The University of Western Ontario
Department of Civil and Environmental Engineering

CEE4426a - Geotechnical Engineering Design
Course Outline – 2025

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 elasticity, shear strength, effective stress and earth pressure theories to site investigation practice and the design of shallow and deep foundations, braced cuts and retaining structures

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 (Mon, Tue & Wed):
  Lectures will be delivered in class.
- 2 tutorial/design hours/week (Wed):
  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.

Instructor

Pablo Barbieri (pbarbie2@uwo.ca) SEB 1023.

Office hours: To be discussed in class.

Textbook

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

Other References

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

1. *Canadian Foundation Engineering Manual*, 4th Edition prepared by Canadian Geotechnical Society, 2006, BiTech Publishing. (Purchase Optional)
2. *Foundation Design and Construction*, M.J. Tomlinson, 6th Edition, 1995, Longman (Purchase Optional)
3. *An Introduction to Geotechnical Engineering*, R.D. Holtz and W.D. Kovacs, 1981, Prentice Hall. (Purchase Optional)
4. *Basic Soil Mechanics*, R. Whitlow, 4th Edition, 2001, Prentice Hall. (Purchase Optional)

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.

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, PA1, 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 over turning, 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

Knowledge Base	T	Engineering Tools	T	Impact on Society	
Problem Analysis	E (A)	Teamwork	T	Ethics and Equity	
Investigation	E (A)	Communication	I	Economics and Project Management	
Design	E (A)	Professionalism	I	Life-Long Learning	I

Evaluation

The final grade is computed as follows:

Assignment Problems	20%
Design Project and Report	30%
Course Participation	10%
Final Examination	40%
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 30% 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.

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

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

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 gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. *GENERAL REGULATIONS & PROCEDURES*

1. All first-year students will report to the Undergraduate Services Office by submitting the Academic Consideration Request Form, for all instances.

2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request Form. Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.

3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.

4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.

5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. *TERM/MIDTERM TESTS*

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.

2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the Academic Consideration Request Form. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.

3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).

4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. *FINAL EXAMINATIONS*

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to report your absence using the Academic Consideration Request Form and request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.

2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.

3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must submit an "Application for a Special Exam" form. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: **It is the student's responsibility to check the date, time and location of the Special Examination.**

D. *LATE ASSIGNMENTS*

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).

2. Be prepared to submit the Academic Consideration Request Form and provide documentation if requested by the instructor (see reverse side for information on documentation).

3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.

4. i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. *SHORT ABSENCES*

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. *EXTENDED ABSENCES*

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. *DOCUMENTATION*

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member*:* Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).
In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.
Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. *ACADEMIC CONCERNS*

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).

2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**

3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2025 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:
https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_135

Academic Accommodations for Students with Disabilities:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=

Scheduling of Term Assignments:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:
https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf

Engineering Academic Regulations:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:	Last day to add a Fall 6-week first quarter ('Q') course	September 12, 2025
	Add Fall/Winter 24-week course or a Fall 12-week course 'WDN'	September 12, 2025
***Drop Deadlines*:**	Drop Fall/Winter 24-week course or a Fall 12-week course 'WDN'	September 12, 2025
	Fall 12-week course resulting in a grade of 'WDN'	December 1, 2025

Contact Information:

Undergraduate Services Office:	SEB 2097 Phone: 519-661-2130	E-mail: engugrad@uwo.ca
Chemical & Green Process Engineering:	TEB 477 Phone: 519-661-2131	E-mail: cbeugrad@uwo.ca
Civil Engineering:	SEB 3005 Phone: 519-661-2139	E-mail: civil@uwo.ca
Computer, Electrical, Mechatronic	TEB 279 Phone: 519-661-3758	E-mail: eceugrad@uwo.ca
Integrated Engineering	ACEB 2410 Phone: 519-661-6725	E-mail: engceli@uwo.ca
Mechanical Engineering:	SEB 3002 Phone: 519-661-4122	E-mail: mmeundergraduate@uwo.ca