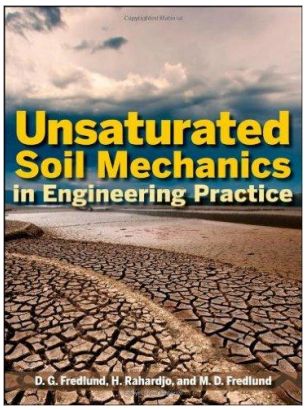
CE 5390 Unsaturated Soil Mechanics
Lecture Sessions: MW 6:00-7:20 pm.
UGLC, Room 340
Fall 2017

Instructor: Reza Ashtiani, Ph.D. (reza@utep.edu)

Office: Engineering Annex. Room 217.



Office Hours: Students are always welcome.

Text: *Unsaturated Soil Mechanics in Engineering Practice*, By: Fredlund and Rahardjo, Second Edition, Publisher: John Wiley and Sons, Inc. 2012.

References:

- *Unsaturated Soil Mechanics*, by: Ning Lu and William J. Likos, First Edition, Publisher: John Wiley and Sons Inc, 2004.
- *Mechanics of Unsaturated Geomaterials*, by: Lyesse Laloui, First Edition, Publisher: John iley and Sons Inc., 2010

Class Website: www.rezasalehi.com/CE-5390

COURSE OBJECTIVES

The objective of this course is to provide civil engineering graduate students with an in-depth understanding of the concepts in unsaturated soil mechanics. This course is designed to underscore the theories, models and analysis methodologies available for the quantification of the influence of moisture on the directional stiffness properties of geomaterials. The main focus of the course will be on providing the students with the rationale behind the theories available to geotechnical engineers to mechanistically design geostructures and analyze soil-structure interactions. The second segment of the course deals with the chemical stabilization of soils. This segment provides information on different types of stabilizers and the mechanism by which they improve the

orthogonal load bearing capacity of stabilized layers. The course requires students to have sufficient background knowledge in geotechnical engineering and mechanics of materials.

Upon successful completion of this course, the student will have gained knowledge in the following areas:

- ***State Variables and Physical Properties of Soils:*** general concepts of soil mechanics such as soil texture and soil consistency. Particle size distributions and their relevance to engineering practice. Soil plasticity, soil-water interaction, diffused double layer, soil water characteristic curve (SWCC), and capillary action in fine grained and coarse grained soils. Additional topics such as field and laboratory compaction of soils will be discussed in details.
- ***Strength and Deformation of Soils:*** Shear strength concept, Mohr-Coulomb failure criteria, triaxial tests, Hankel's pore water pressure parameters, and the determination of the shear strength of soils in the field. Influence of the matric suction on soil strength, Bishop's model for unsaturated soils.

SCHEDULE

A tentative lecture schedule is on the class website. All course materials including lecture notes, reading assignments, supplemental materials such as calculation Excel spreadsheet, Homework Assignment, and etc. will be posted on class website. Please refer to the following link: *http://www.rezasalehi.com/CE-5390.html* to download course materials. The site password is students. Reading assignments from your text and handouts will be assigned in class at the end of each lecture session. Prepared notes will occasionally be handed out in class to supplement, or in some cases to substitute for, reading materials from the textbook. Be sure to save the notes because you will be tested over at least some of the material in them.

GRADING

Your grade for this course will be determined on the basis of ***1050 points*** as follows:

1. Final term paper (400 points)
2. Final Podium Presentation (400 points)
3. Homework Assignments (200 points)
4. Critical Assessment (attendance and involvement in discussions) (50 points)

In accordance with University regulations, students who miss examinations or fail to submit the final deliverables will receive grades of zero. Exceptions to this rule will be made only on a carefully considered individual basis and only if the student contacts the instructor ***before*** the due dates. If you know in advance that you are going to miss an exam or a deadline, it is ***your*** responsibility to inform the instructor before the exam.

GRADE STRUCTURE

Final grades assigned for this course will be based on the percentage of total points earned and are assigned as follows:

Letter Grade	Percentage	Performance
A	90-100%	Excellent Work
B	80-89%	Very Good Work
C	70-79%	Average Work
D	60-69%	Poor Work
F	0-59%	Failing Work

HOMEWORK ASSIGNMENTS

All homework problems will be assigned in the class. The due date for homework submission will appear on the homework assignment and is due before 7:30 pm. Past experience clearly shows that a student's grade is strongly dependent upon the effort that is put into working and

understanding the homework. Please note that each student is responsible to submit the homework assignment individually.

POLICY ON CHEATING

Students are expected to be above reproach in all scholastic activities. Students who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the university. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student, or the attempt to commit such acts (Regents' Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22). Scholastic dishonesty harms the individual, all students, and the integrity of the university. Policies on scholastic dishonesty will be strictly enforced.

COURSE/INSTRUCTOR EVALUATION

An online course/instructor evaluation will be conducted near the end of the semester.

FINAL COMMENT

Good luck to all of you in this course. Please do not hesitate to ask questions in class, or if necessary, to see me outside of class. Any specific comments that students have on how the course might be improved are particularly welcomed, especially during the semester.

CE5390

Unsaturated Soil Mechanics

Tentative Course Outline

Topic No.	***Description***
1	***General Concepts Part 1:*** Soil Structure, Consistency of Cohesive Soils, plasticity, Clay Activity, Atterburg Limits, USCS and AASHTO Soil Classification.
2	***General Concepts Part 2*****:** Weight-Volume Relationships, Standard and Modified Soil Compaction Tests.
3	***State Variables:*** Stress State Variables for Unsaturated Soils, Pore Pressure and Effective Stress Concepts, Bishop Relationship.
4	***Soil Suction:*** Nature of Water in Clays, Repulsive Potential, Repulsive Pressure, Capillary Action, Matric Suction, Osmotic Suction, Soil Water Characteristic Curve (SWCC)
5	***Shear Strength of Soils:*** Stress Path, Mohr Circle, Mohr-Coulomb Failure Criteria, Shear Strength in the Laboratory (Direct Shear Test, Triaxial Compression Test, CU, UU and CD tests), Skempton's Pore Water Pressure Parameters, Shear Strength in the Field (Vane Shear, CPT, SPT, PMT, CBR)
6	***Sub-Soil Exploration****:* In-Situ Tests, Boring Methods, Sampling Methods, Sample Distribution, Soil Exploration Reports.
7	***Clay Mineralogy:*** X-ray Diffraction, D-Spacing, Clay Minerals, Mineralogy and surface Activity, Mineralogy and Soil Plasticity.
8	***Pozzolanic Reactions:*** General definitions and the chemistry**,** Ettringite Formation, Silica Solubility, Eades and Grimm PH Tests.
9	***Chemical Stabilizers:*** Cement, Lime, Fly Ash, Enzymatic Stabilizers, Determination of the type and Stabilizer Contents.
10	***Case Studies:*** ICAR 508, Denver Airport, TxDOT 0-6812