University of Portland
School of Engineering

CE 321 - Geotechnical Engineering (MWF 11:25-12:20)
CE 371 - Geotechnical Laboratory (T or R, 2:30 – 5:40)
Fall Semester, 2007

Instructor: Dr. Matthew R. Kuhn (Room 103, 943-7361, kuhn@up.edu)

Office Hours:

Text: Donald P. Coduto, *Geotechnical Engineering: Principles and Practices*, Prentice Hall, Upper Saddle River, NJ, 1999.

No text is required for the laboratory course, but you may find the following books useful. All are available in Rm. 125.

- J.E. Bowles, *Engineering Properties of Soils and Their Measurements*, N.Y.: McGraw Hill, 1992.
- B.M. Das, *Soil Mechanics Laboratory Manual*, San Jose, Ca.: Engineering Press, 1989.
- C. Liu and J.G. Evett, *Soil Properties: Testing, Measurement, and Evaluation*, Englewood Cliffs, N.J.: Prentice Hall, 1990.

Course Learning Objectives

- An understanding of fundamental concepts of geotechnical engineering and their relation to civil engineering applications.
- Ability to solve geotechnical engineering problems.
- Ability to apply geotechnical concepts to typical engineering situations.
- Ability to perform geotechnical engineering laboratory tests and to collect, analyze, and apply the resulting data.
- An improved proficiency in written and oral communication.

Course Prerequisite: EGR322, Strength of Materials.

Assessment Tools (Lecture):

Homework (11), quizzes (6)	30 %
Examination 1	20 %
Examination 2	20 %
Final examination	30 %

Assessment Tools (Laboratory):

Writing assignments	75 %
Oral presentations (2 per student)	15 %
Attendance & participation	10 %

Overall Evaluation: Grading will be based upon the following descriptors:

"A" Denotes exceptional accomplishment:

mastery of vocabulary and concepts from text and lectures

demonstrated ability to consistently apply mathematics, science, and engineering concepts to textbook problems and laboratory calculations

demonstrated ability to present easily understandable homework solutions

consistently presents assignments on time

insight in extending concepts to less common situations

insight in synthesizing concepts in this course with those from other courses

clear, concise, interesting and properly edited written reports with proper conclusions and recommendations that demonstrate clear insight into the geotechnical issues.

"B" Denotes accomplishment significantly better than average:

thorough understanding of vocabulary and concepts from text and lectures

demonstrated ability to apply concepts to textbook problems

demonstrated ability to present understandable homework solutions

consistently presents assignments on time

clear, concise, interesting and properly edited written reports with proper conclusions and recommendations

"C" Denotes satisfactory accomplishment:

knowledge of vocabulary and concepts from text and lectures demonstrated ability to apply most concepts to textbook problems technical reports with proper conclusions and recommendations

"D" Denotes accomplishment less than satisfactory but still passing

lacks either a knowledge of vocabulary and concepts or the demonstrated ability to apply many concepts to textbook problems

poorly written reports that show little insight into the geotechnical issues

"F" Denotes failure.
less than 50% average score due to lack of the positive outcomes given above

Reading Assignments: You are expected to complete the reading assignments given in the syllabus *before* the class period. The text material will be covered on examinations and occasional quizzes.

Course Objectives:

Learning objectives and outcomes	Assessment
1. Knowledge and comprehension of geotechnical engineering vocabulary and concepts: **a)** knows and can recall definitions of all words in the "Vocabulary" sections for text reading assignments **b)** able to recognize and explain items listed in the course syllabus **c)** able to recall the geological cycle **d)** able to identify major rock types and knows their usual origin. **e)** understands the difference between residual and deposited soils **f)** able to recall the main soil transportation processes and deposition environments **g)** recognizes and can describe differences in soil texture **h)** can recall meaning of symbols from the Unified Soil Classification System **i)** can explain the most common soil investigation and in-situ testing techniques **j)** can identify and interpret terms and information found in typical soil investigation reports **k)** recognizes and can explain the general relationships between soil composition and behavior **l)** understands and can explain the source and significance of capillarity and negative water pressure in soils **m)** understands the basis of soil migration and filtration **n)** understands the mechanical principle of soil consolidation **o)** understands relationships among volume change, water pressure, stress, and strength for direct shear and triaxial tests **p)** can identify terms related to the most common methods for soil improvement **q)** knows basic vocabulary related to seismic geotechnical engineering	Quizzes Examinations Written reports

