

CEE 142: SOIL MECHANICS (3CR)

Instructor:

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Final Exam: August 13th.

Course:

CEE 142, Soil Mechanics
Summer 2023
Class Hours: M-R, 10:00 am – 11:35 am
Classroom: zoom
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Course Description:

Physical properties of soils; mineralogy, composition and fabric. Phase and weight-volume relationships, consistency, gradation and classification of soils. Fluid flow through porous media. Stress-strain behavior; stresses within a soil mass, deformation behavior, measurement of stress-strain properties, shear strength of soil. Volume change in soils; compressibility, pore water pressure, consolidation and settlement. Laboratory experiments to measure physical and mechanical properties of soils. Prerequisites as noted below. Prerequisite: MECH 002 or MECH 003 or CEE 003.

Textbook:

Principles of Geotechnical Engineering, 10th Ed., by Braja M. Das, Cengage Pub.

Reference Materials:

Engineering Principles of Soils & Their Measurement, 4th Ed., McGraw-Hill; by J.E. Bowles.
An Introduction to Geotechnical Engineering by Holtz, W. Kovacs, and T. Sheahan, Pearson Prentice Hall, 2nd Ed.

Tentative Grading:

Homework, Quizzes, and Project	25%
Two Midterm Exams	30%
Comprehensive Final Exam	35%
Laboratory	10%

Course Conduct:

- **Attendance.** The University attendance regulations and CEE department attendance will be followed in CEE 142.
- **Examinations:** Two midterm exams and a final exam will be scheduled for the class. No makeup examinations will be given except for properly documented emergency situations. In general, the opportunity for make-up is granted only when there are extenuating circumstances.
- **Assignments:**
 - **In class lecture handouts** will be completed and submitted by each student as assigned.
 - **Homework assignments** will be submitted by each student as assigned.
 - **Any work below 70% will be supplemented with additional individual assignment for the student.**
 - Homework solutions should conform to the standards of good engineering practice
 - Clearly labeled on numbered pages.

Disclaimer: This document may change as the semester progresses.

- Your name, assignment number, and page number should appear on each page.
- Each problem should start in a new page, and consist of: **1- given data, 2- statement of what is to be found, 3- the solution, and 4- the answer**
- Work should be **organized and presented neatly**. Assumptions should be clearly stated, units should be noted on answers and key intermediate results, and answers should be clearly identified.

Homework **points will be deducted** if any the preceding requirements are not followed.

Laboratory RULES & PROCEDURES should be adhered to strictly. Noncompliance will result in progressively increasing loss of points from the lab reports turned in. The general rules and procedures will be discussed on the first day of the laboratory.

TENTATIVE EXPERIMENT OUTLINE

Lab	EXPERIMENT
1	Sieve and Hydrometer Analysis
2	Consistency Limits (Atterberg Limits)
3	Soil Density
4	Soil Permeability
5	Numerical Lab, Stress Distribution and other
6	Consolidation Test
7	Unconfined Compression Test
8	Direct Shear Test/Calculation Lab
9	Triaxial Compression Test/Calculation Lab
10	Numerical Lab for Slope Stability Analysis

Laboratory Grading: Lab Reports (70%), Lab Exam (15%), Attendance & Participation (15%)

Report Format: Follow the Notes on Report Writing handout. Use Word Processing, Spreadsheet and Computer Graphics tools to generate the main text of your report. Use engineering paper for Appendices and Sample Calculations. Use “Covers” for the reports. Neatness and consistency are important and will be graded seriously!

Laboratory Conduct: Attendance and participation is obligatory. Attendance will be recorded in each laboratory period. Work groups will be made up of 3 to 4 students. Group reports will be prepared and submitted one week following each experiment. Clean all the equipment used and the counter tops after the experiments. Failure to keep the equipment intact and clean will result in loss of points on the laboratory reports.

Academic integrity. It has been my experience in the past that when students study in groups, and communicate they perform better. Obviously, this is a generalization and I am sure there are many exceptions. However, please note that your submitted work for this course should be conducted individually. Academic Integrity is expected from all students in all matters related to this course. In particular, a student assumes responsibility for every assignment, project or exam that he/she submits. University Code of Conduct: <https://studentaffairs.lehigh.edu/content/code-conduct>.

