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## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Exam Question Paper May' 2018

Program: M. Tech. Petroleum Engineering

Semester - II

Subject (Course): Reservoir Geo-Mechanics

Max. Marks : 100

Course Code : GSEG 312

Duration : 3 Hrs.

No. of page/s: Four

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### Instructions:

- a. Answers must carry the supporting material such as equations and diagrams
- b. Abbreviations used in the questions are standard and have their usual meaning
- c. Make appropriate assumptions where data is not supplied

### SECTION A

Answer all five questions. Each Question carries 4 Marks

5x4= 20 Marks

Question 1 Explain hydrostatic state of stress?

(4 Marks)

Question 2 Describe wellbore stresses? How they are different than in-situ stresses.  
(4 Marks)

Question 3 Explain the statement "Properties measured in lab & field are scale dependent"?  
(4 Marks)

Question 4 What does density log measures? How is porosity calculated from density log?  
(4 Marks)

Question 5 What is meant by body and surface forces?

(4 Marks)

### SECTION B

Answer all five questions. Question No. 1 to 4 are compulsory. Answer any one question from Questions No.5. Each Question carries 8 Marks

5x8= 40 Marks

**Question 1** What is Mud weight window? What are the inputs required for drawing mud weight window? Has it any effect on wellbore stability? (8 Marks)

**Question 2** Derive the following equations for a given stress vector

$$\sigma_n = 0.5 * (\sigma_{xx} + \sigma_{yy}) + 0.5 * (\sigma_{xx} - \sigma_{yy}) * \cos 2\alpha + \sigma_{xy} \sin 2\alpha$$

$$\sigma_s = 0.5 * (\sigma_{xx} + \sigma_{yy}) \sin 2\alpha - \sigma_{xy} \cos 2\alpha$$

(8 Marks)

**Question 3** Determine principal stresses and principal directions for following stress vector

$$\sigma_{ij} = \begin{bmatrix} 50 & 25 \\ 25 & 100 \end{bmatrix}$$

(8 Marks)

**Question 4** Give Principal for density porosity logs? What it measures and formula for converting density to porosity? (4 + 4 = 8 Marks)

**Question 5** Elaborate Von Mises rock failure criterion. Give procedure for constructing Mohr's circle. (4+4 = 8 Marks)

OR

**Question 5** A circular solid piece of rock is tested in a compression testing rig to examine its stress / Strain behaviour. The sample is 5 inches in diameter and 10 inches in length with the compression load cell imposing a constant load of 10000 lbf equally at bottom and top of rock sample. Assuming a measured reduction in length of 0.022 inches, find

a) Compressive strength of rock (4 Marks)

b) Strain of rock (4 Marks)

## SECTION C

Answer all two questions. Question No.1 is compulsory. Answer any one question from Questions No. 2. Each Question carries 20 Marks 2x20 = 40 Marks

**Question 1** A plane stress condition exists at a point on the surface of a loaded rock where the stresses have the magnitudes and directions given below (where in this case, minus implies a tension and plus a compression)

$$\sigma_x = -6600 \text{ psi} , \quad \sigma_y = 1700 \text{ psi} , \quad \tau_{xy} = -2700 \text{ psi}$$

Determine the stresses acting on an element that is oriented at a clockwise angle of  $45^\circ$  with respect to original element.

**Question 2** (20 Marks)

2-a) If Pore pressure is 5000 psi and Collapse pressure is 3500 psi, **Determine** the depth of well. (5 marks)

2-b) **What** are stress transformation equations? (5 marks)

2-c) **Explain** different thermal maturation indices for shale reservoir? Draw flowchart for porosity determination in shale gas well? What does FTIR and XRD used for? (10 marks)

OR

**Question 2** Study mud weight window given in next slide. **Identify the problems faced**, interval wise, while drilling the well. (20 Marks)

