

UNIVERSITY OF MASSACHUSETTS AMHERST
Department of Civil and Environmental Engineering

CEE622 Geotechnical Materials Testing
Course Syllabus - Spring 2002

Instructor:

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Office Hours: MW 9:00 – 12:00

Class Time and Location: MW 8:00, Room 15 Marston Hall

Lab Time and Location: M 1:00 to 4:00, Room 32 Marston Hall

Course Objective:

The objective of this course is to acquaint students with geotechnical engineering experimental equipment and test procedures. The course will focus on application of testing principles to the measurement of soil properties and behavior including classification, index and engineering properties. Experiments will emphasize equipment, test procedures, and analysis, evaluation and presentation of data. Prerequisite: CEE 620 Soil Behavior.

Textbook:

There is no textbook for the course. Reference material will be used from sources such as the American Society for Testing and Materials (ASTM), American Society of Civil Engineers (ASCE), Canadian Geotechnical Society (CGS), and various other references.

Course Notes:

1. DeGroot, D.J. (1996). "Laboratory Testing of Soils." *Estimation of Design Parameters for Soils and Rocks from Laboratory and In-Situ Tests*, AIT Short Course Notes.

Reference Textbooks:

1. Head, K.H., *Manual of Laboratory Testing: Volumes 1, 2, and 3*. John Wiley and Sons, NY, 1992 (Vol. 1), 1994 (Vol. 2), 1986 (Vol. 3).

2. ASTM (2002), *Vol. 4.08 Soil and Rock, Part I and Vol. 4.09 Soil and Rock, Part II*, ASTM, PA.

Prerequisite: CEE620

Grading:

Attendance is expected at all lectures; attendance at laboratories is mandatory.
Final grades will be based on the following:

Technical Paper and Presentation = 15%

Laboratory Reports, Technical Notes, and Technical Memos = 85%

Instructions for the technical paper, laboratory reports, technical notes, and technical memos will be distributed by separate handout and discussed in class. Technical memos will count approximately 50% less towards your final grade than reports and technical notes. Although most experiments will

be conducted in groups, some reports and technical notes will be prepared individually and some in groups. Details will be given for each experiment at the time they are conducted.

Course Topics:

1. Introduction

2. Preparation of Engineering Reports

3. Laboratory Electronics

- Transducers (load, pressure, and displacement)
- Data acquisition systems
- Computer control

4. Soil Classification and Index Tests

- Grain size, specific gravity and Atterberg limits

5. Compaction

- Standard and modified proctor tests

6. Hydraulic Conductivity

- Falling and constant head tests
- Rigid and flexible wall permeameters

7. Consolidation

- Incremental loading consolidation
- Constant rate of strain consolidation

8. Strength Testing

- Index tests
- Triaxial
- Direct shear and direct simple shear
- Specialized equipment (e.g., plane strain, hollow cylinder, etc.)

Laboratory Experiments:

Each group of experiments will require one laboratory report or technical note.

1. Calibration of Electronic Transducers

2. Classification

- a. Visual Classification
- b. Grain size, specific gravity, and Atterberg Limits

3. Compaction and Rigid Wall Hydraulic Conductivity

- a. Compaction
- b. Rigid Wall Hydraulic Conductivity

4. Flexible Wall Hydraulic Conductivity

5. Consolidation

6. Drained Shear - Sand

- a. Direct Shear Box
- b. Triaxial Compression

7. Undrained Shear Strength - Index Tests on Clay

8. Undrained Shear Strength - Advanced Tests on Clay

- a. Triaxial Compression and Extension
- b. Direct Simple Shear

Reading List:

Readings are to be done when the specific topic that the reading covers is discussed in class lectures and is part of laboratory experiments.

Data Acquisition and Computer Control:

Sheahan, T.C., DeGroot, D.J. and Mitchell, T.J. (1999). "State of the Art: Automated Laboratory Stress-Strain-Strength Testing of Soils," *Nondestructive and Automated Testing for Soil and Rock Properties, ASTM STP 1350*, W.A. Marr and C.E. Fairhurst, Eds., American Society for Testing and Materials, pp. 203-230.

Sheahan, T.C., Germaine, J.T., and DeGroot, D.J. (1993). "Laboratory Data Acquisition: A Practical Guide for System Selection." *Advances in Site Characterization: Data Acquisition, Management and Interpretation*, Geotechnical Special Publication No. 37, American Society of Civil Engineers, pp. 42-56.

Hydraulic Conductivity:

Daniel, D.E. (1994). "State-Of-The-Art: Laboratory Hydraulic Conductivity Tests for Saturated Soils." *Hydraulic Conductivity and Waste Contaminant Transport in Soil*, ASTM STP 1142, Daniel, D.E. and Trautwein, S.J., Eds., ASTM, Philadelphia, pp. 30-78.

Consolidation:

Sandbeakken, G., Berre, T., and Lacasse, S. (1986). "Oedometer Testing at the Norwegian Geotechnical Institute." *Consolidation of Soils: Testing and Evaluation*, ASTM STP 892, R.N. Yong and F.C. Townsend, Eds., ASTM, pp. 329-353.

Strength Testing:

DeGroot, D.J., C.C. Ladd, and J.T. Germaine. (1992). *Direct Simple Shear Testing of Cohesive Soils*. Research Report No. R92-18, Center for Scientific Excellence in Offshore Engineering, Massachusetts Institute of Technology, Cambridge, MA.

Germaine, J.T. and Ladd C.C. (1988). "State-of-the-Art: Triaxial Testing of Saturated Cohesive Soils." *Advanced Triaxial Testing of Soil and Rock*, ASTM STP 977, R.T. Donaghe, R.C. Chaney, and M.L. Silver, Eds., ASTM, Philadelphia, pp. 421-459.

Lacasse, S. and Berre. T. (1988). "State-of-the-Art: Triaxial Testing Methods for Soils." *Advanced Triaxial Testing of Soil and Rock*, ASTM STP 977, R.T. Donaghe, R.C. Chaney, and M.L. Silver, Eds., ASTM, Philadelphia, pp. 264-289.