Course Syllabus

Instructor: Professor Roman Y. Makhnenko, PhD
2221 Newmark Civil Engineering Laboratory
(217) 300-4587 (phone)
romanmax@illinois.edu

Office hours: Tuesday 3:30 - 5 pm (or by appointment)

Class Meetings: Time: TTh 2:00 – 3:20 pm
Rm.: 2310 Newmark Civil Engineering Laboratory

Class Website: http://compass2g.illinois.edu/

Textbooks and Reading:


Other: Additional reading from handouts

Course description

Rock mechanics is the theoretical and applied science of the mechanical behavior of rock; it is that branch of mechanics concerned with the response of rock to the force fields of its physical environment. For practical purposes, rock mechanics is mostly concerned with rock masses on the scale that appears in engineering and mining work, and so it might be regarded as the study of the properties and behavior of accessible rock masses due to changes in stresses or other conditions. On one hand, shallow, weathered or fragmented rocks can be treated with the approaches similar to soil mechanics. On the other hand, there is an increasing demand to study the behavior of rocks under conditions that occur deep in the Earth’s crust, i.e. at elevated pressures and temperatures. Additionally, accessible rock masses are broken up by joints and faults, and pressurized fluid is frequently present both in open joints and in the pores of the rock itself (after Jaeger et al., 2007).

This course introduces students to the theoretical and practical aspects of rock mechanics. Constitutive behavior of continuum media is reviewed and applied to the behavior of geomaterials. Elastic, inelastic, and failure response of dry rock is discussed. Fluid flow in porous media is described in terms of coupling with rock deformation. Finally, it is shown how rock mechanics principles can be applied to tunneling and deep geological storage.
Class Sessions
Sessions begin at 2:00 pm and end at 3:20 pm. Class notes or slides when used will be posted to the Compass2g website. It is recommended to save on printing (and be sustainable) and try to take written notes (including using electronic devices). You are responsible for what is presented verbally, what is presented on the chalkboard, and what is presented on the slides and the assigned reading materials. After each session, you should review your notes and re-read appropriate assignments.

Participation and Attendance: Participation is an important part of learning and will be strongly encouraged. Three unexcused absences are allowed, after that each case should be reported. Active participation in in-class discussions is worth 10% of your grade.

Homework: No homework will be assigned. However, there will be a list of problems to solve before each midterm. These problems will be available on the Compass2g website and discussed in class before the exam.

Exams: There will be two 80-minute long mid-term exams during the semester and a 2.5-hour long final exam. Although tentative dates are shown in the schedule below, specific dates for the mid-term exams will be announced in class at least one week in advance of the exam. In the exams you will be asked both qualitative and quantitative questions; the exams are not a mere repetition of the problems solved in class. You will be asked to apply material you have learned in lecture and readings, as well as during in-class discussions and questions.

Honor Code: All students at the University of Illinois are expected to uphold the highest ethical standards, be honest, and practice academic integrity. Campus policies are explained in the Student Code, Article 1, Part 4 (http://admin.illinois.edu/policy/code/Full_Code_web2012.pdf). Students at Illinois are also expected to produce original work and properly cite any sources used. Plagiarism will not be tolerated. Section 1-402(d) of the Student Code provides campus policy on plagiarism (http://admin.illinois.edu/policy/code/Full_Code_web2012.pdf). I define cheating as any violation of the Student Code; and I do not tolerate cheating in any form. At a minimum, cheating will result in a 0 on the test, and may result in failing the class and other University penalties. You are encouraged to discuss assignments and study for exams with your classmates and colleagues, but the work that you submit must be your own.

Grade Distribution:
In-class participation 10%
Mid-term exam (1) 20%
Mid-term exam (2) 25%
Final exam 45%

Grades & Performance:
Superior 90 – 100 A (including +/-)
Proficient 80 – 89.9 B (including +/-)
Satisfactory 70 – 79.9 C (including +/-)
Mediocre 60 – 69.9 D (including +/-)
Unacceptable below 60 F
Course Schedule – **Tentative and subject to change**

1. Aug. 29: Introduction, outline of main topics
2. Aug. 31: Rock vs Soil, Rock classification
3. Sept. 5: Stress vector and stress tensor, Mohr’s circle
4. Sept. 7: Displacement and small strain, strain and rotation tensors
5. Sept 12: Material behavior; stress – strain diagram
6. Sept 14: Elastic behavior of rock
7. Sept 19: Inelastic deformation
8. Sept 21: Different regimes of rock failure
9. Sept 26: Linear failure criteria
10. Sept 28: Advanced failure criteria
11. Oct 3: Joints in rock
12. Oct 5: Jointed rock mass behavior
14. Oct 12: **Midterm1**
15. Oct 17: Fluid flow in porous media
17. Oct 24: Theory of poroelasticity
18. Oct 26: Effective stress and constitutive poroelastic relationship
19. Oct 31: Effective media theories
20. Nov 2: Inelastic deformation of fluid-saturated rock
21. Nov 7: Creep of rock
22. Nov 9: Effect of temperature on rock response
23. Nov 14: Review of fluid and thermal effects on rock deformation
24. Nov 16: **Midterm2**
   Nov 18-Nov 26: Thanksgiving break
25. Nov 28: Novel lab methods in rock characterization
26. Nov 30: Tunneling in rock
27. Dec 5: Deep geological storage
28. Dec 7: Induced seismicity
29. Dec 12: Guest lecture
   Dec 18-Dec 21: **Final**