McMaster University | ENGINEERING

COURSE OUTLINE

COURSE INFORMATION

Course Name: Geotechnical Engineering Course Code: CIVENG 3A03

Session Offered: Fall 2025

Calendar Description: Composition of soils, soil identification and classification; compaction; seepage theory; effective stress concept; stresses and displacements using elastic solutions; consolidation theory; numerical solutions.

Instructor(s): Dr. Peijun Guo Phone: 27903 Office:

Email: guop@mcmaster.ca **Office Hours/Contact**: Monday 1:30-4:30 PM

Lecture Schedule Day(s): Wed. Time: 12:30 PM – 2:20 PM

Laboratory Schedule Day(s): Fri. (Session 1) Time: 2:30 PM – 5:20 PM
Tue. (Session 2) Time: 2:30 PM – 5:20 PM

Tutorial Schedule Day(s): Wed. Time: 4:30 PM – 6:20 PM
Mon. Time: 4:30 PM – 6:20 PM

1. COURSE OBJECTIVES

Soils are weak, compressible, porous earthen materials. All civil engineering are founded on or built in geo-materials (soil and/or rock). The stability and safety of engineering structures depend upon the characteristics and behaviour of various types of soil and rock. Geotechnical Engineering is the subdiscipline that deals with the physical and mechanical properties (or behaviour) of geological materials, as well as with their interaction with engineered structures. A geotechnical engineer is normally involved in the analysis, design and construction of foundations for structures, earth and rock dams, embankments, tunnels and underground structures, highways, railways, airfields, bridge abutments and pier foundations, etc. Geotechnical engineers often also get involved in geo-environmental problems dealing with underground contamination and transport, as well as decommissioning of sites and remediation.

The purpose of this course is to develop a good understanding of the mechanics of soil behavior under various natural and imposed loading conditions. Attention will be focused on the behavior of idealized soil elements from which the behavior of large soil masses may be inferred. To complement the theoretical studies, students will be given the opportunity to carry out standard laboratory tests on various soils.

The contents of the courses are as follows: Composition of soils, soil identification and classification; compaction; seepage theory; effective stress concept; stresses and displacements using elastic solutions; consolidation theory; numerical solutions.

2. COURSE SPECIFIC POLICIES

RECOMMENDED TEXTBOOKS

- Budhu, M. 2010. Soil Mechanics and Foundations, 3rd edition, John Wiley & Sons. or
- Knappett, J. and Craig, R.F. 2019. Craig's Soil Mechanics, 9th Edition, CRC Press.

LABORATORY EXPERIMENTS

Labs are mandatory. Without attending labs will result in failure grade of this course. Each individual is required to participate in a total of 4 laboratory experiments (Soil Compaction, Permeability, Seepage and Soil Consolidation) during the term. The experiments are normally performed in groups of 4 that will be assigned in two lab sessions on Monday and Thursday respectively. They will take place in JHE114 (the soil mechanics laboratory on the ground floor of the Engineering Building). You have two week's time to write your lab reports, which must be submitted by 11:59 PM. the same day of the week of you next laboratory experiment. Extensions on due dates for labs will be granted only under exceptional circumstances. Labs that are submitted late will be docked 10% per day.

Details on report write-up and procedures are presented in "Lab Information". You are expected to familiarize yourselves with each experiment (including the principles and the procedure) before the appropriate laboratory period.

TENTATIVE LABORATORY TIMETABLE

The first lab will start on Tuesday Sept. 16 or Fri. Sept 19, 2025, and the last one will be on Tuesday Nov. 21 or Friday, November 24, 2025, depending on the lab sessions.

ASSIGNMENTS

Assignments must be handed in on time. Assignments handed in late WILL NOT be accepted and will be assigned a mark of zero. Copying and plagiarism will not be tolerated.

TUTORIALS

Students are strongly encouraged to take advantage of the tutorials to ask questions and seek clarification. Students will generally be assigned problems that, in some cases, are to be completed during the tutorial session. The TAs and/or instructor will be available during the tutorial period to answer questions concerning assignments, labs, etc. Please bring textbook, notes, paper, drawing instruments, calculators, etc. to the tutorial session and be prepared to work.

