Western University - Faculty of Engineering  
Department of Civil and Environmental Engineering  

CEE 3321A – Soil Mechanics and Hydrogeological Engineering - Course Outline 2021/22

This is the first introductory course in the fundamentals of geotechnical engineering for students enrolled in the Department of Civil and Environmental Engineering. The students are required to attend lectures, analyse and interpret laboratory experiment results to measure the engineering properties of soil, and submit laboratory results in complete and concise reports. The general objectives are for the student to become able to:

- Understand the origin and composition of soil.
- Formulate and analysis soil volume and weight relationship and determine its density, water content and void ratio.
- Develop a comprehensive understanding of basic experiments for soil classification according to standard procedures.
- Identify soil type and classify the soil based on engineering standards.
- Analyze and examine laboratory Proctor compaction test for the determination of soil maximum density.
- Solve 1D and 2D seepage problems based on Darcy’s law and graphical procedures.

Calendar Copy:
Soil classification, clay mineralogy, soil compaction, one- and two-dimensional steady state flow in natural and engineered systems.

Contact Hours:
2 lecture hours/week; 4 tutorial and laboratory hours; (recommended additional personal study - 3 hours/week).
Classes, tutorial and laboratory session attendance are mandatory.

Prerequisites: CEE 2202A/B, CEE 2224
Corequisites: None.
Antirequisite: CEE3326

Note: It is the student's responsibility to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the student's responsibility to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions. The decisions regarding either prerequisite or anti-requisite may not be appealed.
Instructor:
Osama Drbe, MESc, Ph.D. Candidate, email: odrbe@uwo.ca.

Textbook:
Prepared class notes should be brought to each class and may be downloaded from the course website (http://owl.uwo.ca).

Lab manual:

Laboratory:
Four mandatory laboratory reports should be submitted for:

1. Soil grain size distribution (sieving and hydrometer analysis)
2. Atterberg limits
3. Proctor compaction test
4. Constant-head hydraulic conductivity test & seepage analysis

Laboratory experiments will be conducted in groups and the reports should be prepared as a group work. Each group should submit its report to office SEB 3005, 3rd Floor, Spencer Engineering Building, at 2:30 pm on the Wednesday immediately following the last laboratory data collection (unless it was stated otherwise on OWL). Late reports will be deducted 10% per day and will not be accepted seven (7) days after the due date. All reports should be typed, and graphs prepared using a professional drawing software (e.g., MS Excel). Every report should include a mandatory cover page showing the experiments title, submission date, student name and number.

Computing:
Assignments and laboratory reports may require the use of Microsoft Excel for calculation and developing engineering plots.

Units:
SI units will be used in lectures and examinations

Specific Learning Objectives:
1. Soil Characterisation
   a) Identify basic soil groups
   b) Draw soil grain size distribution curves based on sieve and hydrometer analyses results
   c) Describe the basic structure and engineering properties of three clay minerals: kaolinite, illite, and montmorillonite and the general physical and chemical properties of soil-water systems.
   d) Determining soil Atterberg limits (PL, LL and PI)
   e) Laboratory grain size distribution and hydrometer sedimentation
f) Carrying out laboratory Atterberg limit tests

2. **Soil Classification**
   a) Classify soils based on the Unified Soil Classification System (USCS)
   b) Calculate soil properties using phase relations

3. **Soil Compaction**
   a) Introduction to lab compaction test
   b) Draw theoretical and experimental compaction curves [PA. 2]
   c) Determine the optimal water content and maximum dry density of a soil
   d) Establish quality control criteria for field compaction works
   e) List typical engineering applications of soil compaction
   f) Laboratory Proctor compaction testing [IN.1; IN.2; IN.3]

4. **Seepage and Groundwater Flow**
   a) Describe the concepts of steady-state seepage and pore water pressure
   b) Understand the nature of seepage flow in soil
   c) Define and apply Darcy’s law to calculate the steady-state groundwater flow [PA. 1]
   d) Define and measure hydraulic conductivity of soil and know magnitudes of hydraulic conductivities of gravel, sand and clay soils [PA. 2]
   e) Understand critical hydraulic gradient and its engineering significance
   f) Define the governing equation for 2D steady-state seepage flow in soil and solve the equation using the flow-net. Draw flow nets for engineering applications, including (1) calculate the seepage flow in isotropic and anisotropic soils, (2) calculate the pore water pressure in soil and (3) calculate the uplifting force due to seepage [PA. 3].