2. Solving geotechnical engineering problems and applying geotechnical engineering concepts: **a)** can compute apparent and actual geologic dip from numeric or graphical data **b)** can compute grain size distributions from laboratory data **c)** can compute weight–volume relations among soil components **d)** can determine the classification of a soil using three standards: USCS, AASHTO, and visual-manual **e)** can compute Atterberg limits from laboratory data and understand the texture of soils with various plastic and liquid limits **f)** can apply compaction concepts and specifications to typical field and laboratory situations **g)** can compute capillary stresses **h)** can compute soil permeability from laboratory data **i)** can apply Darcy's law to one–dimensional flow and apply the components of hydraulic head to compute flows, velocities,pressures, gradients, and stresses **j)** can construct and use flow nets to compute flows, velocities, water pressures, hydraulic gradients, and stresses **k)** can compute required filter sizes for geosynthetic and soil filters **l)** can compute geostatic stresses: effective, water, and total stresses **m)** can compute induced subsurface vertical stresses by using equations and charts **n)** can estimate settlements from laboratory consolidation data **o)** can use a Mohr circle to estimate stresses upon various surface inclinations. Can locate the pole. **p)** can compute the results of direct shear tests **q)** can compute the results of triaxial tests, both drained and undrained **r)** can compute relations among f, c, P/A, σ_1, and σ_3 **s)** can estimate ground accelerations and liquefaction susceptibility during an earthquake	Homework Examinations Written reports
3. Use of graphical tools and methods **a)** can use a protractor and compass to construct a Mohr circle with 2-digit precision **b)** can plot data with logarithmic axes **c)** can use straight edges and mechanical curves to construct and analyze data plots, flow nets, and Mohr circles	Homework Laboratory calculations

4. Analysis, synthesis, and evaluation of typical geotechnical engineering situations: **a)** can evaluate the relevance of laboratory tests to field situations **b)** can estimate field performance from laboratory tests **c)** can recommend actions on the basis of laboratory tests and calculations **d)** can appraise geotechnical performance on the basis of laboratory tests and calculations	Written reports Oral reports
5. Improved written and oral communication See the "Student Writing Outcomes" on pages 13-14.	Written reports Oral reports

Homework:

Some homework problems will use data collected in the CE371 laboratory.

Grade Descriptors for Homework

Letter grades will be assigned on each homework assignment, based on the following descriptors.

1. Proper selection and manipulation of pertinent equations - 50%
2. Mathematical accuracy - 25%
3. Presentation (see guidelines below) - 25%

Guidelines on Homework Format:

1. You may work with others on a homework assignment, but give them credit on the first page. Failure to give credit is discourteous and will be penalized 25%.
2. Every homework assignment will count toward the final grade.
3. Homework is due at the beginning of class. Late homework will not be accepted.
4. Use either square grid engineering paper, blank (white) paper, or recycled paper.
5. Include a cover page with each homework set. Print on only one side of the paper. Staple pages together.
6. You do not need to rewrite the problem statement, but you should begin each problem with the following introduction:
   Given: Briefly describe the conditions of the problem. If you think that some necessary information was not given in the problem statement, then clearly state your chosen assumption.
   Required: Briefly describe what is required in your problem.
   Calculations: Your calculations.
7. Present calculations in an orderly, linear fashion, explaining important steps and assumptions.
8. Be neat.
9. When possible, give formulas in symbolic form before substituting numbers.

