GEOL 719, Vadose Zone Hydrology

Schedule:

Section 1	T&Th	10:00 – 11:15am	LFG 202

Instructors:

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Dr. Mark Hausner
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Ms. Rose Shillito
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Desert Research Institute
755 East Flamingo Road
Office hours: By appointment

Course Description:

This course will provide a thorough introduction to vadose zone hydrologic processes, and their impact on issues of soil water movement, data analysis and monitoring. This subject area can be used to explain and solve environmental problems that span many areas of hydrology, plant science, and environmental science. It forms the underpinning of issues that include deep recharge of water, surface runoff, ecosystem development, and land restoration.

The course material will include a discussion of the physical properties of porous media (primarily soil) that can affect water status, such as particle size distribution, bulk density, and soil structure. We will then migrate to relationships of water energy, water content, and hydraulic conductivity in soil, and how these can be used to interpret flow direction, available water for plants, etc. We will look at methods of monitoring and measuring soil water parameters and how they can be used in the field to solve practical problems. Numerical modeling tools will be introduced.

Course Objectives:

- To understand how soil texture and structure affect water movement and storage in soil;
- To understand relationships between soil water pressure, water content and hydraulic conductivity;
- To understand basic techniques for monitoring soil water, storage, movement and characterizing soil hydraulic properties;
- To use this knowledge to be able to design monitoring systems, collect and evaluate data and to use these data for predicting water, heat and solute movement in soil

Broad Course Outline:

- Physical properties of porous media (primarily soil) that can affect water status
- Relationships of water energy, water content and hydraulic conductivity in soil
- Methods of measuring and monitoring soil water parameters
- Numerical modeling tools
- Laboratory and field demonstrations
- Data analysis

Class Notes (Provided) and Suggested Text Book:

- "Vadose Zone Hydrology/Environmental Soil Physics", Lecture Notes by Dani Or, Markus Tuller and John Wraith (2015) – made available on http://classes.dri.edu
- "Environmental Soil Physics", Daniel Hillel (1998) Academic Press, 771p.
  **Note: Hillel's "Intro to Environmental Soil Physics", 2003 is also acceptable.*

Moodle:

All course information including syllabus, class notes, homework assignments, journal articles, etc., will be posted on Moodle at: http://classes.dri.edu. Please go to the website and click on "Vadose Zone Hydrology," then create an account so that you may access the course via the Moodle site. Please visit the Moodle frequently as the instructors will use Moodle for communication and providing updated course information.

Grades:

**subject to change!*
Assignments: 100 points (5 Assignments × 20 points each)
Projects: 200 points (25 points for the final Proposal; 75 points for the project presentation, and 100 points for the project report)
TOTAL: **300 points** possible; grade based on % of 300

Final course grades will be assigned as follows:
A to A- = 100 - 90 %
B+ to B- = 89 - 80 %
C+ to C- = 79 - 70 %
D+ to D- = 69 - 60 %,
F = < 60 %

Project Suggestions - Analyzing Lysimeter Data:

In 2008, three large weighing lysimeters were constructed for the purpose of measuring vadose zone processes. Data have been collected since August 2008. Because of the close connection between this class and the lysimeter project, there is an opportunity to analyze lysimeter data as the final class project and answer some basic questions about the soil water status in the lysimeters. Data related to soil water parameters will include, but are not limited to, water content, matric potential, soil temperature, soil heat flux, CO_2 concentrations, etc. for specific depths and positions. Possible tasks/research questions, are listed below:

1. How deep does rainwater infiltrate into the soil? How fast does water evaporate from the soil?
2. What is the soil water storage as measured using different technologies? How do the technologies compare?
3. What is the wetting front velocity? Is it uniform or non-uniform across the surface?
4. Are particular instruments more or less sensitive to changes in water status?
5. etc.

Additional Information

Withdrawals:

Withdrawals from the course are possible through the date specified in this semester's Catalog. Until then you may drop with no questions asked. After that date, withdrawals are not permitted for any reason.

Copyright and Fair Use Requirements:

The university requires each member of the University Community to become familiar with and follow copyright and fair use requirements. You are individually and solely responsible for violations of copyright and fair use laws. The University will neither protect nor defend you nor assume any responsibility for employee or student violations of copyright or fair use laws. Violations of copyright laws could subject you to federal and state civil penalties and criminal liabilities as well as disciplinary action under University policies. To help familiarize yourself with copyright and fair use policies, the University encourages you to visit its copyright web page at: http://www.unlv.edu/committees/copyright.

