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

CEE 3321A – Soil Mechanics and Hydrogeological Engineering - Course Outline 2022/23

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.
- Understand the concept of effective stress and its importance in soil mechanics

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

Prequisites: CEE 2202A/B, CEE 2224

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.
**Contact Hours:**

2 lecture hours/week;

4 tutorial and laboratory (required) hours;

Submission of laboratory reports is **mandatory**.

Recommended additional personal study - 3 hours/week.

Lectures will be delivered in person. Lectures will be organized into learning modules which students should review on a weekly basis. Quizzes at the end of each module will be used to track participation. Review of lecture material and self-study should take approximately 5 hours per week. Four 4-hour tutorial sessions will be delivered during the scheduled tutorial hours. Tutorials are not mandatory but students seeking assistance with assignments or clarification on lecture material are strongly encouraged to attend.

Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

**Contingency plan for an in-person class pivoting to 100% online learning**

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor.

**Instructor:**
Dr. A. Sadrekarimi, PEng, SEB3010D, email: asadrek@uwo.ca.

**Office Hours:**
Thursdays 12:30 - 3:30 pm in person or virtually with prior appointment.

**Textbook:**

**Lab manual:**
Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

All course material will be posted to OWL: http://owl.uwo.ca.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

**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 reports should be prepared as a group and submitted online to the course website by the specific due dates which will be announced by the instructor. Late reports will be deducted 0.5 (out of 4 marks) per day and will not be accepted 7 days after the due date. All reports should be typed and graphs prepared using a professional drawing software (e.g, MS Excel), and converted to a PDF file for submission. Every report should include a mandatory cover page showing the experiments title, submission date, student name and number.

**Computing:**

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 [I1; I3]

f) Carrying out laboratory Atterberg limit tests [I1; I3]

2. **Soil Classification**
   
a) Classify soils based on the Unified Soil Classification System (USCS) [PA3]

b) Calculate soil properties using phase relations [PA2]

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].

g) Use the computer program Seep/W to analyze seepage

The instructor may expand or revise material presented in the course as appropriate.

**General Learning Objectives**

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

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**Evaluation:**

The final course mark will be determined as follows:

- Lab reports: 20%
- Mid-term exam(s): 20%
- Participation: 10%
- Final exam: 45%

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 tentatively held during the lecture period on Tuesday, November 15th. The final examination will be 2 hours, held during the examination period of the fall term. Randomized questions will be assigned to each participant. **No two students will have the same set of questions.** In addition to the material covered in the class lectures, the exams may include questions from the laboratory portion of the class. Data plots and other figures may be drawn with a computer or by hand on graph paper. When needed, neatly draw all sketches and data plots using a straight edge, French curve, compass, etc., and show all relevant labels. When feasible, site plans and schematics should be drawn to a proportional scale. Failure to submit legible, neat, professional looking solutions will adversely affect your exam mark.

**Tutorials**

Six tutorial sessions will be available for your benefit and learning. At the beginning of each tutorial session, the teaching assistants will display the assignment problems and the student groups
should solve those problems. The TA will then review and provide the solutions for the past assignments, and answer student questions.

**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 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:

http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

**Attendance:**

Any student who, in the opinion of the instructor, has not engaged sufficiently in 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.

**Course Format:**

This course will be delivered **in-person**. In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online at the discretion of the course instructor.

**Accommodation:**

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: Academic Accommodation for Students with Disabilities.
**Religious Accommodation**
Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar.

**Use of Recordings:**
All of the remote learning sessions for this course will be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals under special circumstances. Please contact the instructor if you have any concerns related to session recordings. Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

**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.

**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 the Instructor in tutorial sessions. Office hours will be arranged for the students to meet with the Instructor and teaching assistants. Other individual consultation can be arranged by appointment with the instructor.

**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. Please turn off your cell phone before coming to a class, tutorial, quiz 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.

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

**Assessments worth less than 10% of the overall course grade:**

Academic consideration may be granted for work less than 10% of the total course grade with instructor approval without referring to the academic counsellors. Such consideration may include an extension of assignment due date, make-up exam, or reweighting course components.

**Assessments worth 10% or more of the overall course grade:**

For work totaling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University’s medical illness policy at https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

The Student Medical Certificate is available at https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.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.

**Absences from Final Examinations**

If you miss the Final Exam, please contact Western Engineering Undergraduate Services as soon as possible. They will assess your eligibility to write the Special Examination.

You may also be eligible to write the Special Exam if you are in a “Multiple Exam Situation” (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

**Academic Policies:**

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy,

https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf,
the centrally administered e-mail account provided to students will be considered the individual’s official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

Non-programmable calculators are only allowed during the exams and quizzes in this course.

**Scholastic offences** are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

Computer-marked multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

**Support Services:**

Please visit the Western Engineering Undergraduate Services webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.eng.uwo.ca/undergraduate/index.html

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at


To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.
Learning-skills counsellors at the Student Development Centre (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/.

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