CIV_ENG_250-0 – Earth Surface Engineering
Fall Quarter 2022

Course description: This course addresses the fundamentals of the mechanics of geomaterials, with emphasis on the processes and phenomena that govern the equilibrium of the Earth's surface. The course focuses on the analysis of the structure and properties of soils and rocks, and the way these materials respond to loading (mechanical and hydraulic loading). The course comprises theoretical sessions, practical sessions, and laboratory sessions. The theoretical sessions develop foundational concepts, theories, and approaches underpinning the characterization, analysis, and prediction of the structure, properties, and behavior of geomaterials. The practical sessions apply the gathered theory to solve a variety of earth surface engineering problems, with an outlook on the interplay between the structure, properties, and behavior of geomaterials and the engineering performance of natural and built environments. The laboratory sessions propose and guide through hands-on activities and laboratory tests of geomaterials to address basic earth surface engineering problems.

Course goals: At the end of this course, students will be able to:

1) Compute the properties of three-phase materials including soils
2) Classify the properties of soils through the analysis of experimental data and the development of appropriate laboratory tests
3) Calculate stresses at depth in the presence and absence of water
4) Determine the direction and magnitude of seepage flows in soils
5) Characterize the compression and consolidation behavior of soils through the analysis of experimental data and the development of appropriate laboratory tests
6) Characterize the shearing behavior of soils, rocks, and discontinuities through the analysis of experimental data and the development of appropriate laboratory tests
7) Relate the treated content of earth surface engineering with grand challenges in sustainability and resilience
8) Communicate in oral, written, and graphical form with appropriate means
9) Employ computer software and techniques for design and communication
10) Work individually and in a team to solve problems related to earth surface engineering
11) Structure and write reports summarizing the results of technical calculations and analyses

Course outcomes: The following Course Assessment Table (CAT) relates Course Goals to Accrediting Board for Engineering and Technology (ABET) Outcomes as follows:

Course Goals	ABET Outcome	ABET Outcome Description	Performance indicator
1, 3, 4, 6	1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Goal 1, 3, 4, 5, 6 Mid-term exam Final exam
8, 9, 10, 11	3	An ability to communicate effectively with a range of audiences	Homework assignments – Form
			Think tank presentation – Form
7	4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Think tank presentation – Content
2, 5	6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Homework assignments – Content

Course structure and materials:

Instructor	Prof. Alessandro ROTTA LORIA Office: Tech A120 E-mail: af-rottaloria@northwestern.edu Office hours: Wednesday 11:00 am to 12:15pm, Tech A120 or via Zoom by appointment
Teaching Assistant	Mr. Andony LANDIVAR MACIAS E-mail: alandivar@u.northwestern.edu Office hours: Thursday 11:00 am to 12:00 pm, Tech AG32 or via Zoom by appointment
Class times & location	Mondays (M), Wednesdays (W), and Fridays (F) from 10:00 to 10:50 am, Annenberg Hall G32
Lab times & location	Tuesdays (T) on selected dates, from 9:30 am to 12:20 pm, Tech AG40
Suggested textbooks	Holtz, R. D., and Kovacs, W. D. (1981). *An introduction to geotechnical engineering*. Pearson (HKS) Lambe T.W., and Whitman, R.V. (1979) *Soil Mechanics*. Wiley (LW)
Course assessment	**1) Class attendance – 5%**. 3.33 points will be assigned for every attended class on M, W, and F (total classes considered: 30); one "freebie" absence for which no points will be deducted from the attendance grade is granted (graded from 0 to 100). **2) Homework assignments – 20%**. Assessed through the quality of technical reports summarizing the results of homework problems to be solved individually (graded from 0 to 100). The reports must be written in digital format and composed of three sections: 1) Problem statement and definition of unknowns; 2) Solution; 3) Summary of results and concluding remarks. They should be sent to the T.A. by the specified deadline. Both the content and form of the reports will be evaluated, accounting for 80% and 20% of the grade, respectively. **3) Laboratory sessions – 15%**. Lab sessions will involve the resolution of practical problems through hands-on activities, whose results will need to be summarized in the form of a group technical lab worksheet (graded from 0 to 100). The quality of the report will be assessed by considering its content and will account for 50% of the grade; attendance will count the remaining 50% of the grade. **4) Mid-term exam – 25%**. Assessed through the results of a quiz composed of 25 questions to be answered in 50 minutes (graded from 0 to 100) **5) Think tank presentation – 5%**. Assessed through the quality of 5-minute-long group presentations given in front of the class (graded from 0 to 100). The presentations should discuss with a critical attitude the link between Earth Surface Engineering and the content of one or more presentations featured at the Northwestern Sustainability Lecture Series. In other words, the presentations should discuss the ways Earth Surface

