**CEE4450 Introduction to Petroleum Geomechanics**

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**Course Schedule:** T&Th 1:35 – 2:55am

**Classroom:** Mason 3133

**Course Prerequisite:** COE3001 – Deformable Bodies Mechanics

**Course Objectives:** This course introduces students to the basic concepts of geomechanics and their engineering applications with a focus on the petroleum- and energy-related applications and the aspects related to environmental engineering. Specific topics include: linear elastic behaviors of continuum, engineering geology, rock properties and failure mechanisms, flow in fractured and porous media, wellbore stability, hydraulic fracturing, hydrocarbon production, reservoir compaction, and fluid injection and induced seismicity.

**Coursebook:** A collection of handouts/notes and references will be used in this class.

**Recommended References:**

1. Fjar, E., R. M. Holt, P. Horsrud, A. M. Raaen and R. Risnes (2008). *Petroleum Related Rock Mechanics*, Elsevier. 2nd Edition. (electronic version available in the library)
2. Hyne, N. J. (2001). *Nontechnical guide to petroleum geology, exploration, drilling, and production*. 2nd Edition, Penn Well Corp, Tulsa, OK. (electronic version available in the library)
3. J. P. Harrison and J. A. Hudson (2005). *Engineering Rock Mechanics – An Introduction to the Principles*. Elsevier. (electronic version available in the library)

**Additional References:**

1. Zoback, M. D. (2010). *Reservoir Geomechanics*. Cambridge University Press.
2. Economides, M. J. and K. G. Nolte (2000). *Reservoir Stimulation*. Wiley.
3. Jaeger, J. C., N. G. W. Cook and R. W. Zimmerman (2007). *Fundamental of Rock Mechanics*. Blackwell, Malden, MA.
4. Davis, R. O. and A. P. S. Selvadurai (1996). *Elasticity and Geomechanics*. Cambridge University Press, New York.
5. Poulos, H. G. and E. H. Davis (1974). *Elastic Solutions for Soil and Rock Mechanics*. John Wiley and Sons. (http://www.usucger.org)

**Grading:** Homework 25%

Pop Quizzes 5%

Midterm Exam 25%

Final Exam 30%

Term Project 15%

**Office Hours:**

TBA

**Academic Honor Code**

Full compliance with the GT Academic Honor Code (www.honor.gatech.edu) is expected. You are allowed (and encouraged) to work together with other students on homework, but you must write up and turn in your own solutions. For assignments using computer-generated outputs, it is ***NEVER*** appropriate for different students to turn in copies of the same printout. Please list any people with whom you studied together for your assignment. Exams are to be your work alone. Exams will be closed book. But you will be allowed to bring one page/side of notes to every exam. For any questions involving these or any other Academic Honor Code issues, please consult us or [www.honor.gatech.edu](http://www.honor.gatech.edu).

**Attendance**

Participation in class as described by the Institute policy is mandatory (http://www.finaid.gatech.edu/content/verification-participation-0).

**Electronic Usage Policy**

Please turn your cell phone off when you are in class. Please notify the instructor if you will use a tablet or laptop to take notes.

**Homework**

Homework is assigned biweekly. All the assignments will be posted in T-Square. HW must be submitted in hard copy.

**Field Trip and Guest Lectures**

There will be a one-day weekend field trip with report as a bonus assignment. Attendance of the field trip is optional, but strongly encouraged. There will be guest lectures (expected during the class hours; specific date/time TBA).

**Academic Accommodations for Students with Disabilities:**

The Office of Disability Services helps ensure that students with disabilities have equal access to all programs and activities offered at Georgia Institute of Technology. Reasonable accommodations are provided to self-identified students with disabilities who meet the academic and technical requisites for admission or participation in the program of study. Incoming students with apparent course work deficiencies due to a disability should contact the coordinator for Students with Disabilities at 404-894-2563. Consideration may be given to the substitution or modification of certain course requirements – within the limitations impose by the accreditation criteria for the degree program in which the student is enrolled – and to the extent that such substitutions or modifications of the course or curriculum do not detract from the quality of the educational experience implied by the course or curriculum designation. Such substitutions or modifications must be approved by the school chair, department head, or college dean and the Undergraduate Curriculum Committee and/or the Graduate Committee. Additional information can be obtained from:

Office of Disability Services

Smithgall Student Services Building  
Suite 123  
353 Ferst Drive  
Atlanta, GA 30332-0285

404-894-2563

<http://disabilityservices.gatech.edu/>

**Tentative Course Outline**

Two lectures will be replaced by a field trip during the semester.

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| --- | --- | --- |
| **Week** | **Lecture #** | **Topic** |
| 1 | 1 | Introduction |
|  | 2 | Rock Cycle |
| 2 | 3 | Discontinuities and Geological Structures |
|  | 4 | Effective Stress |
| 3 | 5 | State of Stress in the Earth’s Crust |
|  | 6 | Stress Regimes in Petroleum Environments |
| 4 | 7 | Principal Stresses and Mohr Circle |
|  | 8 | Stress-Strain Curves and Rock Failure Mechanisms |
| 5 | 9 | Hooke's law |
|  | 10 | Linear Elasticity |
| 6 | 11 | Fundamental Solutions and Principle of Superposition (I) |
|  | 12 | Fundamental Solutions and Principle of Superposition (II) |
| 7 | 13 | Instructors’ discretion |
|  | 14 | Instructors’ discretion |
| 8 | 15 | Midterm Exam |
|  | 16 | Wellbore Stability (I) |
| 9 | 17 | Wellbore Stability (II) |
|  | 18 | Hydromechanical Rock Properties |
| 10 | 19 | Flow in Fractured and Porous Media |
|  | 20 | Reservoir Production (I) |
| 11 | 21 | Reservoir Production (II) |
|  | 22 | Friction and Mohr-Coulomb Failure Criterion |
| 12 | 23 | Fluid Injection and Induced Seismicity |
|  | 24 | Hydraulic Fracturing (I) |
| 13 | 25 | Hydraulic Fracturing (II) |
|  | 26 | Microseismicity |
| 14 | 27 | Poroelastic Phenomena |
|  | 28 | Reservoir Compaction |
| 15 | 29 | Instructors’ discretion |
|  | 30 | Reading period |
| 16 |  | Final Exam |