

PETE 7241 - Geomechanics with applications in Petroleum Engineering Problems

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Office Hours: W 2:30-3:30
Class: PTH 2427
Prerequisite: Fluid Mechanics, Mechanics of Materials (CE3400) or any equivalent course

Fall 2015

Course Description

The first part of the course deals with the fundamentals of rock mechanics. This includes theories of elasticity, finite deformations, viscoelasticity and failure mechanics, borehole stresses, and acoustic wave propagation. Fundamentals of the theory of poroelasticity will be explained. After that we will talk about methods for obtaining parameters that are relevant for rock mechanics field application, ranging from laboratory tests to borehole logs. In the last part of the course, we will discuss applications of rock mechanics in borehole stability, sand production, hydraulic fracturing and reservoir compaction/ reservoir subsidence.

Course References

- [Z] Reservoir Geomechanics, Mark Zoback, Cambridge University Press, 1st edition.
- [J] Jaeger and Cook, Fundamentals of rock mechanics, Wiley-Blackwell; 4 edition.
(Required textbook)
- [F] Petroleum Related Rock Mechanics by Erling Fjaer, Rune M. Holt, Per Horsrud, and Arne M. Raaen (Hardcover - Jan 1, 1992)
- [W] Theory of Linear Poroelasticity with applications to Geomechanics and hydrogeology, Herbert F. Wang, Princeton University Press.

Outlines

Background Mathematics

- Tensor Analysis
- Tensor Calculus

Elasticity

- Strain
- Stress
- Constitutive Equations
- Large deformations
- Stress Functions
- Planar Elasticity in Cartesian and Polar Coordinate system

Viscoelasticity

- Theory
- Some Examples

Poroelasticity

- Biot's poroelastic theory for static properties
- The effective stress concepts

Failure Mechanics

- Basic concepts
- Compressive strength criteria
- Shear failure – Mohr-Coulomb criterion
- Failure criteria which depends on the intermediate stress
- Fracture Mechanics

Some geological aspects of rock mechanics

- In-situ stresses
- Rock mechanical properties

Stresses around borehole, and borehole failure criteria

- Stresses around a borehole – general linear elastic solution
- Stresses around a borehole in a poroelastic formation
- Borehole failure criteria

Reservoir Compaction: Subsidence and well problems

- Elastic Modeling
 - Compaction of the reservoir
 - Stress changes in depleting reservoirs
- Consolidation Theory

***(If time allows)* Sand Prediction**

- What is sand production?
- Mechanisms for sand production

Modeling for sand production

Grade Calculation

Quizzes	10%
Homework	25%
Midterm	25%
Final Project	30%
Final Exam	10%

Disability Services

If you have a disability that may have some impact on your work in this class and for which you may require accommodations, please see an advisor in the office of Disability Services (112 Johnston Hall) so that necessary accommodations may be arranged. After you receive accommodation letters, please see the instructor as soon as possible to discuss the provisions of those accommodations.

Misconduct/Dishonesty

Any kind of misconduct and dishonesty will be reported to the department chair, the Dean of Engineering, and/or the Dean of students in writing. Then the case will be investigated by the university (Not by the instructor) and the students have the right to appeal to the university.