The University of Western Ontario  
Department of Civil and Environmental Engineering  

CEE4426a - Geotechnical Engineering Design  
Course Outline – 2022/23

Introduction  
This course is intended to extend the core knowledge and understanding of the mechanics of soils that were developed in courses CEE3321/3322. Students will be introduced to commonly encountered geotechnical engineering systems and the approaches required for their design. The concepts and methodology of site investigation will also be introduced. The students will be able to analyze and interpret the laboratory test, field test and borehole data presented in geotechnical reports to select appropriate design parameters. They will be able to select suitable analytical methods to predict the behaviour of a range of geotechnical structures, interpret the results of these predictions and make rational design decisions based on the results. They will improve their communication skills by documenting design decisions in coherent and legible design calculations. The students will develop problem-solving skills while working individually or as members in a group. The students will employ relevant software packages in their designs. They will develop an understanding of the impact of engineering on non-technical issues.

Calendar Copy  
Application of shear strength, effective stress, and earth pressure theories to the design of shallow and deep foundations, earth slopes, braced cuts, and retaining structures and related safety issues.

Prerequisites  
CEE3322/21 or the former CEE3326.

Antirequisites  
The former ES426a.

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 or Antirequisite conditions.

Contact Hours  
- 3 lecture hours/week (Tue, Wed and Fri):  
  Lectures will be delivered in class.
- 2 tutorial/design hours/week (Mon):  
  Tutorial and design sessions will be delivered in class. Tutorials are optional, but students seeking assistance with weekly assignments or clarification on lecture material are strongly encouraged to attend. The three design sessions are mandatory.

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**
Associate Prof. Tim Newson ([newson@eng.uwo.ca](mailto:newson@eng.uwo.ca)), SEB 3084.
Office hours: To be discussed in class.
Admin Support: Sandra McKay ([smckay@uwo.ca](mailto:smckay@uwo.ca)), SEB 3005.

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

**Other References**
The following books form a useful additional source of reference materials:

Students are responsible for checking the course OWL site ([http://owl.uwo.ca](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.

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**
None.

**Units**
SI units will be used in teaching, design project, tutorials and final exam.

**Specific Learning Objectives**
The specific objectives of the course are:

1. **Site Investigation:**
   By the end of this section, the students will be able to:
   i) Describe the purpose and structure of typical geotechnical site investigations. [KB4]
   ii) Describe the methods available for ground exploration and for retrieving samples from site. [KB4]
iii) Understand the use of field and laboratory tests for determining parameters for geotechnical design. [I3]

iv) Design a suitable site investigation for a given geotechnical structure. [I1]

2. Shallow Foundations:
   By the end of this section, the students will be able to:
   i) Describe the difference between ultimate and allowable bearing capacity, and reasons for the different approaches to apply factors of safety. [KB4]
   ii) Describe the factors considered in the general bearing capacity equation and use it to calculate the bearing capacity. [D2]
   iii) Identify the cases where the assumptions of the general bearing capacity equation are not valid and apply proper correction factors for these cases. [D2]
   iv) Design shallow foundations on clay or sand that satisfy the allowable bearing capacity requirements based on soil properties interpreted from laboratory tests or field investigations. [D1, PA2, PA3]
   v) Determine the distribution of stress increase underneath the foundation due to its load. [D1]
   vi) Design shallow foundations that satisfy the short and long-term settlement requirements. [D2]

3. Deep Foundations:
   By the end of this section, the students will be able to:
   i) Describe the load-carrying mechanisms for piles. [KB4]
   ii) Describe different types of piles and installation methods. [KB4]
   iii) Design single piles and pile groups that satisfy the bearing capacity requirements. [D4]
   iv) Calculate the settlement of single piles. [D4]
   v) Design pile groups that satisfy the settlement requirements. [D2]

4. Retaining walls:
   By the end of this section, the students will be able to:
   i) Calculate the distribution of lateral earth pressure at rest. [D2]
   ii) Describe the different theories of lateral earth pressure and their assumptions, and use Rankine and Coulomb theories to calculate the distribution of lateral earth pressure acting on retaining walls. [KB4]
   iii) Design concrete retaining walls including consideration of different failure modes such as overturning, sliding, bearing capacity and general stability; and determine the factor of safety of the wall against each of these failure modes. [D2]
   iv) Design sheet pile walls including cantilever and anchored types. [D2]

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

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

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Evaluation

The final grade is computed as follows:

- Assignment Problems 20%
- Design Project and Report 35%
- Final Examination 45%

TOTAL 100%

1. The mark for the design project shall be multiplied by the number of group members and the product allocated to the members in proportion to each member's contribution to the work. At the end of the course, group members must individually recommend (in the appropriate form), a suitable allocation to be used. A summary of the work done by each member (with reference to the three design project reports) must be attached to the final report submission.

2. Criteria for the various coursework submissions are described later in this document.

3. The penalty for late submission of coursework shall be 10% per day; thus, if any submission is more than 5 days late it cannot receive a passing grade.

4. 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.

5. 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 design project, assignment or test marks from previous years. Previously completed assignments and design project reports cannot be resubmitted.

1. Examinations

A three-hour closed book final examination will be held during the regular examination period.

Only approved programmable calculators are permitted in the final exam. Students should consult the list of approved calculators outside the Departmental Office. To get approval to use a calculator not on the list you must consult with Dr. Newson at least three weeks prior to the quiz/exam where you wish to use the calculator.

2. Coursework

There will be a group geotechnical design project that is sub-divided into three parts. Groups will be assigned by the instructor at the start of the project. The overall solution to the design and the report is worth 35% of the final assessment mark.

Tutorial question sheets will be given out during the course. These will not be assessed, but have the aim of familiarizing students with the topics covered during the lectures and preparing them for the end of year examination. Two short design assignments (10% each) will be assessed and individual submissions are required.

Assignments and components of the design project are to be submitted online to OWL by the due date. Assessed coursework will be marked and returned as soon as possible.
3. **Use of English**

In accordance with Senate and Faculty Policy, students may be penalized 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 final examinations 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.

**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](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, 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 and Accessibility**

**Religious Accommodation**

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at:


**Accommodation Policies**

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

[https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf).

**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](http://www.uwo.ca/univsec/board/code.pdf).

**Sickness and Other Problems**

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

**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:

The Student Medical Certificate is available at


The mechanism employed to handle the absence (e.g., an extension, make-up opportunity, or reweighting) will be decided by the instructor and will be applied on case-by-case basis.

**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 a 23-hour period, more than 3 exams in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

**Masking Guidelines**

Students will be expected to wear triple layer, non-medical, paper masks at all times in the classroom as per University policy and public health directives. Students who are unable to wear a mask must seek formal accommodation through Western Accessible Education, and present medical documentation. Students are not permitted to eat or drink while in class to ensure masks stay in place. Students will be able to eat and drink outside of the classroom during scheduled breaks. *Students unwilling to wear a mask as stipulated by Western policy and public health directives will be referred to the Dean, and such actions will be considered a violation of the student Code of Conduct.*

**Academic Policies**

The website for Registrar 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.

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:


**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/.

Consultation
Students are encouraged to discuss problems with their teaching assistant and/or the instructor in tutorial sessions. Office hours (online) 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.

Course Breakdown
Total = 44.11 AU’s
Engineering Science = 25% or 11.03 AU’s; Engineering Design = 75% or 33.08 AU’s