Department of CAEE — Fall Semester, 2009
The University of Texas at Austin — Uniques No. 15735, 15740, 15745, 15750, 15755

CE 357

GEOTECHNICAL ENGINEERING

	Class Lectures:	*Laboratory:*
Days:	Monday, Wednesday, Friday	(varies with lab section)
Time:	1:00 p.m. – 1:50 p.m.	
Building:	Ernest Cockrell, Jr., Hall	Ernest Cockrell, Jr., Hall
Room:	ECJ 1.204	ECJ – B.140
	Instructor:	*Teaching Assistant:*
	Dr. Jorge G. Zornberg	(varies with lab section)
Office:	ECJ 9.227G	
Phone:	(512) 232 - 3595	
E-mail:	zornberg@mail.utexas.edu	
Office Hours:	Mon, Fri 2:00 p.m. - 3:00 p.m.	

Required Course Texts

1. *Class Textbook:* Coduto, Donald P. (1999). *Geotechnical Engineering: Principles and Practices.* Prentice Hall, Upper Saddle River, New Jersey. (ISBN 0-13-576380-0).

2. *Course Notes: CE 357 – Geotechnical Engineering* - Available in the Textbook Department of the University Co-op (2246 Guadalupe St.). This packet contains supporting materials for the course lectures. *Please bring these course notes to class each day.*

3. *Laboratory Text:* Daniel, David E., and the Civil Engineering Faculty (1998). "Laboratory Notes for CE 357 - Geotechnical Engineering." (available at University Co-op).

4. *Other Materials:* To plot data and perform graphical solutions in homework assignments, laboratory reports, and exams, *you must have a straight edge, compass, protractor, and a good French curve*. You will also need several sheets of 3-cycle and 5-cycle semi-logarithmic graph paper.

There are a number of good, basic textbooks on geotechnical engineering that you may find helpful in your studies for this course. I suggest the following books, which should be available in the library:

Bardet, Jean-Pierre (1997). *Experimental Soil Mechanics.* Prentice Hall, Upper Saddle River, New Jersey.

Bowles, Joseph E. (1986). *Engineering Properties of Soils and Their Measurement.* Third edition. McGraw-Hill, New York.

Cernica, John N. (1995). *Geotechnical Engineering: Soil Mechanics.* John Wiley and Sons, New York.

R. F. Craig (1997). *Soil Mechanics*. Sixth Edition, Chapman & Hall.

Das, Braja M. (2002). *Principles of Geotechnical Engineering.* Fifth edition, Brooks/Cole, Pacific Grove, California.

Holtz, Robert D., and Kovacs, William D. (1981). *An Introduction to Geotechnical Engineering.* Prentice Hall, Englewood Cliffs, New Jersey.

Lambe, T.W., and Whitman, R. (1969) *Soil Mechanics.* Wiley and Sons, New York.

McCarthy, David F. (2002). *Essentials of Soil Mechanics and Foundations: Basic Geotechnics*. Sixth edition, Prentice Hall, Upper Saddle River, New Jersey.

Sowers, George F. (1979). *Introductory Soil Mechanics and Foundations: Geotechnical Engineering.* Fourth edition, Macmillan Pub., New York.

Course Objectives

The overall objectives of this course are to introduce the terminology used in geotechnical engineering and to provide a basic understanding of important geotechnical principles and methods of analysis. Geotechnical engineering focuses on how soil and rock support and affect the performance of structures built on or below the earth's surface. This course will introduce the student to the basic principles that govern the behavior of soils, foundations, and other geotechnical engineering works. The central concepts to be covered in this class are:

(1.) index properties and classification of soils;
(2.) soil permeability and pore water movement;
(3.) stresses in soil and the effective stress concept;
(4.) soil compressibility, consolidation, and settlements;
(5.) shear strength of soil; and
(6.) engineering soil properties and their measurement.

An understanding of these basic concepts is essential in the design of foundations for structures, retaining walls, tunnels, excavations, earth fills, dams, pavements, stable earth slopes, sanitary landfills, and environmental remediation projects. By the end of this course, the student should be able to:

(1.) Classify the different types of geotechnical materials.
(2.) Become familiar with the tests needed to describe and predict the behavior of a soil, permitting the student to work effectively with specialists in geotechnical engineering.
(3.) Apply basic hydraulic flow principles to interpret the behavior of geotechnical components in hydraulic systems (e.g. earth dams).
(4.) Explain the response in effective stresses to a change in total stresses.