	Engineering can address modern problems in sustainability. A Q&A session will follow each group presentation. Each student will be required to share their thoughts during the respective group presentation. Both the content and form of the presentations will be evaluated, accounting for 80% and 20% of the grade, respectively. **6) Final written exam – 30%**. Assessed through the quality of a written exam lasting two hours and including two broad problems: one theoretical problem and one practical problem (graded from 0 to 100). *Remark*: Student groups will need to be composed of 4 people. Potential exceptions will be discussed upon the need. Course grading: A = 100-93, A- = 92-90, B+ = 89-87, B = 86-83, B- = 82-80, C+ = 79-77, C = 76-73, C- = 72-70, D+ = 69-67, D = 66-65

Course content

Color meaning: **Theoretical session** | ***Practical session*** | **Lab session** | ***Special session*** | ***Exam***

Week	Day	Lecture	Laboratory	Remarks
1	W	**1. An introduction to earth surface engineering**		
	F	**2. Origin, exploration, and characterization of geomaterials** HKS (3.1, 3.2, 3.3, 11.6, 12.6, 5) LW (7)		
2	M	**3. Phase relations** HKS (2.1, 2.2, 2.3) LW (3.1)		
	W	**4. Classification and index properties of soils** HKS (2.4-2.10, 4.1-4.9, 4.11-4.13) LW (3.2-3.5, 4)		
	F	***5. Determination of phase relations, index, and classification properties***		
3	M	**6. Stresses in the subsurface without and with hydrostatic water** HKS (6.1, 6.2, 6.9-6.11) LW (8.1, 8.2; 16 except 16.3)		
	T		**Lab #1: soil classification**	*Lab work #1 assigned*
	W	**7. Analysis of the stress state in the subsurface** HKS (11.1-11.2) LW (8.4, 8.5)		
	F	***8. Characterization of stress state in field conditions***		*Homework #1 assigned*
4	M	**9. Principles of mass transfer in the subsurface** HKS (7.1-7.6) LW (17, 19.1-19.3)		
	W	**10. Analysis of groundwater seepage in the subsurface** HKS (8.1-8.3) LW (9, 11.3, 12, 20, 26)		
	F	***11. Stress analysis with the Mohr's circles of stress***		*Homework #2 assigned*; ***Lab #1 worksheet due***
5	M	**12. Deformation of soils and rocks** HKS (7.1-7.6) LW (17, 19.1-19.3)		***Homework #1 due***
	W	**13. Analysis of the compressibility of soils** HKS (8.1-8.7, 8.10, 8.11) LW (10, 12.2)		
	F	***14. Analysis of problems of groundwater seepage***		
6	M	**15. Analysis of the consolidation of soils** HKS (9.1) LW (27.1-27.4)		***Homework #2 due***
	T		**Lab #2: oedometer test**	*Lab work #2 assigned*

	W	***Interim summary of course content***		
	F	***Mid-term exam***		
7	M	***2022 Sustainability Lecture Series***		
	W	**16. Strength of soils** HKS (11.5) LW (9.2 and 9.3)		
	F	***17. Analysis of oedometer test results***		***Lab #2 worksheet due*** *Homework #3 assigned*
8	M	**18. Analysis of the deformation and strength of soils under drained conditions** HKS (12.1-12.5, 12.8, 12.9) LW (10, 11, 20, 21)		
	W	***19. Analysis of drained triaxial test results***		
	F	***Think tank session about the Sustainability Lecture Series***		***Presentations by students***
9	M	**20. Mohr circles and stress paths under drained conditions** HKS (12.1-12.5, 12.8, 12.9) LW (10, 11, 20, 21)		
	T		**Lab #3: triaxial test**	*Lab work #3 assigned*
	W	**21. Analysis of the deformation and strength of soils under undrained conditions** HKS (12.10,12.11,12.14, 12.17, 13.10) LW (26.1, 28, 29)		
	F	***22. Analysis of undrained triaxial test results***		***Homework #3 due*** *Homework #4 assigned*
10	M	**23. Mohr circles and stress paths under drained conditions – part I** HKS (12.10,12.11,12.14, 12.17, 13.10) LW (26.1, 28, 29)		
	T		**Lab #4: direct shear test**	*Lab work #4 assigned*
	W	**24. Mohr circles and stress paths under drained conditions – part II** HKS (13.1-13.6) LW (8.6)		***Lab #3 worksheet due***
	F	***Thanksgiving vacation***		
11	M	**25. Analysis of the deformation and strength of rocks** HKS (11.4.4, 13.16, 12.15)		***Homework #4 due***
	W	**26. Analysis of the strength of discontinuities** HKS (11.4.4, 13.16, 12.15)		
	F	***Final summary of foundational course content***		***Lab #4 worksheet due***

