Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NPEC507	Petroleum Geomechanics & Hydraulic Fracturing	3	1	0	4

Course Objective

The objective of the course is to provide the fundamentals of geomechanics including stress/strain relationships of rocks and failure criteria which goes into designing, evaluating and optimizing hydraulic fracturing operations.

Learning Outcomes

Upon successful completion of this course, students will:

- Have the ability to analyze in-situ stresses, and the effects of poro-thermo-mechanical data of rocks.
- Have the ability to design a 2D fracture from models, and to evaluate the fracture productivity.

Unit No.	Topics to be Covered	Lecture Hours (L+T)	Learning Outcome
1	Stress/strain in 2D & 3D, transformation in space, principal and deviatoric stresses and strains, introduction to thermo and poroelasticity.	6	Knowledge of stress and strain in a body in 2D and 3D, principal stresses and the effect of pressure and temperature on
2	Theory of elasticity & inelasticity, constitutive relationships for rocks. Failure criterion for rocks and rock strengths.	6+1	Knowledge of theory of elasticityanditsa
3	Effective stresses: in-situ stresses, measurement techniques for stresses and rock mechanical parameters, and stresses around a wellbore.	5+2	Knowledge of stresses in-situ, their measurement techniques and mechanical properties. Ability to calculate stress around wellbores.
4	2D fracture models: PKN and KGD fracture shapes, propagation, widths, lengths and net pressures for Newtonian & non-Newtonian fluids, fluid leak-off efficiency and surface pressures during fracturing. Review of fracture conductivity & equivalent skin factor of fractured vertical wells.	5+2	Knowledge of PKN and KGD fracture propagation models. Knowledge of productivity of a fractured well.
5	Techniques of gathering the rock mechanical and in-situ stress data for modeling fracture propagation. Height migration (deviation from 2D model) and propagation issues.	5+2	Ability to gather mechanical and stress data to model fracture propagation for fracture treatment design.
6	Pseudo-2D and 3D fracture model introduction, heat transfer models, fracture tip effects, and fracture tortuosity.	5+2	Basic knowledge of pseudo-2D and 3D fracture propagation models and other special propagation effects.
7	Design of fracture fluids, rheology, and polymer induced damage, pressure drop during pumping volume requirements for both pad and slurry, proppant mixing and injection schedule, and final propped fracture width.	5+2	Basic knowledge on effect of fracturing fluid rheology on fracture treatments. Design of pumping schedule during fracture propagation.
8	Fracture evaluation using pressure diagnostics, well testing and other techniques. Parametric studies for fracture design optimization.	5+3	Knowledge of fracture conductivity evaluation using well testing and other methods.
	Total contact hours:	**42 +14 = 56**	

Text Books:

1. Petroleum Rock Mechanics – Drilling Operation and Well Design, Bernt S. Aadnoy&Reza Looyeh, Elsevier, 2019
2. Petroleum Related Rock Mechanics Volume 33, E. Fjaer et al., Elsevier, 1992

References:

1. Petroleum Production Systems, Economides et al., Prentice Hall, 2012
2. Recent Advances in Hydraulic Fracturing, SPE Reprint Series, 1990