(5.) Apply the theory of consolidation to estimate time-dependent settlements. Select and justify the selection of solutions to settlement-related problems.
(6.) Acquire the background knowledge needed to complete more advanced courses in geotechnical engineering (CE 360K - *Foundation Engineering*, CE 375 - *Earth Slopes and Retaining Structures*, as well as courses at the graduate level).
(7.) Improve professional engineering skills, including the presentation of technical data and written communications.

Course Prerequisites

- Engineering Mechanics 319 - *Mechanics of Solids*
- Civil Engineering 319F - *Elementary Mechanics of Fluids*

Schedule

This class will meet for an average of two lectures each week. A tentative schedule for the class lectures is attached. During most weeks, the class will meet for lectures or exams on Monday and Wednesday with no class on Friday. However, because of various national and international committees, meetings and conferences, I will have to travel on university-sanctioned business during this semester. I will cover these periods by holding classes on Fridays. Therefore, *because we will be having class on several Fridays during the semester, you should not make plans to leave town on any given Friday*. In addition, the class will often meet on the Friday before each exam for a question-and-answer review session. Check the attached lecture schedule for the planned meeting days, as well as tentative dates for all examinations.

Recommended reading assignments from the course textbook are indicated on the lecture schedule. Clarifying and expanding your class notes by reading the appropriate text sections after each lecture is highly recommended. Additional handouts may be given in class; extra copies of these handouts will be placed in the class box outside of ECJ 9.227.

Attendance

Students are expected to attend all class periods, and attendance may be periodically recorded. *Attendance in all laboratory periods is mandatory.*

Examinations

There will be two midterm exams, given during the regularly scheduled class time, and a *comprehensive* final examination. In addition to the material covered in the class lectures, the exams may include questions from your work in the laboratory portion of the class. Make-up examinations will not be given. Students who miss a midterm exam will receive a grade of zero for that exam. Exceptions to this rule will be made only on a carefully considered basis, and only

if the student contacts me *before* the exam. In such cases, your score on the other class exams will count proportionally more in computing your final score.

All of the examinations will be closed-book, closed-notes. However, you are permitted to bring sheets (8.5 x 11 inch) written on one side only, of your *own handwritten* equations to each exam. One sheet will be permitted for the first exam, two sheets for the second exam, and three sheets will be allowed for the final exam. This way, the new sheet you prepare for each exam will be used again for later exams. You may write only equations (no notes, no graphs) on one side of these sheets. Design charts and similar materials will be provided when needed. The organizational effort required to create your equation sheets is an effective means of reviewing the course content before an exam. In addition, you need to bring a straight edge, compass, protractor, and a French curve to the exams.

The final examination will cover all of the material from the semester. According to the university schedule, the final exam will be held from 2:00 pm to 5:00 pm on Friday, December 11, 2009.

Homework Assignments

Homework problems will be assigned every week and will be due at the *beginning of class* on the date specified. Extra copies of the assignments will be placed in the class box outside of ECJ 9.227. To encourage you to stay current with the class lectures, late assignments will not be accepted for grading. Assignments will be returned in class. Homework solutions will be posted on Blackboard.

As you will quickly learn after college, most practicing engineers spend more time and effort communicating their ideas, analyses, and results than they do performing technical calculations. To encourage the development of these vital professional skills, some of your assignments will require a written response. Neatly draw all sketches and data plots using a straight edge, French curve, compass, etc., and show all relevant labels. Engineering computation paper is recommended for your assignments; *pages torn from a spiral notebook are unacceptable*. As much as possible, your assignments should reflect real-world engineering practice where your submission to a client involves much more than calculations. Above all, present your results clearly and concisely so that someone else, who may be less knowledgeable than you are, can understand and apply your results correctly.

Failure to submit legible, neat, professional-looking assignments will adversely affect your grade. Although the assignments may not count in your final grade in proportion to the effort required, much of what you learn in this course will come from doing the assignments. Use the assignments as an opportunity to understand more completely the material presented in class and to develop your professional engineering skills.

