

Subject Code: 1ET4060303	Subject Title: Geo-mechanics and Strength of Material
Pre-Requisite	--

RATIONALE:

The students of petroleum engineering are mainly involved in survey of land for finding petroleum under the ground with various techniques. It is required the understanding of the land, soil and rock mechanics for the drilling of the well. It is also important to study the strength of material of the land surveyed for crude. After finding the suitable land having worth amount of petroleum data will given to further drilling engineers for further process of drilling petroleum well. The actual petroleum production will start after drilling well and installation of the equipment for pumping the crude.

This course has been introduced at Diploma level in order to develop the skills in student so that they can understand the various methods of finding the crude resources under the ground with latest technologies.

COMPETENCY:

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire knowledge of Geomechanics and Strength of Material.

COURSE OBJECTIVE:

1. To understanding Geomechanical properties of the reservoir/Seal rocks
2. Differentiate between strain energy and strain energy density
3. To explain the experimental methods for spring stiffness Test, The tension test
4. Understand failure planes in different rocks

TEACHING AND EVALUATION SCHEME:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)			
Lecture	Tutorial	Practical	Credit	Theory		Practical	
				University Assessment	Continuous Assessment	University Assessment	Continuous assessment
3	-	2	4	60	40	20	30

DETAILS OF COURSE CONTENTS:

UNIT	TOPIC	Total Hrs.	Weightage in marks
1	Basics of mechanics Fundamental assumptions in elementary mechanics of materials; viscoelasticity or rheology; mechanical properties of metals –	16	25

	concepts of stress and strain; stress-strain behavior; inelasticity; elastic properties of materials; tensile properties; elastic recovery during plastic deformation; compressive, shear, and torsional deformation; hardness; variability of material properties; design/safety factors. Testing of material properties. Thermal stresses – bars subjected to tension, asymmetric loading, and stress calculation of cylindrical bodies.		
2	Introduction to Rock Mechanics Structural rock mechanics and comminution; strength of geological materials; influence of geological history (burial and uplift) on rocks – normally consolidated and over consolidated rocks; effective stress, undrained modulus of elasticity, coefficient of compressibility, coefficient of consolidation, Significance of drainage path length and the rate of consolidation; stress and strain in geological materials and their measurements; cohesion, friction, and failure; influence of fabric; drained and undrained strength; Atterberg limits	14	20
3	Introduction to Reservoir Geomechanics The tectonic stress field; pore pressure at depth in sedimentary basins; basic constitutive laws; rock failure in compression; tension and shear; faults and fractures at depth; compressive and tensile failures in vertical wells; determination of S3 from mini-fracs and extended leak-off tests and constraining the magnitude of SHmax from wellbore failures in vertical wells; wellbore failure and stress determination in deviated wells; stress fields – from tectonic plates to reservoirs around the world; wellbore stability; critically stressed faults and fluid flow; effects of reservoir depletion	12	15

COURSE OUTCOME:

On completion of the course, student will be able to

CO1 - Understand the structure and mechanical properties of different materials viz., metals, soil, minerals and rocks

CO2 - Determine the geo-mechanical properties of materials and predicting the failure based on the various failure theories

CO3 - Estimate the changes in shear strength of reservoir rocks vis-à-vis reservoir production, and its effect on the petrophysical properties

CO4 - Apply the understanding of stress-field to optimize production

CO5 - Evaluate the failure of the wall of the wellbore during drilling activities.

CO6 - Analyze stress-field around boreholes using laboratory data and extending it to field situations.

LIST OF PRACTICAL:

1. Hardness test
2. Impact test

3. Tension test
4. Torsion test
5. Bending test
6. Shear test
7. Compression test
8. Fatigue test(To find endurance limit)
9. Triaxial test of reservoir rocks
10. Mohr's Coulomb failure criterion

LIST OF REFERENCES:

Sr. No.	Title of Books	Author	Publication
01	Reservoir Geomechanics	Zobak, M. D.	
02	Geomechanics in reservoir simulation	Longuemare, P.	
03	Geomechanis applied to petroleum Engineering	Nauroy, J. F	
04	Contact Mechanics and Friction	Valentin Popov,	
05	A Textbook of Strength of Materials	Bansal R. K	