10. Every number that you use in your calculations should be given with its units.

11. Whenever you think there could be confusion, explain the steps in your calculations.

12. If you include a graph in your work, it should be complete with a title, axis labels, and units.

13. Underline the final answer, *with its units*. You should give your answer with an appropriate number of significant figures that is consistent with the precision of the given data and your idealizations.

Quizzes:

Quizzes will occasionally be given to assess the following:

1. Your knowledge and recall of definitions of all words in the “Vocabulary" sections for text reading assignments. Note that you are responsible for the reading assignments in the syllabus including those that are shown on the day of the quiz.

2. Your ability to recognize and explain items listed in the course syllabus

Examinations:

Grade Descriptors for Examinations

1. Proper selection and manipulation of pertinent equations - about 60%

2. Mathematical accuracy - about 20%

3. Knowledge of vocabulary and concepts from text and lectures - about 20%

Examination Format

Examinations will be closed book and closed notes. A formula sheet will be provided by the professor.

You should not expect the examination questions to be the same as those given in the homework assignments. Just as each homework question requires different solution methods (rather than repetitive drill), examination questions will likely be different than those in homework assignments. Certain questions will test the students' insight in extending concepts to less common situations and in synthesizing concepts in this course with those from other courses.

There will be no make–up examinations and no credit for missed examinations. Cheating will result in forfeiting an examination.

Laboratory Writing Assignments and Calculations

Calculations or a written report will be prepared on each laboratory session.

Writing Assessment

Grades on writing assignments will be based upon technical and writing quality, in roughly equal proportion..

Technical content:
correct and clearly presented calculations
clear presentation of testing results

proper and carefully constructed conclusions and recommendations

Writing quality (see pages 13-14):
proper organization and development
clear introduction
clear presentation of background material
clear and concise presentation of laboratory procedures
proper technical writing style
correct editing

Guidelines

1. All reports are due at the beginning of class. You should turn in a hard copy and an electronic copy of each report. Reports handed in after the start of class will be penalized 25%. Reports will not be accepted after 5:30 p.m.

2. Reports should be typed. Calculations should be by hand, unless a spreadsheet is appropriate.

3. Do not use folders or binders for your written reports. Just staple your work, with the grading sheet (if any) on top.

Laboratory Oral Reports

Each student will give two oral presentations: a *debriefing* on the results of the previous week's laboratory test and a *briefing* on how to conduct a laboratory test.

Your presentations should be 6-8 minutes, not including time for audience questions. Points will be deducted if your presentation is longer or shorter.

An overhead projector and screen will be available in the classroom. If you will be using them, it is your responsibility to get them set up. If you need a slide projector, arrange this with the instructor and the Instructional Media Center 2 to 3 days ahead (Library basement).

You are encouraged to use “props" (material samples, testing equipment, etc.) during your presentations.

Debriefing Presentations

You can use the following format for *debriefing* presentations:

1. Introduce yourself and clearly state the topic of your presentation. You should give credit to your laboratory partners, and briefly outline your presentation. (30 sec.)

2. Explain the purpose of the laboratory test, the soil property that is being measured, the general principle that is involved in its measurement, and the types of problems that the test would be useful in analyzing. (1-2 min.)

3. Briefly describe the equipment and the procedure. (1 min.)

4. Give a brief description of the soil that was tested, and present the results of your laboratory tests. (2 min.)

5. Explain the engineering significance of the results and how the results could be applied to a design situation. (1-2 min.)

6. Briefly summarize and conclude your presentation. Invite questions from the audience. (30 sec.)

Briefing Presentations

To prepare for this presentation, you should read about the laboratory test in the laboratory manuals in Rm. 125. You should then make an appointment to work with the instructor to review the test procedures and prepare your presentation. Your classmates will be relying on you for instructions on how to perform their laboratory tests.