Accommodations for Students with Disabilities: If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of

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Academic Support Services, University Center 212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

Principles of Equitable Community: Lehigh University endorses The Principles of Our Equitable Community http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

Course Learning Objectives:

Upon successful completion of this course, students will be able to:

1. Understand soil classification systems and basic soil properties
2. Analyze soil behavior when subjected to stresses and pore water pressures
3. Apply basic principles to common practical problems of design and construction
4. Perform basic soil laboratory testing techniques

Tentative Course Outline / Topic:

	Topic	Reading Assignment
A.	Introduction & Physical Properties of Soils 1. Formation, identification and classification of soils 2. Soil Index Properties: particle size, shape & applications 3. Weight - Volume relationship (e, n, S, γ, ω, D_r, other) 4. Consistency of soil (LL, PL, SL, other) and soil structure (fabric and assembly) 5. Engineering Classification of soil (AASHTO and USCS) 6. Clay minerals (types, identification methods) 7. Clay – Water Interaction (charge deficiency, hydration, DDL, CEC, swelling, other)	Chapters 1 & 2 Chapter 3 Chapter 4 Chapter 5 Ch.2 & Notes
B.	Mechanical/Chemical Soil Stabilization and Site Improvement 1. Soil Compaction a. Moisture-Density relationship b. Field compaction techniques c. Field compaction control in field d. Deep compaction techniques (vibroflotation, dynamic, blasting etc.) 2. Chemical Soil Stabilization Overview (lime, fly ash, other) 3. Intro. to site improvement: dewatering and other techniques	Chapter 6 Notes

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	Topic	Reading Assignment
C.	Soil – Water System 1. Water percolation in soils - Definitions (hydrologic cycle, aquifer, aquitard, Groundwater flow) - Darcy's Law (Seepage velocity, hydraulic gradient, discharge rate) - Hydraulic conductivity (Constant & falling head, triaxial, & empirical relations) - Horizontal and vertical flow - Determination of hydraulic conductivity in the field (pump tests, etc.) - Seepage: Two-dimensional flow (continuity, hydrodynamics of steady state flow, flow nets, unconfined flow through earth dams) - Numerical analysis of seepage (FD solution of Laplace's equation) 2. Soil stress with and without seepage - Total, hydraulic and effective stress concepts - Heave and filters, capillarity, quick condition	Chapter 7 Chapter 8 Chapter 9
	Midterm Exam 1	
D.	Stress – Strain and Soil Deformation 1. Stress/strain components 2. Stress-strain behavior and yielding 3. Hooke's Law, Plane strain and axisymmetry 4. Stresses at a point: Mohr's circle	Chapter 10 and Notes
E.	Load Induced Stresses and Deformation in Soil 1. Sub-surface stresses in soil - Overburden stresses - Applied stresses (surface loads) 2. Stress invariants & Stress paths	Chapter 10 and Notes
F.	Soil Compression 1. Immediate and Consolidation Settlement - Immediate Settlement - Terzaghi's Theory of consolidation and compressibility - Settlement and time rate of settlement	Chapter 11 Chapter 12
	Midterm Exam 2	
G.	Soil Strength 1. Shearing resistance of soils - Coulomb's and Taylor's Models & Mohr-Coulomb Failure Criteria - Undrained and Drained shear strength - Shear strength tests (laboratory and field)	Chapter 13 Chapter 12
H.	Sampling and Field Testing 1. Sub-soil exploration (boring logs, purpose & planning, depth & spacing) 2. Field testing methods (sampling, SPT, CPT, VST, PMT, PLT, RQD)	Notes
I.	Lateral Earth Pressure (tentative) 1. Lateral earth pressure theories and applications - Rankine's Theory - Coulomb's Theory - Retaining walls, reinforced earth 2. Introduction to Slope Stability - Infinite Slope Stability Analysis - Finite Slopes: Theories and Application	Chapter 14 & Notes
	Final Exam: Comprehensive Final	

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