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

CEE 4424b – Earth Structures Engineering
Course Outline 2020/21

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
- 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.

Prerequisites: 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, with a live recording video subsequently posted to the course OWL site for those students not wanting to attend lectures in-person for the term. 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 synchronously through Zoom each week during the scheduled tutorial hours. These sessions will be used for tutorials, case studies and design sessions and where appropriate will be recorded live for subsequent posting to the course OWL site for those students not wanting to attend the sessions in-person for the term. The sessions are not mandatory but students seeking assistance with weekly assignments or clarification on lecture material are strongly encouraged to attend. The link to the Zoom meeting will be posted to OWL.

**Instructor:**

Dr. Tim Newson, SEB 3084, tnewson2@uwo.ca
Office hours: To be discussed in class.

**Teaching Assistants:**

Mohammad Mahmoud Hammad - mhammad2@uwo.ca
Esraa Ahmed ElSherbini ElSayed - eelsayed@uwo.ca
Ahmed Fouad Hussein - ahusse48@uwo.ca

**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:

1) Geotechnical Site Investigation. 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;
   b) understand the planning of site investigations, identify the various phases of the investigation process and understand the relationships between the key components of each phase;
   c) understand the links between the site materials, the proposed structure, the sampling process and the geotechnical testing for the best design outcomes;
   d) understand and interpret advanced in-situ geotechnical site investigation tests (shear vane, cone penetrometer, pressuremeter and plate load test);
   e) describe the various geophysical tests available and their ability to characterize soil volumes.

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;
   b) understand the stress changes that occur in the surrounding ground due to their construction and the influence of water in their design;
   c) analyze the stability, settlement and consolidation of embankments;
   d) analyze surface ground movements due to tunnel construction;
   e) describe remedial and ground improvement techniques for embankment construction;
   f) describe the use of staged construction, monitoring and the observational method for embankments.

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;
   b) analyze the stability of sloping earth surfaces using both analytical and graphical methods;
   c) understand the effects of crest loadings, dynamic loadings, submergence and drawdown processes on the stability of slopes;
   d) recommend appropriate factors of safety and construction procedures for various different scenarios;
   e) analyze the stability of excavations and cuttings using analytical and graphical methods;
   f) describe appropriate remediation and monitoring methods for unstable slopes and excavations.

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

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:

- Design assignments: 15%
- Case studies: 15%
- Design project: 30%
- Final examination: 40%

Total: 100%

1. Examination:
A three-hour written final examination will be held during the regular examination period. Programmable calculators will be permitted in the final exam. The final examination will be AN OPEN BOOK TAKE HOME EXAM. Calculators or other external sources of information, including books, notes or crib sheets, are permitted. The written examination may be followed by a 10-minute oral examination in which the written examination will be reviewed and discussed with the student.

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. This requires written analysis of the case material prior to 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 at the beginning of the case class. 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 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.

**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, 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 as determined by the course instructor.

**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

**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/ 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

**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.

The attached document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.