

Petroleum Geomechanics

1.1 Course Number: PE423

1.2 Contact Hours: 3-0-0 Credits: 9

1.3 Semester-offered: 5th Year (Odd)

1.4 Prerequisite: Basic knowledge of Physics, Mathematics and Geology

1.5 Syllabus Committee Member: Dr. Alok Kumar Singh & Dr. Hemant Kumar Singh

2. Objective: Main aim of this course to understand the fundamentals of geomechanics and its application in petroleum engineering.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Elastic Theory	Definition, Scope, Historical Background, Importance, Stress/Strain in 2D & 3D, Stress-Strain transformation in plane, Mohr's circle, Principal and Deviatoric Stresses and Strains, Elastic moduli, Poisson ratio, Strain energy, Creep, Thermoelectricity, Pore elasticity	15
2	Physical and Mechanical Properties	Rock density, porosity, permeability, P-wave and S-wave velocity and transient time, Young's modulus, Modulus of Rigidity, Bulk modulus, Relations to convert elastic moduli and Poisson's ratio, Biot's effective stress coefficient, In situ stresses and its measurement.	7
3	Rock Strength and Failure Criteria	Laboratory tests for rock strength, Rock strength from petrophysical and well log data, Rock strength anisotropy, Rock failure criteria: Mohr's coulomb, The Griffith criteria, Hoek-Brown criteria, True Triaxial failure criterion, impact of fluid effect on various failure criteria.	8

4	Pore Pressure and Fracture Gradient	Normal and Abnormal Pore pressure, Origins of abnormal pore pressure, Overpressure, Pore pressure seals and compartment, fracture gradient, fracture gradient prediction method: Eaton's method, Matthew and Kelly method, Depth dependent K_0 method, Temperature impact of fracture gradient	6
5	Wellbore Stability	Stresses around wellbore and wellbore failure	4
		Total	40

4. Readings

4.1 Textbook:

- Mark D. Zoback, Department of Geophysics, Stanford University, 2007 Cambridge University Press
- Petroleum Related Rock Mechanics – Drilling Operation and Well Design, Bernt S. Aadnoy & Reza Looyeh, Elsevier, 2019
- Petroleum Related Rock Mechanics Volume 33, E. Fjaer et al., Elsevier, 1992

4.2 Reference books:

- Petroleum Production Systems, Economides et al., Prentice Hall, 2012
- Recent Advances in Hydraulic Fracturing, SPE Reprint Series, 1990
- Brady B., Brown E., Rock mechanics for underground mining, Springer, 2006 (Third Edition)
- Goodman R.E. Introduction to Rock Mechanics, Wiley, 1989.

5 Outcome of the Course: On successful completion of this course, students will be able to learn:

- The comprehensive knowledge about stress and strain in 2D/3D and its transformation in plane.
- The elastic properties of rock and its failure criteria.
- How the geomechanics will be use in the field of petroleum engineering.