Statements

Academic Integrity
Students in this course are required to comply with the policies found in the booklet, "Academic Integrity at Northwestern University: A Basic Guide". All papers submitted for credit in this course must be submitted electronically unless otherwise instructed by the professor. Your written work may be tested for plagiarized content. For details regarding academic integrity at Northwestern or to download the guide, visit:https://www.northwestern.edu/provost/policies-procedures/academic-integrity/index.html

Accessibility
Northwestern University is committed to providing the most accessible learning environment as possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (e: accessiblenu@northwestern.edu; p: 847-467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the term, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.

COVID-19 Classroom Expectations Statement
Students, faculty and staff must comply with University expectations regarding appropriate classroom behavior, including those outlined below and in the COVID-19 Expectations for Students. With respect to classroom procedures, this includes:

- Policies regarding masking, social distancing and other public health measures evolve as the situation changes. Students are responsible for understanding and complying with current University, state and city requirements.
- In some classes, masking and/or social distancing may be required as a result of an Americans with Disabilities Act (ADA) accommodation for the instructor or a student in the class even when not generally required on campus. In such cases, the instructor will notify the class.

If a student fails to comply with the COVID-19 Expectations for Students or other University expectations related to COVID-19, the instructor may ask the student to leave the class. The instructor is asked to report the incident to the Office of Community Standards for additional follow-up.

Diversity, Equity, and Inclusion
In this course, we embrace diversity and foster equity and inclusion. In line with the Northwestern vision on diversity, equity, and inclusion, we believe that the best way to get a good idea is to have many diverse ideas, and the best way to foster a diversity of ideas is through a culture in which there is synergy and inclusion among a diverse group of people.

We are committed to ensuring that students of all ages, backgrounds, religions, races, ethnicities, gender identities/expressions, national origins, sexual orientations, physical abilities, and all other visible and non-visible differences feel welcome and respected, are treated equitably, and are able to fully engage with the learning and research communities.

Exceptions to Class Modality
Class sessions for this course will occur in person. Individual students will not be granted permission to attend remotely except as the result of an Americans with Disabilities Act (ADA) accommodation as determined by AccessibleNU.

Maintaining the health of the community remains our priority. If you are experiencing any symptoms of COVID do not attend class. Follow the steps outlined on this site for testing, isolation and reporting a positive case. Next, contact your instructor as soon as possible to arrange to complete coursework.

Students who experience other personal emergencies should contact the instructor as soon as possible to arrange to complete coursework.

Should public health recommendations prevent in-person class from being held on a given day, the instructor or the university will notify students.

Prohibition of Recording of Class Sessions by Students
Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy and state law.

Students requesting the use of assistive technology as an accommodation should contact AccessibleNU. Unauthorized use of classroom recordings – including distributing or posting them – is also prohibited. Under the University's Copyright Policy, faculty own the copyright to instructional materials – including those resources created specifically for the purposes of instruction, such as syllabi, lectures and lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.

Support for Wellness and Mental Health
Northwestern University is committed to supporting the wellness of our students. Student Affairs has multiple resources to support student wellness and mental health. If you are feeling distressed or overwhelmed, please reach out for help. Students can access confidential resources through the Counseling and Psychological Services (CAPS), Religious and Spiritual Life (RSL) and the Center for Awareness, Response and Education (CARE). Additional information on all of the resources mentioned above can be found here:
https://www.northwestern.edu/counseling/
https://www.northwestern.edu/religious-life/
https://www.northwestern.edu/care/