Instructor may expand on material presented in the course as appropriate, including the concept of effective stress and its importance in soil mechanics.

**General Learning Objectives**
E=Evaluate, T=Teach, I=Introduce; (I) = Introduction, (D) = Developing, (A) = Advanced level

<table>
<thead>
<tr>
<th>Problem Analysis</th>
<th>E</th>
<th>Team Work</th>
<th>T</th>
<th>Ethics and Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation</td>
<td>E</td>
<td>Communication</td>
<td>I</td>
<td>Economics and Project Management</td>
</tr>
<tr>
<td>Design</td>
<td>E</td>
<td>Professionalism</td>
<td>I</td>
<td>Life-Long Learning</td>
</tr>
<tr>
<td>Engineering Tools</td>
<td>T</td>
<td>Impact on Society</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Evaluation:**
The final course mark will be determined as follows:

- Weekly Assignments: 25% (15%+10%)
- Lab reports: 15%
- Mid-term exams: 20%
- Final exam: 40%

Total 100%
Note:  
(a) **Students must pass the final examination to pass this course.** Students who fail the final examination will be assigned the aggregate mark, as determined above, or 48%, whichever is less.  
(b) **Students must turn in all laboratory reports, and achieve a passing grade in the laboratory component, to pass this course.** Students who do not satisfy this requirement will be assigned 48% or the aggregate mark, whichever is less.  
(c) **Students who have failed this course previously must repeat all components of the course.** No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted.  
(d) Should any of the exams conflict with a religious holiday that a student wishes to observe, the student must inform the instructor of the conflict no later than two weeks before the scheduled test. (For further information on Accommodations for Religious Holidays see [http://www.uwo.ca/univsec/handbook/appeals/accommodation_religious.pdf](http://www.uwo.ca/univsec/handbook/appeals/accommodation_religious.pdf))

**Examinations:**  
A 50-minute mid-term exam will be scheduled during the lecture period on Wednesday, November 10th. The final examination will be 3 hours, held during the examination period of the fall term. Both the midterm and the final examinations will be **CLOSED BOOK:** no programmable calculators or other external sources of information, including books, notes or crib sheets, are permitted. In addition to the material covered in the class lectures, the exams may include questions from the laboratory portion of the class. Students will need to bring their own calculator, straight edge, compass, and protractor to the exams.

**Tutorials**  
The course includes several tutorial sessions, which will alternate with the laboratory sessions. At the beginning of each tutorial session, a teaching assistant will display a series of problems. The TA will solve 2 to 3 problems, and the students will solve the rest of problems. **One submission per group** is required at the end of the tutorial session. The group submission will be marked by the TA and it is worth **10%** of the total evaluation mark. Attending tutorial sessions is **mandatory**.

**Weekly Assignments**  
Homework assignments will be posted on the course website ([http://owl.uwo.ca](http://owl.uwo.ca)). The assignments should be solved **individually** and submitted on the due date (shown on the first page of each assignment) at 2:30 pm to office SEB 3005, 3rd Floor, Spencer Engineering Building. Late submissions will be deducted 10% per day and not be accepted seven (7) days after the due date. The weekly assignments are worth **15%** of the total evaluation mark. Data plots and other figures may be drawn to scale by hand or plotted from a computer. All plots should be clearly labelled with all required information. Sub-standard figures and plots, unprofessional and/or disorganized reports will adversely affect assignment marks.

**Use of English**  
In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.
Plagiarism Checking:
The University of Western Ontario uses software for plagiarism checking. Students are required to submit their Laboratory Reports and exams in electronic form to Turnitin.com for plagiarism checking.

Cheating:
University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.
For more information on scholastic offenses, please see: https://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

Attendance:
Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Accessibility:
Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Conduct:
Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please turn off your cell phone before coming to a class, tutorial, lab, or exam.
On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: http://www.uwo.ca/univsec/board/code.pdf

Sickness and Other Problems:
Students should immediately consult with the Instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.
Students that are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help
For more information concerning medical accommodations, please see: http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf
**Notice:**
Students are responsible for regularly checking their email, course website (https://owl.uwo.ca) and notices posted outside the Civil and Environmental Engineering Department Office.

**Consultation:**
Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultation can be arranged by appointment with the appropriate instructor.

**Course breakdown:**
Engineering Science = 60%; Engineering design = 40%

The document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.