Assessment

A letter grade is assigned for each presentation. Assessment is based upon:

- a clear introduction that relates the topic to your audience
- an organized, interesting, and technically accurate body
- clear delivery, with professional posture, appropriate gestures, consistent and effective eye contact, and absence of “filler" words
- minimal use of notes
- conformance with time limits

Laboratory Attendance and Participation

Laboratory attendance and participation is necessary for preparing a written or oral report. Attendance also includes the following:

- arriving on time.
- attentiveness during lectures and presentations.
- active involvement in laboratory work and clean up.

Academic Integrity

The University's Code and Guidelines of Academic Integrity are available on the web (www.up.edu > Academics > Registrar > Academic Regulations). Students should read and be familiar with the code and guidelines and should be aware of the various types of violations: cheating, forgery, and plagiarism. In this course, all violations will be considered as being of Level 2 or higher.

Accommodation for Disability

If you have a disability and require an accommodation to fully participate in this class, contact the Office for Students with Disabilities (OSWD), located in the University Health Center (503-943-7314), as soon as possible.

If you have an OSWD Accommodation Plan, you should make an appointment to meet with Dr. Kuhn to discuss your accommodations. Also, you should meet with Dr. Kuhn if you wish to discuss emergency medical information or special arrangements in case the building must be evacuated.

UNIVERSITY OF PORTLAND

SCHOOL OF ENGINEERING

CE 321 - Geotechnical Engineering

Homework Problems

Problem Set No. 1

1. Problem 2.6, p. 32
2. Problem 2.7
3. Problem 2.15, p. 45
4. Problem 2.17

Problem Set No. 2

1. Problem 4.1, p. 113
2. Problem 4.7
3. Problem 4.22, p. 134
4. Calculations and results from your laboratory sieve analysis.

Problem Set No. 3

1. Problem 5.4, p. 155
2. Problem 5.8
3. Problem 5.10
4. Calculations and results of your laboratory Atterberg limits tests on two soils.

Problem Set No. 4

1. Problem 6.6, p. 192
2. Problem 6.21, p. 205
3. (Holtz and Kovacs) Suppose that you are a control inspector for earthwork construction and are checking the field compaction of a layer of soil. The laboratory compaction curve for the soil is shown further below. Specifications call for the compacted density to be at least 95% of the maximum laboratory value and within "2% of the optimum water content. When you did the sand cone test, the volume of soil excavated was 1153 cm^3. It weighted 2209 g wet and 1879 g dry.
   a. What is the compacted dry density ?
   b. What is the field water content ?
   c. What is the relative compaction ?
   d. Does the test meet specifications ?
   e. What is the degree of saturation of the field sample ?
   f. If the sample were saturated at constant density, what would be the water content?
4. Data sheets and calculations from the compaction laboratory.

Problem Set No. 5

The following soil investigation reports are on reserve in the library:

- *Geotechnical Investigation, New OMSI Facilities*, Geotechnical Resources, Inc., 1990.
- *Geotechnical Investigation, Academics Hall, University of Portland,* Geotechnical Resources, Inc., 1993.

Read the following sections of these reports:

Project description - background
Site description
Field exploration - subsurface conditions
Appendices: Field (subsurface) explorations
Boring logs

Take note of the following information:

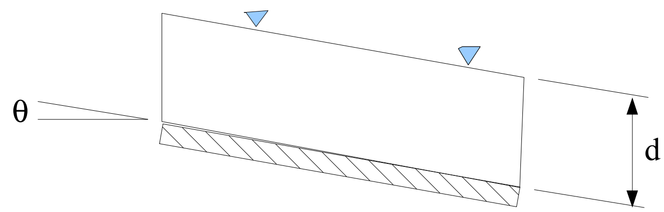
- The intended use of the site
- The particular geotechnical concerns at each site
- The type of drilling equipment that was used (auger, rotary drilling, etc.)
- The range in depth of the borings
- The number of soil layers encountered at the site
- The types of field tests that were performed
- The methods that were used for recovering soil samples
- The activities of the soil engineer as he/she directed the soil boring operation

Problem Set No. 6

1. Problem 7.13, p. 236
2. Problem 7.6, p. 235
3. Problem 7.21
4. Data sheets and permeability calculations from the permeability laboratory.