QUIZZES

Four quizzes, each will be 45 minutes long, will be scheduled during the tutorial time slots. The questions in a quiz primarily focus on the new materials since previous quiz and will be **in the format of multiple choices**. However, you may need to perform proper calculations to make the correct choice. **Three higher marks of the four quizzes will be counted for the final grade**.

3. SCHEDULE

WEEK 1 Sept. 2	- Introduction to soil mechanics and foundation engineering; Origin & description of soil particles and minerals (Budhu-Chapter 2; Craig-Chapter 1) - Clay-water interaction; Grain size analysis using sieve and sedimentation tests (Budhu-Chapter 2; Craig-Chapter 1)	
WEEK 2 Sept. 8	- Phase relations and interrelations; Typical values; Relative density of coarse-grained soils (Budhu-Chapter 4; Craig-Chapter 1)	- Assignment 1 (Phase relations) posted
WEEK 3 Sept. 15	- Atterberg limits of fine-grained soils; Plasticity chart - Soil classification (Budhu-Chapter 4; Craig-Chapter 1); - In-situ tests for identification of soils (Lecture notes)	- Assignment 2 (Atterberg limits and soil classification) posted
WEEK 4 Sept. 22	- Introduction of soil improvement; Compaction (Budhu-Chapter 5; Craig-Chapter 1);	- Quiz 1

	- Moisture-density relations; Proctor tests; Effects of compaction on soil properties (Budhu-Chapter 5; Craig-Chapter 1)	
WEEK 5 Sept. 29	- National Day (No lecture on holiday Monday)	
WEEK 7 Oct. 6	- Total, pressure and elevation heads; Darcy's Law; Permeability tests; Layered soil systems (Budhu-Chapter 6; Craig-Chapter 2)	- Assignment 3 (Compaction and permeability) posted
WEEK 8 Oct. 13	Midterm Recess	
WEEK 9 Oct. 20	- Two-dimensional seepage; Laplace equations; Flow nets (Lecture notes; Craig-Chapter 2) - Capillary rise; Frost heave (Lecture notes)	- Quiz 2
WEEK 10 Oct. 27	- In-situ stresses: Effective stresses, buoyant densities, Geostatic stresses (Budhu-Chapter 7)	- Assignment 4 (Geostatic stresses)
WEEK 11 Nov. 3	- Elastic stresses and deflections; Boussinesq equations (Part 1) (Budhu-Chapter 7)	- Quiz 3
WEEK 12 Nov. 10	- Boussinesq equations (Part 2); Flexible and rigid footings (Budhu-Chapter 7)	- Assignment 5 (Induced stresses in soil) posted
WEEK 13 Nov. 17	- Consolidation definitions; Soil compressibility and oedometer tests; Unloading of soils; Pre-consolidation pressure (Budhu-Chapter 9; Craig-Chapter 4)	- Assignment 6 (Compressibility of soil) posted
WEEK 14 Nov. 24	- Simple settlement calculations; - Terzaghi 1-D consolidation theory; Coefficient of consolidation - Degree of consolidation (Budhu-Chapter 9; Craig-Chapter 4)	- Assignment 7 (Consolidation of soil) posted - Quiz 4
WEEK 15 Dec. 1	- Rates of settlement - Secondary compression; Casagrande and Taylor methods (Budhu-Chapter 9; Craig-Chapter 4)	
4. ASSESSMENT OF LEARNING		**WEIGHT %**
Laboratories		15% (Group submission)
Assignments		20%
Quizzes		30% (take 3 higher marks of 4 quizzes)
Final Exam		35%
5. LEARNING OUTCOMES		
1. To understand the physical and mechanical behaviour of soil under various natural and imposed loading conditions • CEAB attribute 1.3 “Competence in Engineering Fundamentals”		
2. To identify/employ techniques, based on fundamental notions of mechanics, to analyze stress and seepage in soil as well as soil deformation under various conditions • CEAB attribute 2.2 “Ability to identify a range of suitable fundamentals that would be useful for analyzing a technical problem”		

3. To solve problems using different methods by making proper assumptions/ simplifications, based on the fundamentals
   • CEAB attribute 5.3 "Ability to create, adapt, modify and extend tools and techniques to solve problems

6. COMMUNICATIONS

Lectures and tutorials are important components form of communication in this course. Therefore, course attendance is expected for lectures, tutorials, and labs. Avenue to Learn is the main resource platform, where announcements, course notes and related information will be posted. Students are strongly encouraged to attend the lectures and tutorials to ask questions and seek clarification.

