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

CEE 4424b – Earth Structures Engineering
Course Outline 2021/22

This course has been developed to provide knowledge and understanding of the geotechnical, geological, and hydrological principles involved in the solution of earth structures engineering problems. Based on their knowledge of soil mechanics and geology, students will be introduced to the analysis, design and construction of slopes, dams and other structures made from soil and rocks.

The topics covered in this course include:

- Geotechnical site investigation and modelling
- Embankments and tunnels in soft ground
- Slopes, excavations and cuttings
- Earth dams

By the end of this course, students will be able to analyze laboratory and field tests data, to identify the appropriate analytical and design approaches for a range of earth structures, to recognize the complexities of construction materials, construction techniques and quality control, and to understand the methods available for the remediation and monitoring of geotechnical structures. Design problems and assignments will enable students to improve their problem-solving and communication skills, whilst working individually and in groups. Through studying and analyzing the outcomes of engineering cases, students will also be exposed to the complex and multidisciplinary challenges facing civil engineers. Where relevant, the students will use industry standard software packages in their designs.

Calendar Copy:
This course is intended to be a comprehensive introduction to the design of slopes, dams and other structures made from soil and rock materials. The material will cover the theory and analysis of a range of geotechnical problems involving natural slopes, cuttings, embankments, dams and waste facilities.

Prequisites: CEE3322A/B.

Anti-requisites: None.

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 Anti-requisite. 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 Anti-requisite conditions.
Contact Hours:

3 lecture hours/week:
Lectures will be delivered in-person. Recommended additional personal study, including review of lecture material and self-study, is approximately 3 hours/week.

2 tutorial hours/week:
A 2-hour session will be delivered during the scheduled tutorial hours. These sessions will be used for tutorials, case studies and design sessions and where appropriate will be recorded for subsequent posting to the course OWL.

Instructor:
Dr. Tim Newson, SEB 3084, tnewson2@uwo.ca

Teaching Assistants:
To be confirmed.

Administrative Support:
Sandra McKay, smckay@uwo.ca, SEB 3005

Textbook:
Prepared class notes should be brought to each class and may be downloaded from the course website.

Other References:

Units:
SI units will be used in lectures and examinations.
Specific Learning Objectives [GA Indicator – bold denotes evaluated indicator]:

1) Geotechnical Site Investigation and Modelling. At the end of this section and after completion of the Design Project the student should be able to:
   a) correctly use relevant terminology and understand the purpose of geotechnical site investigations and the approaches used for modelling of earth structures [KB4]
   b) understand the planning of site investigations for earth structures, identify the various phases of the investigation process and understand the relationships between the key components of each phase [I1]
   c) understand the links between the site materials, the proposed structure, the sampling process and the geotechnical testing/modelling for the best design outcomes [D1]
   d) understand and interpret advanced in-situ geotechnical site investigation tests [I3]

2) Embankments and Tunnels in Soft Ground. At the end of this section and after completion of the Design Project the student should be able to:
   a) describe the different forms and methods of embankment and tunnel construction [KB4]
   b) understand the stress changes that occur in the surrounding ground due to their construction and the influence of water in their design [KB4]
   c) analyze the stability, settlement and consolidation of embankments [PA1, PA2, D1, D4]
   d) analyze surface ground movements due to tunnel construction [PA1, PA2]
   e) describe remedial and ground improvement techniques for embankment construction [D4]
   f) describe the use of staged construction, monitoring and the observational method for embankments [KB4].

3) Slopes, Excavations and Cuttings. At the end of this section the student should be able to:
   a) describe the key slope failure mechanisms for natural and man-made slopes and excavations [KB4]
   b) analyze the stability of sloping earth surfaces using both analytical and graphical methods [ET1, ET2]
   c) understand the effects of crest loadings, dynamic loadings, submergence and drawdown processes on the stability of slopes [KB4]
   d) recommend appropriate factors of safety and construction procedures for various different scenarios [PA2]
   e) analyze the stability of excavations and cuttings using analytical and graphical methods [ET1, ET2]
   f) describe appropriate remediation and monitoring methods for unstable slopes and excavations [D4].

4) Earth Dams. At the end of this section the student should be able to:
   a) describe the different types of earth dam structure [KB4]
   b) understand the major design considerations used in the construction of earth dams (including core and filter design) [D2]
   c) describe foundation treatments available for the most efficient dam designs [KB4]
   d) analyze the stability, settlement/distortion and seepage behaviour of large earth dams [ET1, ET2]
   e) describe the risks associated with rapid drawdown and earthquakes for dams [KB4]
   f) understand the construction of earth dams, their monitoring, performance and maintenance [PA2].