Problem Set No. 7

1. An inclined permeable soil layer is underlaid by an impervious layer, as shown in the figure below.
   a. Sketch a set of flow and equipotential lines for the soil.
   b. *Derive* an equation that gives the flow rate of seepage as a function of the slope angle, *q,* and thickness, *d.*



2. Problem 8.9, p. 284
3. Compute the seepage rates for your laboratory letter.

Problem Set No. 8

1. Problem 10.7, p. 336
2. Problem 10.9, p. 345
3. Compute solutions to the three questions raised in the graving dock laboratory problem.

Problem Set No. 9

1. Problem 11.6, p. 389. Use the data in your text to do the following:
   a. Plot the void ratio, *e*, on a semi-logarithmic diagram. Choose an appropriate extent for each axis.
   b. Using Casagrande's method, find σ'_c .
   c. Using Schmertmann's method, adjust the textbook data.
   d. Determine C_c and C_r.

Problem Set No. 10

1. Problem 11.11, p. 408
2. Problem 11.27, p. 419

Problem Set No. 11

1. Problem 10.17, p. 355 (also, identify the pole)
2. Problem 10.20, p. 360 (also, identify the pole)
3. Problem 13.1, p. 479
4. Problem 13.7, p. 484

Problem Set No. 12

1. Problem 13.19, p. 514
2. Use your laboratory data to compute the factor of safety for the concrete gravity dam.

Student Writing Outcomes

Audience analysis

- can distinguish between the different writing styles appropriate for the student–teacher relationship and the engineer-client relationship
- can present technical information and analysis to a non–technical reader
- can recognize terms and concepts that require definition or explanation to a less–technical reader
- can adopt a proper level of detail to suit the reader
- can analyze client needs in preparing a consulting report and a solicited engineering proposal

Organization

- General
  - can present ideas that are logically organized
  - can organize writing material into each of five categories: introduction, background, methods, results, and conclusions, discussion, and/or recommendations
- Introductions
  - can clearly describe the purpose of the work
  - can clearly describe the writer's relation to the work
  - can outline (in full sentences) the content of the writing
  - can identify and clearly describe the scope of a project
- Background information
  - can identify and present background information that clarifies the remainder of the writing
  - can identify and present the broader context of immediate technical issues
- Methods
  - can present methods with clarity
  - can explain why the methods were chosen
  - can present methods with an appropriate level of generality or detail for the intended readers
  - can present methodologies in a manner that clarifies and provides a context for the results
  - when appropriate, can reference published procedures
- Results
  - can present results with clarity
  - can use tables and figures to effectively present results
  - can present numerical results with an appropriate number of digits
  - can distinguish between results and conclusions
- Conclusions, discussion, and/or recommendations (CDR's)
  - can clearly present CDR's
  - can write CDR's that are supported by the writer's methods and results
  - can avoid speculation
  - can present CDR's that stay within the scope of a project
- Proposals:
  - can identify and clearly describe a scope of work

- can effectively present qualifications without bombast

- Executive summaries: can write a clear and organized executive summary of an engineering report or laboratory report
- Paragraphs: can write organized and coherent paragraphs, each with a central theme

<u>Style</u>

- when appropriate, can write in a direct and concise style by
  - avoiding excessive use of the passive voice
  - focusing on the real subject and verb
  - avoiding expletives
  - avoiding excessively ornate language
  - avoiding unnecessary qualifiers
- when appropriate, can write clearly and precisely by
  - avoiding vague and omnibus words
  - avoiding vague pronoun references
  - defining abbreviations
  - avoiding verbs as modifiers
  - avoiding jargon and cliches
- can avoid long, garbled sentences
- can avoid a choppy, telegraphic style

