CIV E 697 Rock Engineering

Fall 2024 - September 03 to December 09

Class time: Tuesday, Thursday 9:30-10:50 Location: NRE 2-122

Instructor:

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Office Hours:

Course Description:

*4 (fi) (first term, 3-1S-1) Elements of structural geology, analysis of the geometry of rock defects, properties of intact rocks. Properties of rock masses and stresses in rock masses, stability of rock slopes. Rock foundations and underground excavations in rock. Case studies

Prerequisites: None but students in this course should also be taking CIV E 680 (Advanced Soil Mechanics) and CIV E 664 (Solid Mechanics)

Course synchronous and asynchronous content delivery schedule:

While delivered primarily in-person, there will be several periods where lectures will be scheduled virtually and it could be scheduled at alternate times (with approval from class)

Land Acknowledgment:

The University of Alberta respectfully acknowledges that we are situated on Treaty 6 territory, traditional lands of First Nations and Métis people.

Lab Sections:

Section	Day	Time	Location
LAB D1		1:00 - 1:00	

Seminar Sections:

Section	Day	Time	Location
SEM E1		1:00 - 1:00	

Course Objectives & General Content:

Fundamentals of failure process in intact rock, energy and stress instability, and rock compressibility. Strength of jointed rock masses. Rock mass classifications. Flow (dual porosity) and coupled processes in rock. Role of a synthetic rock mass.

Learning Outcomes:

By the end of this course, students should be able to:

1. Describe key geological features and rock properties relevant to engineering applications and understand the significance of in-situ stress in rock masses.

2. Compare continuum and discontinuum concepts in rock engineering analyses and apply concepts of energy and stress to rock fracturing.

3. Students will gain hands-on experience conducting laboratory tests to analyze the failure processes of strong rocks and utilize the Hoek-Brown failure criterion for predicting rock strength. They will also be able to provide geotechnical descriptions of rock discontinuities and assess their shear strength.

4. Apply the Geological Strength Index (GSI), the Hoek-Brown criterion, and the Cohesion Weakening Friction Strengthening (CWFS) model to evaluate rock mass strength.

5. Employ empirical rock mass classification systems such as Q and RMR, calculate the modulus of rock masses, and understand its significance in engineering design.

6. Comprehend the concepts of Discrete Fracture Network (DFN) and Synthetic Rock Mass models and their applications, as well as analyze the interplay of thermal, hydraulic, and mechanical processes in rock masses for engineering purposes.

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Tutorias			40%
Labs			20%
Final Exam			40%

The Faculty recommended grade point average for a 600 level course is 3.3. Instructors have the leeway to deviate from this average and can assign grades based on their own scheme. All grades are approved by the department chair (or delegate). The office of the Dean has final oversight on all grades.

Term Work

All term work solutions will be posted no later than the last day of classes. All term work will be returned to students by the final day of classes, with the exception of major term work due in the last week of classes. The latter will be returned by the day of the final examination or the last day of the examination period if there is no final examination in the course as per university policy; instructors will make accommodations to return these term work. It is the responsibility of the student to pick up all their term work at the specified time and place. Any unreturned term work, shall be retained and then shredded six months after the deadline for reappraisal and grade appeals. Final examinations will be kept for one year as required by university guidelines and the Government of Alberta's Freedom of Information and Protection of Privacy Act.

Additional Notes

Progress Assessment:

There are three Quiz assessments of your progress.

Tutorials:
There are 6 tutorials.
Tutorials 1 to 3 are due Nov 10, and
Tutorials 4 to 6 are due at the time of the final exam.

Arrangements will be made for external access to the RocScience software that is used for the tutorials. Note: The software from RocScience is also available in the Computer Labs in NREF 2-117 and 2-125

Text and References (Mandatory):

Handouts and Reading Assignments will be provided to cover basic material as there is no single recommended text. There is a list of books provided in Reference #0 - Books

Lab Information:

Lab Topic	Date

Students will undergo safety training as a part of this course and are expected to follow appropriate lab safety procedures at all times.

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit http://www.deanofstudents.ualberta.ca/ for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

Labs:
There will be three rock mechanics Grad Labs. All labs are mandatory.

Lab Topic	Date (may be adjusted)
Lab 1: Dynamic Stiffness	Oct. 25
Lab 2: UCS and Index Tests	Nov. 8
Lab 3: Joint Shear Characteristics	Nov. 22

Note: Students will undergo lab specific safety training as part of this course and are expected to follow appropriate lab safety procedures at all times.

eClass:
The University of Alberta eClass will be used for distributing all class material. Any material handed out in class will also be posted on eClass.

Textbooks:
Handouts and Reading Assignments will be provided to cover basic material as there is no single recommended text. There is a list of books provided in Reference #0 - Books

Sources for Research Material:

1. Australian Institute of Mining and Metallurgy (AIMM) Bulletin
2. Canadian Geotechnical Journal
3. Canadian Institute of Mining and Metallurgical (CIM) Bulletin
4. Engineering Geology
5. Geomechanics and Tunnelling
6. Geotechnical and Geological Engineering
7. Geotechnical Testing Journal, American Society for Testing Materials
8. Géotechnique
9. International Journal of Fracture
10. International Journal of Geomechanics
11. International Journal Rock Mechanics and Mining Sciences
12. Journal of Geophysical Research
13. Journal of Geotechnical and Geoenvironmental Engineering, (ASCE)
14. Journal of Mining Engineering (American Society Mining Engineers, SME)
15. Journal of Rock Mechanics and Geotechnical Engineering
16. Journal of the South African Institute of Mining and Metallurgy (SAIMM)
17. News Journal for the International Society for Rock Mechanics (only on-line)
18. Quarterly Journal of Engineering Geology and Hydrogeology
19. Rock Mechanics and Rock Engineering
20. Transactions of the Institute of Mining and Metallurgy (IMM) Section A: Mining industry (United Kingdom)
21. Tunnelling and Underground Space Technology

Web Sites

1. http://www.rocscience.com: Practical Rock Engineering by Dr. Evert Hoek

CIV E 697 Rock Mechanics
(Fundamental Rock Behaviour)
Lecture Topics

1. Introduction – Geology and Rock Description
2. In-situ stress in rock masses
3. Continuum vs Discontinuum concepts in rock engineering analyses
4. Rock Fracturing: Energy vs Stress concepts
5. Intact rock: Lab Failure processes (Strong Rocks)
6. Intact Rock: Hoek-Brown Failure Criterion
7. Discontinuities: Geotechnical description and shear strength
8. Rock mass strength:
   a) GSI, Hoek-Brown
   b) Cohesion Weakening Friction Strengthening (CWFS Model)
9. Empirical rock mass classification systems (Q, RMR)
10. Rock mass Modulus
11. DFN -Synthetic Rock Mass
12. Thermo-Hydro-Mechanical (THM) Process