mixing, pore water velocity
		- Flick's First and second laws
		- Convection, Diffusion, Dispersion
		- Dispersivity
		Solute Transport Equation
		- Interpretation from BTCs
		- Effect of Displacement length, aggregation, pH on BTCs
		- Relationship between dispersion coefficient and pore water velocity
		- Production and decay of chemicals
		<b>Home-Work 5: Probs. 1 and 3 pages 510; examples 16.1, 16.2, 16.3 page 508-509 Due on: November 29</b>
Nov 23-27		-----Thanks Giving Holidays -----
		- CDE Equilibrium and nonequilibrium transport equations
		- Processes, reactions
		- Potential of groundwater contamination
		Estimation of Solute Transport Parameters (DOC- BTC)
		- Retardation Coefficient
		- Apparent Diffusion Coefficient
		- Inverse Modeling
		- Mobile- Immobile fraction
<b>Monday- December 7</b>	<b>10:30 to 12:30 PM</b>	<b>----- Final Examination (In class examination; Skeen: N120) -----</b>

### Other Text Books:

1. Soil Hydrology- Kutilek and Nielsen
2. Environmental Soil Physics- Hillel
3. Soil Physics: Agriculture and Environmental Applications- H. Don Scott
4. Nature and Properties of Soils- N. Brady
5. Principles of Soil Physics- Jury, Gardner and Gardner