Disabilities:

If you have a documented disability that may require assistance, you will need to go to the Disability Resource Center (DRC) for coordination of academic accommodations. The Disability Resource Center is located in the Student Services Complex – Building A (SSC-A, Room 137). The DRC phone number is 702-895-0866 (TDD-895-0652) or drcssc@ccmail.nevada.edu.

Academic Misconduct:

Academic honesty / dishonesty matters will be treated in accordance with the Academic honesty/ dishonesty statement as printed in the UNLV Undergraduate Catalog.

Religious Holidays:

It shall be the responsibility of the student to notify the instructor no later than the last day of late registration of his or her intention to participate in religious holidays which do not fall on State holidays or periods of class recess. This policy shall not apply in the event that administering the test or examination at an alternative time would impose an undue hardship on the instructor or the University, which could not reasonably have been avoided.

Nondiscrimination:

The University of Nevada, Las Vegas, does not discriminate on the basis of race, color, creed, religion, national or ethnic origin, gender, age, sexual orientation, disability or veteran status.

Writing Center:

Students are welcome to use the UNLV Writing Center (CDC-3-301) free of charge. Consultants can assist students at all stages of the writing process, from generating ideas to developing and polishing later drafts. Students may make 30-minute appointments by calling the Center at 702-895-3908.

Course Schedule:

Note: Schedule can change either way depending on student input and other interesting subjects.
Markus Berli (MB), Mark Hausner (MH), Rose Shillito (RS), Jeremy Koonce (JK), TBD = To be determined

Week/Date		Topic	Instructor	Reading	Activity
1	1/19	Class introduction	ALL		
	1/21	Introduction to soils	MB/RS	Or & al. Section 1.1-1.5 and Rose's notes	
2	1/26	Introduction to soils	MB/RS	Or & al. Section 1.1-1.5 and Rose's notes	
	1/28	Soil solid phase	MB	Or & al. Section 1.1-1.5	*Homework #1 Due*
3	2/02	Soil liquid phase	MB	Or & al. Section 1.6	
	2/04	Soil physical properties - Lab demo	RS/JK	Rose's notes	
4	2/9	Energy state of soil water	MB	Or & al. Section 1.7	
	2/11	Water potential and its components	MB	Or & al. Sections 1.8-1.10	*Homework #2 Due*
5	2/16	Water potential and its components	MB	Or & al. Sections 1.8-1.10	
	2/18	Soil water characteristics	MB	Or & al. Section 1.11	
6	2/23	Water flow in saturated soils	MH/MB	Or & al. Sections 2.1-2.6	
	2/25	Water flow in unsaturated soils	MB/MH	Or & al. Sections 2.7-2.9	*Homework #3 Due*
7	3/01	Water flow in unsaturated soils	MB/MH	Or & al. Section 2.10	
	3/03	Infiltration	MB	Or & al. Sections 2.11, 2.12	
8	3/08	Evapotranspiration	MB	Or &al. Section 3	
	3/10	SEPHAS introduction/field trip	ALL		
9	3/15	Water flow and storage - Lab demo	RS/JK	Rose's notes	
	3/17	Hydrology	ALL		
10	3/22	Spring Break			No class
	3/24	Spring Break			No class
11	3/29	Soil gaseous phase and transport	MB/MH	Or & al. Section 6 Mark's notes	
	3/31	Thermal properties of soil	MH	Mark's notes Or & al. Section 4	*Proposal Due*

Week/Date		Topic	Instructor	Reading	Activity
12	4/05	Solute Transport	MH/MB	Mark's notes Or & al.5.1-5.4	
	4/07	HYDRUS-1D	MH/RS	Mark's notes	*Homework #4 due*
13	4/12	HYDRUS-1D	MH/RS	Mark's notes	
	4/14	HYDRUS-1D	MH/RS	Mark's notes	
14	4/19	HYDRUS-1D	MH/RS	Mark's notes	
	4/21	TBD	ALL		*Homework #5 due*
15	4/26	Projects	ALL		*Presentations*
	4/28	Projects	ALL		*Presentations*
16	5/03	Projects	ALL		*Presentations*
	5/05		ALL		
17	5/10 5/12	Finals week/Projects	ALL		*Presentations and Project Reports Due (5/12)*