Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Geomechanics (GSEG 312) **Semester:** V
Programme: B Tech APE-Upstream **Time:** 03 hrs.
Max. Marks: 100 **Nos. of page(s): Three**

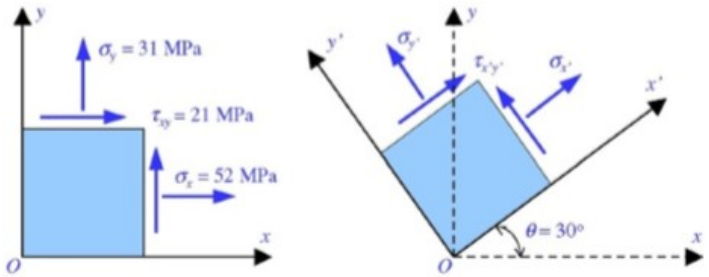
Instructions:

- All the questions are compulsory.
- *Answers should be precise & to the point.*
- Assume appropriate data if required.

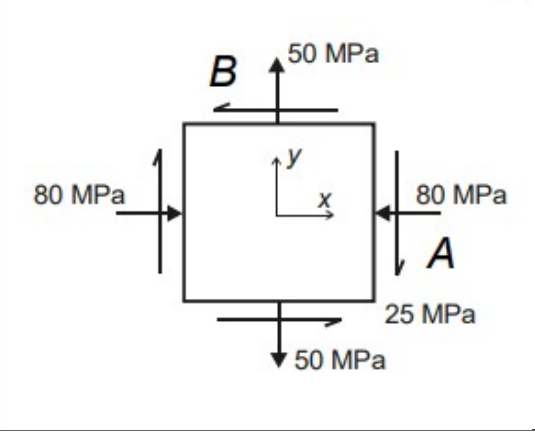
SECTION A

S. No.		Marks	CO
Q 1	There are two conventional methods used for testing the strength of rocks against fracturing (tension) and collapse (shear); name those methods and explain briefly how they work.	**4**	**CO1**
Q 2	Use the given laboratory data as shown in the table and using concept of the Mohr-Coulomb failure model, find the area where the rock material will be intact.	**4**	**CO2**
Q 3	Draw a neat diagram to represent the position of stresses around a wellbore in the rock formation where $(\sigma_v, \sigma_H, \sigma_h)$. represents principal in-situ stress state, and, $(\sigma_x, \sigma_y, \sigma_z)$. and $(\sigma_r, \sigma_\theta, \sigma_z)$, represent stress states at the wellbore in cartesian and cylindrical coordinate systems, respectively.	**4**	**CO4**
Q 4	How geomechanics is used to design wells & support drilling?	**4**	**CO1**
Q 5	a) A sedimentary rock weighs 165 lb/ft3. What is its specific gravity? (Note: Water = 8.345 lb/gal, 7.48 gal/ft3 , 62.4 lb/ft3 , 1 gm/cm3, 1000 kg/m3) b) Determine the ratio of horizontal to vertical stress for a gravity loaded material	**2** **2**	**CO1**

Test No.	Confining Pressure σ_3 (bar)	Yield Strength σ_1 (bar)
1	0	690
2	41	792
3	69	938
4	138	1069
5	207	1248
6	310	1448

	with a Poisson's Ratio of 0.25?		
SECTION B			
Q 6	(a) Name two key field estimating methods useful in identifying the magnitude and orientation of in-situ stresses and explain how they are performed. (b) Describe the advantages and disadvantages of both methods, and explain how reliable their results are.	**4+4**	**CO3**
Q 7	Calculate the in-situ stresses at a depth of 11,500 ft for a formation in the Gulf of Mexico, where the formation rock grain density is 2600 kg/m3, the formation pore fluid density is 1100 kg/m3 and the formation porosity is 4%. Assume the Biot's constant as 0.90 and Poisson's ratio as 0.25.	**8**	**CO3**
Q 8	For an oil field, where a vertical well is drilled to a maximum depth of 10,000 ft, the average specific gravity and pore pressure gradient are given as 2.3 and 0.38 psi/ft, respectively. Assuming the Biot's constant and Poisson's ratio as 1 and 0.28, respectively. (a) Calculate overburden and horizontal stresses (b) Determine normal and shear stresses at the bottom of the wellbore wall in a Cartesian coordinate system.	**4+4**	**CO3**
Q 9	An element in plane stress is subjected to stresses as shown in Figure. Using the transformed stress equations, determine the stresses acting on an element oriented at an angle 30 degree. 	**8**	**CO1**
Q 10	Explain any three rock failure theories. List out their limitations along with your thought process & understating.	**8**	**CO2**
SECTION-C			
Q 11	An oil field has a vertical well in a sandstone reservoir with variable rock strength. One of the important issues is to determine the need for sand control equipment, such as screens. Use the table defining the data obtained from the field, investigate the possibility of sand production for both initial conditions and the depleted phase of the field.	**20**	**CO4**

Variable	Value
Depth (m)	1200
Overburden Stress (s.g.)	1.88
Max/Min Horizontal Stresses (s.g.)	1.51/1.51
Initial Pore Pressure (s.g.)	1.04
Depleted Pore Pressure (s.g.)	0.54
Rock Cohesive Strength (s.g.)	0.40
Rock Friction Angle (Degrees)	27

Q 12	The state of plane stress at a point is represented by the stress element below. (a) Draw the Mohr's circle (b) Determine the principal stresses and the maximum shear stresses, and draw the corresponding stress elements. 	**8+12**	**CO2**