<u>Mechanics and usage</u>

- can consistently write proper sentences
- can recognize commonly misused words
- can demonstrate proper punctuation
- can demonstrate proper parallel constructions
- can demonstrate consistent subject–verb agreement
- can recognize and consistently use a proper verb tense

<u>Layout</u>

- can use conventional formats for letters, memorandums, reports, and proposals
- can properly reference tables and figures

University of Portland
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CE 321 - Geotechnical Engineering
Syllabus
Fall Semester, 2007

Lesson No.	Date	Topics	Text Reading	Homework (Lesson due)
1	8-27	**Introduction**	1.0, 1.2	
		Course description and requirements	2.0-2.2	
		Perspectives on geotechnical engineering		
		Engineering Geology		
		Rock–forming minerals		
		The geologic cycle		
2	8-29	The geologic cycle, cont.	2.3	
		Igneous, sedimentary, & metamorphic rocks		
		Rock weathering		
3	8-31	Residual soils	2.5	
		Soil formation, transportation, and deposition		
4	9-3	Structural geology	2.4	No. 1 (6)
5	9-5*	**Soil Composition and Classification**		
		Soil as a particulate material	4.1-4.2,	
		Particle size distribution	4.4	
		Friction, cohesion, and plasticity		
6	9-7	Liquid, plastic, and shrinkage limits	4.6	No. 2
		Weight-volume relationships	4.3	(9)
7	9-10	Weight-volume relationships, cont.	4.4	
		Clay soils and mineralogy	4.5, 4.7	
8	9-12	Soil classification		
		Unified Soil Classification System	5.3	
9	9-14	Soil classification, cont.		No. 3
		AASHTO Classification System	5.2	(11)
		Compaction and ground improvement		
		Soil compaction methods	6.1-6.2	
		Soil compaction standards		
10	9-17	Soil compaction standards	6.3 to p. 194	No. 4
		Soil compaction assessment		(13)
11	9-19*	Soil compaction assessment, cont.		
		Site Exploration	3.4-3.5	
		Soil subsurface exploration		

12	9-21	Soil subsurface exploration, cont.	3.6 to p.72, CPT (pp. 75-78)	No. 5 (14)
13	9-24	**Groundwater and Soil Hydraulics**		
		Groundwater hydrology concepts	7.1	
		Groundwater flow conditions	7.2	
		One–dimensional flow and Darcy's law	7.3 to p. 225	
14	9-26*	Head and pore water pressure Hydraulic head and its components	7.3	No. 6 (19)
15	9-28	Soil hydraulics examples		
		Seepage velocity	pp. 232-233	
16	10-1	Examination No. 1		
17	10-3	Soil hydraulics examples Flow nets	8.1 to p. 252	No. 7 (21)
18	10-5*	Flow nets, cont.		
19	10-8	Soil hydraulics examples	pp. 270-271	
		Soil migration and filtration	8.5	
20	10-10	Capillarity	7.6	
		Negative water pressure	p. 344-345	
21	10-12	**Stresses within a soil mass** Geostatic stresses Induced subsurface stresses	10.1-10.4 (parts of 10.5)	No. 8 (24)
		FALL BREAK !!		
22	10-22	Induced subsurface stresses, cont.	10.7	
		Effective stresses	10.10	
23	10-24	**Compressibility and Settlement**		
		Settlement processes	11.1-11.2	
		Consolidation process	11.3	
24	10-26	Consolidation process, cont. Consolidation tests		No. 9 (27)
25	10-29	Preconsolidation stress	11.4	
		Reconstructed consolidation curve		
26	10-31	Consolidation settlement predictions	11.5, 11.7	No. 10 (29)
27	11-2*	Consolidation settlement predictions, cont.		
28	11-5	**Shear strength of soils**		
		Mohr's circle and the pole	10.9	
		Direct shear testing	pp. 500-503	
29	11-7	Direct shear testing, cont.		No. 11
		Shear failure in soils	13.2	(33)
		Mohr-Coulomb failure criterion	13.3 to p.478	