Laboratory Assignments

Each student in this class must register for a laboratory section as listed in the University Course Schedule for this semester. The laboratory is a crucial component of this course. ***As mentioned, attendance to all laboratory class meetings is mandatory.*** Please consult with the laboratory instructor ahead of time if you must miss a scheduled laboratory meeting. The laboratory sections meet in ECJ B.140; a tentative schedule of the laboratory exercises is attached. Your laboratory instructor will discuss grading and other matters concerning this part of the course.

Grading

Your final letter grade will be determined by your performance relative to others in the class. Divisions between grade levels, as well as a likely "class curve", are not pre-determined. Your final score for this course will be computed using the following weights:

Class Assignments	15 %
Laboratory Assignments	15 %
Midterm Exam # 1	18 %
Midterm Exam # 2	18 %
Class Participation	4 %
Final Examination	30 %
Total	100 %

University Policies and Deadlines

Dropping the course: Students are strongly urged to make any changes in their course schedules during the first week of classes so that other students who wish to add the course can be accommodated. The following policies are in effect for students wanting to drop this course:

- From the 1st through the 12th class day, an undergraduate student can drop a course on ROSE or TEX, and receive a refund.
- From the 13th through the 20th class day, an automatic 'Q' grade is assigned; approval from the Dean and the departmental advisor is required.
- From the 21st class day through the mid-semester deadline, approval is required from the Dean, the course instructor, and the departmental advisor.
- After the mid-semester deadline, drops are not permitted except upon the approval of the student's Dean. "Urgent and substantiated, nonacademic reasons acceptable to the Dean" are required in order to drop a class.

Religious Observances: A student who is absent from a class or examination for the observance of a religious holy day may complete the work missed within a reasonable time after the absence, provided the student has notified the instructor in writing before the absence and not later than the 15th class day.

Students with Disabilities: The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. Any student with a documented disability (physical or cognitive) who requires academic accommodations should contact the Services for Students with Disabilities area of the Office of the Dean of Students at 471-6259 as soon as possible to request an official letter outlining authorized accommodations. For more information, contact that Office, or TDD at 471-4641, or the College of Engineering Director of Students with Disabilities at 471-4321.

Academic Integrity

Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. Violations will be reported to the Office of the Dean of Students. For further information, visit the Student Judicial Services web site http://www.utexas.edu/depts/dos/sjs/. Remember, as an engineer, you are held to a high standard of ethical conduct.

All written work submitted for this class *must* be entirely your own. This requirement will be strictly enforced for examinations. In doing class or laboratory assignments, however, you are encouraged to consult with your fellow classmates regarding the most appropriate solution to a given problem. Still, each student must prepare *his or her own, individual* submission for each assignment. For example, you are permitted to work together in deciding the best approach to a problem, but everyone must work through the entire problem on his or her own. *Identical copies of computations or data plots are not acceptabl*e. Working together on assignments should foster your understanding of the course material; avoid working with other students unless all parties gain from the experience.

Course and Instructor Evaluation

A course and instructor evaluation will be conducted in class at the end of the semester. In addition, comments (verbal, written, or e-mail) about the course are very welcome at any time. Your suggestions for improving the course content or presentation are particularly appreciated.

Class Participation

Class participation is strongly encouraged. Do not hesitate to raise questions, ask for clarification, or suggest your own ideas during class. In addition, at all times you are invited to submit written questions and comments on paper or via email.