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

<table>
<thead>
<tr>
<th>Knowledge Base</th>
<th>T</th>
<th>Engineering Tools</th>
<th>E(A)</th>
<th>Impact on Society</th>
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<tbody>
<tr>
<td>Problem Analysis</td>
<td>E(A)</td>
<td>Teamwork</td>
<td>T</td>
<td>Ethics and Equity</td>
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<tr>
<td>Investigation</td>
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<td>Communication</td>
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<td>Economics and Project Management</td>
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<tr>
<td>Design</td>
<td>T</td>
<td>Professionalism</td>
<td>I</td>
<td>Life-Long Learning</td>
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Evaluation:
The final course mark will be determined as follows:

<table>
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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Design assignments</td>
<td>15%</td>
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<tr>
<td>Case studies</td>
<td>15%</td>
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<tr>
<td>Design project</td>
<td>30%</td>
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<tr>
<td>Final examination</td>
<td>40%</td>
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<tr>
<td>Total</td>
<td>100%</td>
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1. Examination:
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. Design assignments:
Two individual design calculation assignments will be completed during the course. Each assignment must be submitted prior to the due date to OWL. Late assignments will be assessed a penalty of 10% per day, to a maximum of 3 days, after which they will receive a mark of zero.

3. Case studies:
Two group case assignments will be completed during the course. Each requires a two-part written analysis of the case material prior and after the class. The cases will be presented by practicing engineers who are experts in geotechnical engineering. Each assignment must be turned in to OWL by the group. Group membership will be assigned by the instructor. Late assignments will be assessed a penalty of 10% per day, to a maximum of 3 days, after which they will receive a mark of zero.

4. Design Project:
The design project is a major component of the coursework. Students will tackle a design problem in groups that will be assigned by the instructor. The design project involves a site that has previously been considered for construction of a geotechnical earth structure. This assignment is in three parts: 1) Planning and costing a suitable site investigation, 2) Interpreting the available site investigation and in-situ/laboratory data, and conducting an analysis on an embankment, slope or dam, 3) Producing an interpretive geotechnical report with recommendations. The submission should be sufficiently detailed such that it could be presented to a client for review and approval of the project. Your submission should clearly indicate the name of the individual who undertook prime responsibility for each aspect of the work and the name of the individual who reviewed that aspect of the work. All hand calculations are to be on squared paper and must be organized and presented in a neat, clear and professional manner. All pages of calculations must have the date, initials.
of the originator and initials of the checking engineer. All calculations are to be checked. All drawings are to be of professional quality with the name of originator and checking individual shown.

5. 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 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.

Course delivery with respect to the COVID-19 pandemic:
Although the intent is for this course to be delivered in-person, the changing COVID-19 landscape may necessitate some or all of the course to be delivered 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 assessments affected will be conducted online as determined by the course instructor.

When deemed necessary, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western’s Remote Proctoring website at: https://remoteproctoring.uwo.ca.

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, 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. 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
**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 see the Instructor and teaching assistants. Other individual consultation can be arranged by appointment with the instructor.

**Course breakdown:**
Engineering Science = 50% = 23 AU's; Engineering Design= 50% = 23 AU's.
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.

NEW: Requests for Academic Consideration using the Self-Reported Absence Form

If you experience an unexpected illness or injury or an extenuating circumstance (48 hours or less) that is sufficiently severe to temporarily render you unable to meet academic requirements (e.g., attending lectures or labs, writing tests or midterm exams, completing and submitting assignments, participating in presentations) you should self-declare using the online Self-Reported Absence portal. This option should be used in situations where you expect to resume academic responsibilities within 48 hours or less.

Each student will be allowed a maximum of two self-reported absences between September and April and one self-reported absence between May and August. Self-reporting may not be used for final exams or assessments (e.g. midterm exams, tests, reports, presentations, or essays) worth more than 30% of any given course.

For full instructions about the Self-Reporting System refer to the Academic Calendar link here.

A. GENERAL REGULATIONS & PROCEDURES (other than self-reported absences)

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.

2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.

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 (other than self-reported absences)

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. 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, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.

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

4. Discuss with the instructor if and when the test can be rescheduled. N.B. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.
C. **FINAL EXAMINATIONS (cannot be self-reported)**

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to 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 sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. 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 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.

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**Calendar References:** Check these regulations in your 2021 Western Academic Calendar available at [www.westerncalendar.uwo.ca](http://www.westerncalendar.uwo.ca).

**Self-Reporting Absences**

**Absences Due to Illness**

**Academic Accommodations for Students with Disabilities**

**Academic Accommodations for Religious or Holy Days**

**Course Withdrawals**

**Examinations**

**Scheduling of Term Assignments**

**Scholastic Offences**

**Student Medical Certificate**

**Engineering Academic Regulations**

**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.

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**Add Deadlines:**

- First term half course (i.e. “A” or “F”) September 16, 2021
- Full courses and full-year half course (i.e. “E”, “Y” or no suffix) September 16, 2021
- Second term half course (i.e. “B” or “G”) January 11, 2022

**Drop Deadlines:**

- First term half course (i.e. “A” or “F”) November 12, 2021
- Full courses and full-year half courses (i.e. “E”, “Y” or no suffix) November 30, 2021
- Second term half or second term full course (i.e. “B” or “G”) March 7, 2022

**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: cbegrad@uwo.ca
- Civil Engineering:  
  SEB 3005  
  Phone: 519-661-2139  
  E-mail: civil@uwo.ca
- Computer, Electrical, Mechatronic Systems & Software Engineering  
  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

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