As a courtesy and to ensure timely response to emails, you must include your name and student ID number in the email signature and course code in the email subject line. **Emails to the instructor or TAs must be sent from your McMaster University email account via the "@mcmaster.ca" alias (not Avenue).** Emails should be written in a professional manner, spell checked and proofread.

It is the student's responsibility to:

- Maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- Use the University provided e-mail address or maintain a valid forwarding e-mail address.
- Regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their "@mcmaster.ca" alias.
- Accept that forwarded e-mails may be lost and that e-mail is considered received if sent via the student's @mcmaster.ca alias.
- Check the McMaster/Avenue email and course websites on a regular basis during the term.

HEALTH AND LAB SAFETY

The Faculty of Engineering is committed to McMaster's University Workplace and Environmental Health and Safety Policy which states: "Students are required by University policy to comply with all University health, safety and environmental programs".

It is your responsibility to understand McMaster University workplace and environmental health and safety programs and policies. For information on these programs and policies please refer to McMaster University Environmental & Occupational Health Support Services at University Health and Safety (UHS) - Human Resources (mcmaster.ca). It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for some of the experiments and the laboratory equipment.

The safety requirements for the labs are listed below. Students not abiding by these safety requirements will be asked to vacate the laboratory and will receive a grade of zero for that particular lab.

- Closed-toe shoes must be worn at all times.
- No loose clothing allowed, and long sleeve shirts must be worn.
- No short (i.e., above the knee) pants or skirts are permitted in the lab
- Lab coats must be worn over top of your clothing in these instances.
- Long hair must be tied back.
- Safety glasses must be worn for Proctor compaction test (The safety glasses will be provided but your can bring your own safety glasses if you have).
- Ear plugs for Proctor compaction test will be supplied.

7. POLICIES

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/.

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

USE OF GENERATIVE AI

You may use generative AI for **editing or revising your lab reports** as long as the use of generative AI is referenced and cited. Use of generative AI outside the stated use will constitute academic misconduct. It is the student's responsibility to be clear on the limitations for use generative AI and to do so appropriately.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

The McMaster Student Absence Form is a self-reporting tool for **Undergraduate Students** to report absences that last up to 5 days and provides the ability to request accommodation for any missed academic work. Please note, this tool cannot be used during any final examination period. You may submit a maximum of 1 Academic Work Missed requests per term. It is **your** responsibility to follow up with your Instructor immediately regarding the nature of the accommodation. If you are absent more than 5 days or exceed 1 request per term you **must** visit your Associate Dean's Office (Faculty Office). You may be required to provide supporting documentation. This form should be filled out immediately when you are about to return to class after your absence.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

PROTECTION OF PRIVACY ACT (FIPPA)

The Freedom of Information and Protection of Privacy Act (FIPPA) applies to universities. Instructors should take care to protect student names, student numbers, grades, and all other personal information at all times. For example, the submission and return of assignments and the posting of grades must be done in a manner that ensures confidentiality – see http://www.mcmaster.ca/univsec/fippa/fippa.cfm.

ANTI-DISCRIMINATION

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer, or the Human Rights Consultant, as soon as possible

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

8. MCMASTER GRADING SCALE

Grade	Equivalent Grade Point	Equivalent Percentages
A+	12	90-100
A	11	85-89
A-	10	80-84
B+	9	77-79
B	8	73-76
B-	7	70-72
C+	6	67-69
C	5	63-66
C-	4	60-62
D+	3	57-59
D	2	53-56
D-	1	50-52
F	0	0-49