Topic Outline and Tentative Schedule — CE 357, Fall Semester 2009

Day	Date	#	Lecture	Sections in Coduto (1999)
Mon	Aug 24		- No Class: MLK Day	
Wed	Aug 26	1	Course Introduction; Geotechnical Engineering	1.1-1.3
Fri	Aug 28	2	Phase Relationships	4.1-4.3
Mon	Aug 31		- No Class	
Wed	Sep 02		- No Class	
Fri	Sep 04			
Mon	Sep 07		- No Class: Labor Day	
Wed	Sep 09		- No Class	
Fri	Sep 11	3	Soil Index Properties	4.4-4.8
Mon	Sep 14	4	Soil Classification	5.1-5.6
Wed	Sep 16	5	Site Investigations, Boring and Sampling	3.1-3.13
Fri	Sep 18	6	Darcy's Law for Groundwater Seepage	7.3-7.5; 8.1
Mon	Sep 21	7	Darcy's Law for Groundwater Seepage (cont.)	7.2-7.3
Wed	Sep 23	8	Total and Effective Stresses	10.1-10.4; 10.7
Fri	Sep 25	9	Seepage Pressures, Capillarity	7.6; 8.3; 10.10
Mon	Sep 28	10	Seepage Pressures, Capillarity (cont.)	7.6; 8.3; 10.10
Wed	Sep 30	11	Review session (optional)	
Fri	Oct 02	12	**Midterm Exam No. 1**	
Mon	Oct 05		- No Class	
Wed	Oct 07		- No Class	
Fri	Oct 09			
Mon	Oct 12	13	Soil Compaction	6.0-6.3
Wed	Oct 14	14	Introduction to Consolidation	11.0-11.3
Fri	Oct 16	15	Consolidation Settlements	11.4
Mon	Oct 19	16	Consolidation Settlements	11.4-11.7
Wed	Oct 21	17	Time-Rate of Consolidation	12.1
Fri	Oct 23	18	Time-Rate of Consolidation	12.2-12.6
Mon	Oct 26	19	Surcharging	12.7; 19.2
Wed	Oct 28	20	Mohr's Circle	10.9
Fri	Oct 30			
Mon	Nov 02	21	Shear Strength of Soils – Direct Shear	13.0-13.3
Wed	Nov 04	22	Direct Shear Tests – Triaxial Compression Tests	13.0-13.3
Fri	Nov 06			
Mon	Nov 09	23	Triaxial Compression Tests (cont.)	13.4-13.8
Wed	Nov 11	24	Triaxial Compression Tests (cont.)	13.4-13.8
Fri	Nov 13			
Mon	Nov 16	25	Stress Distribution Beneath Surface Loads	10.5-10.6
Wed	Nov 18	26	Review session (optional)	
Fri	Nov 20	27	**Midterm Exam No. 2**	
Mon	Nov 23	28	Settlement of Footings on Clay	17.4
Wed	Nov 25	29	Settlement of Footings on Sand	17.4
Fri	Nov 27		- No Class: Thanksgiving	
Mon	Nov 30	30	Shrinkage and Swell Problems	18.1-18.4
Wed	Dec 02	31	Geotechnical Applications in Soil Mechanics	
Fri	Dec 04			

Final Examination: Friday, December 11, 2:00 p.m. – 5:00 p.m.

Laboratory Schedule CE 357, Fall Semester 2009

Week of:	Monday	Tuesday	Wednesday	Thursday	Friday
August 24	--	--	- no lab -	- no lab -	- no lab -
August 31	Water Content	Water Content	Water Content	Water Content	Water Content
September 7	HOLIDAY	Specific Gravity	Specific Gravity	Specific Gravity	Specific Gravity
September 14	Specific Gravity & Grain Size	Grain Size	Grain Size	Grain Size	Grain Size
September 21	Atterberg Limits, Classification	Atterberg Limits, Classification	Atterberg Limits, Classification	Atterberg Limits, Classification	Atterberg Limits, Classification
September 28	Hydraulic Conductivity	Hydraulic Conductivity	Hydraulic Conductivity	Hydraulic Conductivity	Hydraulic Conductivity
October 5	Compaction	Compaction	Compaction	Compaction	Compaction
October 12	Consolidation (set up/loading)	Consolidation (set up/loading)	Consolidation (set up/loading)	Consolidation (set up/loading)	Consolidation (set up/loading)
October 19	Consolidation (loading)	Consolidation (loading)	Consolidation (loading)	Consolidation (loading)	Consolidation (loading)
October 26	Consolidation (data reduction)	Consolidation (data reduction)	Consolidation (data reduction)	Consolidation (data reduction)	Consolidation (data reduction)
November 2	Direct Shear	Direct Shear	Direct Shear	Direct Shear	Direct Shear
November 9	Unconfined Compression, Lab Vane	Unconfined Compression, Lab Vane	Unconfined Compression, Lab Vane	Unconfined Compression, Lab Vane	Unconfined Compression, Lab Vane
November 16	Q-type Triaxial Test	Q-type Triaxial Test	Q-type Triaxial Test	Q-type Triaxial Test	Q-type Triaxial Test
November 23	- no lab -	- no lab -	- no lab -	- no lab -	- no lab -
November 30	Final Lab Meeting	Final Lab Meeting	Final Lab Meeting	Final Lab Meeting	Final Lab Meeting