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.

**Contact Hours:**
2 lecture hours/week; 4 tutorial hours; (recommended additional personal study - 3 hours/week). Submission of laboratory reports is mandatory.

Lectures will be delivered asynchronously through pre-recorded videos posted to the course OWL site. 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 synchronously through Zoom 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. The link to the Zoom meeting will be posted to OWL.
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 participating in the course for their private or group study purposes. 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.

**Prequisites:** CEE 2202A/B, CEE 2224

**Corequisites:**

**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:**

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

Ms. Sandra McKay, Administrative Support, SEB3005, smckay@uwo.ca

**Office Hours:**
Tuesdays 2:30 - 3:30 pm via Zoom (link can be found on course OWL site)

**Textbook:**


**Lab manual:**


**Laboratory:**
All laboratory training will be through online videos and live sessions will be conducted to answer any questions. 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 individually 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:**

Assignments 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 [PA.1]
   b) Draw soil grain size distribution curves based on sieve and hydrometer analyses results [PA. 2]
   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) [PA. 2]
   e) Laboratory grain size distribution and hydrometer sedimentation [IN.1; IN.2; IN.3]
   f) Carrying out laboratory Atterberg limit tests [IN.1; IN.2; IN.3]

2. Soil Classification
   a) Classify soils based on the Unified Soil Classification System (USCS) [PA. 3]
   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 [PA. 3]
   d) Establish quality control criteria for field compaction works [PA. 3]
   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 [PA. 1]
   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

**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>T</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:

- Lab reports: 40%
- Participation: 10%
- Mid-term exam: 20%
- Final exam: 30%
- 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 Tuesday, November 10th. The final examination will be 3 hours, held during the examination period of the fall term. Both the mid-term and the final examinations will be conducted through OWL. Randomized questions will be assigned to each participant through OWL. **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. Online live proctoring maybe administered during these exams.

In addition to online submission, you will be asked to scan and upload your solution to each question within the exam time. 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 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:

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.

**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.

**Academic Consideration for Student Absence**

Students will have up to two (2) opportunities during the regular academic year to use an online portal to self-report an absence during the term, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student’s final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student’s final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are not met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to
contact their Faculty academic counselling office to obtain more information about the relevant documentation.
Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.** For Western University policy on Consideration for Student Absence, see Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs and for the Student Medical Certificate (SMC), see: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

**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.

**Conduct:**
Some components of this course will involve online interactions. To ensure the best experience for both you and your classmates, please honour the following rules of etiquette:

- Please “arrive” to class on time
- Please use your computer and/or laptop if possible (as opposed to a cell phone or tablet)
- Ensure that you are in a private location to protect the confidentiality of discussions in the event that a class discussion deals with sensitive or personal material
- To minimize background noise, kindly mute your microphone for the entire class until you are invited to speak, unless directed otherwise
• In order to give us optimum bandwidth and web quality, please turn off your video camera for the entire class unless you are invited to speak
• Please be prepared to turn your video camera off at the instructor’s request if the internet connection becomes unstable
• Unless invited by your instructor, do **not** share your screen in the meeting

The course instructor will act as moderator for the class and will deal with any questions from participants. To participate please consider the following:

• If you wish to speak, use the “raise hand” function and wait for the instructor to acknowledge you before beginning your comment or question
• Remember to unmute your microphone and turn on your video camera before speaking
• Self-identify when speaking.
• Remember to mute your mic and turn off your video camera after speaking (unless directed otherwise)

General considerations of “netiquette”:

• Keep in mind the different cultural and linguistic backgrounds of the students in the course.
• Be courteous toward the instructor, your colleagues, and authors whose work you are discussing.
• Be respectful of the diversity of viewpoints that you will encounter in the class and in your readings. The exchange of diverse ideas and opinions is part of the scholarly environment. “Flaming” is never appropriate.
• Be professional and scholarly in all online postings. Cite the ideas of others appropriately.

Note that disruptive behaviour of any type during online classes, including inappropriate use of the chat function, is unacceptable. Students found guilty of Zoom-bombing a class or of other serious online offenses may be subject to disciplinary measures under the Code of Student Conduct.

**Online Proctoring Notice:**
Tests and examinations in this course will be conducted using both Zoom and the remote proctoring service, Proctortrack. When Zoom is used for exam invigilation, you will be required to keep your camera on for the entire session, hold up your student card for identification purposes, and share your screen with the invigilator if asked to do so at any time during the exam. The exam session using Zoom will not be recorded. Proctortrack will require you to provide personal information (including some biometric data). The session will be recorded. By taking this course, you are consenting to the use of this software. More information about remote proctoring is available in the Online Proctoring Guidelines at the following link: https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf.
Completion of this course will require you to have a reliable internet connection and a device that meets the system and technical requirements for both Zoom and Proctortrack. Information about the system and technical requirements are available at the following links:
https://www.proctortrack.com/tech-requirements/,
https://support.zoom.us/hc/en-us.
* Please note that Zoom servers are located outside Canada. If you would prefer to use only your first name or a nickname to login to Zoom, please discuss this with your instructor in advance of the test or examination.

**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.

**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/](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](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.