30	11-9	Shear strength of sands and gravels Mohr-Coulomb failure criteria	13.4	
31	11-12	Triaxial testing of sands	pp. 504-508	
32	11-14	Examination 2		
33	11-16	Triaxial testing of sands, cont.	13.5 to p.490	No. 12 (37)
34	11-19	Triaxial testing of sands, cont. Shear strength of clays and silts	pp. 490-493	
35	11-21	UU testing and CU testing		
		THANKSGIVING		
36	11-26	**Geotechnical earthquake engineering** Earthquake sources, intensities and magnitudes	20.1	
37	11-28	Site response Liquefaction	20.2	
38	11-30	Liquefaction, cont.	20.3 to p.695	
39	12-3*	Liquefaction assessment	pp. 695-701	
40	12-5	Ground improvement	19.1-19.7	
41	12-7	Course review and evaluation		
	Dec. 13 10:30-12:30	(Wednesday) *Final Examination*		

* Quiz dates

University of Portland
School of Engineering

CE 371 - Geotechnical Laboratory
Syllabus - Section A – Tuesdays
Fall Semester, 2007

Lesson No.	**Date**	**Content**	**Assignment**	**Due Dates**
1	8-28	Course description Engineers and writing		
2	9-4	Sieve analysis for particle size distributions	C	9-10
3	9-11	Atterberg limits	C–L	C: 9-17 L: 9-18
4	9-18	Compaction testing	C–L	Calculations: 9-24 Draft I: 9-27 Draft II: 10-3 Final: 10-22
5	9-27*	Field description of soils		
6	10-2	Permeability testing	L	Calculations: 10-12 Draft: 10-23 Consultation Final: 11-7
7	10-9	Soil hydraulics & flow net construction	C	10-26
8	10-23	Consolidation testing, I Computerized data acquisition	P	Draft I: 11-13 Draft II: 11-21 Final: 11-30
9	11-1*	Consolidation testing, II	C	11-7
10	11-6	Direct shear testing of sand	C	11-28
11	11-13	Drained triaxial testing of sand		
12	11-20	No class (Thanksgiving)		
13	11-27	CU triaxial testing of clay		
14	12-4	Course review		

Report formats:
- C -Calculations, due as CE321 homework
- L -Engineering letter
- P -Proposal

* Combined sections, Thursdays

University of Portland
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CE 371 - Geotechnical Laboratory
Syllabus - Section B – Thursdays
Fall Semester, 2007

Lesson No.	Date	Content	Assignment	Due Dates
1	8-30	Course description Engineers and writing		
2	9-6	Sieve analysis for particle size distributions	C	9-10
3	9-13	Atterberg limits	C–L	C: 9-17 L: 9-20
4	9-20	Compaction testing	C–L	Calculations: 9-24 Draft I: 9-27 Draft II: 10-3 Final: 10-22
5	9-27*	Field description of soils		
6	10-4	Permeability testing	L	Calculations: 10-12 Draft: 10-25 Consultation Final: 11-7
7	10-11	Soil hydraulics & flow net construction	C	10-26
8	10-25	Consolidation testing, I Computerized data acquisition	P	Draft I: 11-15 Draft II: 11-21 Final: 11-30
9	11-1*	Consolidation testing, II	C	11-7
10	11-8	Direct shear testing of sand	C	11-28
11	11-15	Drained triaxial testing of sand		
12	11-22	No class (Thanksgiving)		
13	11-29	CU triaxial testing of clay		
14	12-6	Course review		

Report formats:

- C -Calculations, due as CE321 homework
- L -Engineering letter
- P -Proposal

* Combined sections, Thursdays