

Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9522 – Advanced Soil Mechanics

COURSE OUTLINE 2022-2023

DESCRIPTION

This graduate level course explores the engineering mechanics of soil. The course will be delivered through a series of lectures, laboratory assignments, coursework assignments and self-study material. The primary objectives of the course are: (i) to better understand fundamental aspects of the stress-strain response of soil, (ii) to study constitutive concepts for modelling the stress-strain behaviour of soil, (iii) to expose the student to various advanced laboratory and field tests for soils, and their interpretation and (iv) to learn through case studies and application, how soil should be considered in civil engineering design. The topics covered include: basic elasticity and plasticity theory, anisotropy and strain-rate effects, laboratory and in situ measurement of soil properties, basic constitutive models, critical state soil mechanics, and applied soil mechanics. On completion of the course, students are expected to have the necessary knowledge and skills to approach the design of a number of challenging Canadian geotechnical engineering problems.

ENROLLMENT RESTRICTIONS/PREREQUISITES

Enrollment in this course is restricted to graduate students in the civil and environmental engineering programs, as well as any student that has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program. The course is intended for students who have completed a civil engineering undergraduate degree or equivalent. It is expected that students will have a strong understanding of soil mechanics, geotechnical and foundation engineering obtained by having already taken suitable courses. Pre-requisites are CEE4426 Geotechnical Engineering Design or the permission of the instructor. Students without a suitable background in soil mechanics should discuss this with the instructor before registering for the course.

INSTRUCTOR CONTACT INFORMATION

Dr Tim Newson

Email address: tnewson@eng.uwo.ca

Office: SEB3084

Contact policy:

- Contact instructor via email (above)
- Weekly Office hours will be held via Zoom (time TBD)

COURSE FORMAT

Contact hours - two lecture and one laboratory hour per week. 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>.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1: <i>Introduction</i>	Introduction to the course and the critical state soil mechanics concept	<ul style="list-style-type: none"> • Lectures 	Week 1
2: <i>Elasticity</i>	Effective stresses. Volume change behaviour of soils. Stress-strain invariants. Isotropic / anisotropic moduli. Modeling of drained and undrained behavior. The role of elasticity in soil mechanics. Small strain elasticity theories.	<ul style="list-style-type: none"> • Lectures • Assignment • Literature review • Laboratory task 	Week 2-3
3: <i>Plasticity, Yield and Basic Soil Models</i>	Plasticity theory. Yield in metals. Combined loading and yield loci. Yield in sands and clays. Volume change and plastic hardening. Friction block model. Plastic potential. Normality and stability.	<ul style="list-style-type: none"> • Lectures • Laboratory task 	Week 4-5
4: <i>Critical State Soil Mechanics (CSSM)</i>	Introduction to the elasto-plastic modeling of soils. Critical state concept. Behavior of normally/over-consolidated clays, and loose/dense sands. Critical state and constant volume. Stress-dilatancy.	<ul style="list-style-type: none"> • Lectures 	Week 6-7
5: <i>Shear Strength</i>	Mohr-coulomb failure. Critical state line and undrained/drained strength. Peak and residual strengths. Stress paths and laboratory tests.	<ul style="list-style-type: none"> • Lectures • Laboratory task 	Week 8
6: <i>Cam Clay Models</i>	Introduction. Cam clay / Granta gravel. Triaxial test predictions. Applications of models and critical state soil mechanics.	<ul style="list-style-type: none"> • Lectures • Assignment 	Week 9
7: <i>Beyond CSSM</i>	Fissured/varved clays. Strength and yield anisotropy. Strain-rate and viscous effects. Interpretation of	<ul style="list-style-type: none"> • Lectures • Assignment 	Week 10

	lab/in situ data using CSSM. Physical and numerical modelling.		
8: <i>Summary & final presentations</i>	Class presentations and wrap-up.	<ul style="list-style-type: none"> • Communication and reading skills 	Week 11

Notes: 1) all topics may not be covered due to time constraints.
2) there will be no classes during the mid-semester reading week.

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	30%	<ul style="list-style-type: none"> • Assignments • Literature review 	<ul style="list-style-type: none"> • Understanding of advanced concepts and theories • Awareness of important current problems in the field of study • Understanding of computational and/or empirical methodologies to solve related problems
Research & scholarship	25%	<ul style="list-style-type: none"> • Literature review 	<ul style="list-style-type: none"> • Ability to conduct critical evaluation of current advancements in the field of specialization
Application of knowledge	35%	<ul style="list-style-type: none"> • Assignments • Laboratory tasks 	<ul style="list-style-type: none"> • Ability to apply knowledge in a rational way to analyze a particular problem • Ability to use coherent approach to design a particular engineering system using existing design tools
Communication skills	10%	<ul style="list-style-type: none"> • Oral presentation 	<ul style="list-style-type: none"> • Ability to communicate (oral and written) ideas, issues, results and conclusions clearly and effectively

ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Homework Assignments (3)	Topic 2; Topic 6+7	Week 5, 10/11	10% x 3
Laboratory Tasks (3)	Topics 2-5	Week 11	30%
Literature Review report (one)	Literature review of a selected topic	Week 10	30%
Literature Review presentation (one)	Literature review of a selected topic	Week 11	10%

Activities in which collaboration is permitted:

- Laboratory Tasks (group assignment)
- Literature Review: Report/Oral presentation (group assignment)

Activities in which students must work alone (collaboration is not permitted):

- Homework Assignments (individual)

REQUIRED TEXTBOOK

None.

OPTIONAL COURSE READINGS

There is no set textbook for the course. There are a number of textbooks that cover many of the aspects of the course material and which are available through Western Libraries, either physically or online. These include:

- Atkinson, J.H. (1993). An Introduction to the Mechanics of Soil and Foundations. McGraw Hill.
- Bolton, M. (1987). A Guide to Soil Mechanics. MacMillan Education.
- Mitchell, R.J. (2005). Fundamentals of Soil Behaviour. 3rd Edition, Wiley.
- Wood, D.M. (1988). Soil Behaviour and Critical State Soil Mechanics. Cambridge University Press.

Prepared class notes will be made available through the course OWL site at <http://owl.uwo.ca/>, along with other useful reference material and data for assignments.

CHEATING, PLAGIARISM/ACADEMIC OFFENCES

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence at the following website: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

CONDUCT

Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities as appropriate.

HEALTH/WELLNESS SERVICES

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Faculty of Engineering has a Student Wellness Counsellor. To schedule an appointment with the counsellor, contact Kristen Edwards (khunt29@uwo.ca) via confidential email and you will be contacted by our intake office within 48 hours to schedule an appointment. Students who 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.

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness. Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at:

<https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html>

ACCESSIBLE EDUCATION WESTERN (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): http://academicsupport.uwo.ca/accessible_education/index.html

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and

their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.