

**CE 5320 Advanced Geotechnical Engineering
Lecture Session: TR 6:00-7:20
Classroom Building, C304
Fall 2018**

Instructor: Reza Ashtiani, Ph.D. (reza@utep.edu)
Office: Engineering Annex. Room A-217.

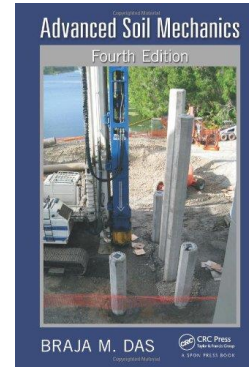
Office Hours: Students are always welcome.

Text: Advanced Soil Mechanics, by Braja M. Das, Fourth Edition, Publisher: CRC Press-Taylor & Francis, 2014.

References:

- Unsaturated Soil Mechanics in Engineering Practice, By Fredlund and Rahardjo, John Wiley and Sons, 2012.
- Soil Strength and Slope Stability, by Duncan and Wright, John Wiley and Sons, 2005.

Class Website: www.rezasalehi.com/CE-5230



OBJECTIVES OF COURSE

The objective of this course is to provide civil engineering graduate students with an in-depth understanding of the concepts in geo-mechanics as well as analysis and design of geo-structures. 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 geo-structures and analyze soil-structure interactions. 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:

- **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. Elastic settlements, Consolidation theory, e -log σ plots, normally consolidated and over

- consolidated clays, accelerated settlement and pre-compression of soils.
- **Factor of Safety concept:** variation of the factor of safety during the construction, reliability analysis of FS, probability of failure in the analysis and design of geo-structures.
 - **Analysis and Design of Geo-structures:** active and passive earth pressure, Rankin and Coulomb's theories, design of retaining structures, general concepts of shallow foundations, analysis of the bearing capacity for foundations, and slope stability.

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-5320.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 comprehensive examination (400 points)
2. Homework Assignments (300 points)
3. Term Project (300 points)
4. Critical Assessment (attendance and involvement in discussions) (50 points)

In accordance with University regulations, students who miss examinations 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 exam. If you know in advance that you are going to miss an exam, 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

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. Homework solutions will be available on due dates. 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.

Advanced Geotechnical Engineering

Tentative Course Outline

<i>Topic No.</i>	<i>Description</i>
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	Stresses in Soils: Geostatic and External Stresses in Soils, Pore Water Pressure Concept, Boussinesq and Westergaard Relationships for External Stress. Calculations, Effect of Ground Water Table.
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	Settlement Analysis of Soils: Consolidation Theory, Immediate Settlement in Granular Soils, Primary consolidation, Secondary Compression, Time Rate of Settlement, Methods for Accelerating Consolidation Settlements, Pre-compression.
7	Lateral Earth Pressure: At Rest Active and Passive Pressure, Rankin's Theory, Coulomb's Theory, Retaining Structures.
8	Factor of Safety: Stability Conditions for Analysis, End of Construction Stability, Long-term and Short term Stability, Staged Construction, Rapid Draw Down.
9	Reliability and Factors of Safety: Factor of safety Criteria, Reliability and Probability of failure, Reliability Index and Probability of Failure.
10	Retaining Structures: Design and Analysis of Gravity and Cantilever Walls, Stability Analysis, Overturning and Sliding along the base, Bearing Capacity Failure, backfill Drainage.
11	Curved Failure Surfaces: Logarithmic Spiral, Canquot and Kerisel Solutions, Braced Cuts, Pressure Variation for the Design of Sheetings, Struts and Wales.
12	Bearing Capacity of Shallow Foundations: Terzaghi's Ultimate Bearing Capacity, Effect of Ground Water Table, Factor of Safety, One-Way and Two-Way Eccentricity.
13	Sub-Soil Exploration: In-Situ Tests, Boring Methods, Sampling Methods, Sample Distribution, Soil Exploration Reports.