Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

Course: Reservoir Geomechanics **Semester: II**
Program: M.Tech. (PE) **Time: 03 hrs.**
Course Code: PEGS 8007 **Max. Marks: 100**

Instructions: All questions are compulsory

SECTION A

S. No.		**Marks**	**CO**
Q 1	(A) The elasticity of the material is defined as (i.) An ability to resist and recover from deformations produced by forces (ii.) The ability to flow of material (iii.) The ability to deform permanently (iv.) The ability to break easily (B) The data source for the least principal stress in GEM is (i.) Leak-off Test (ii.) Extended leak-off Test (iii.) Minifrac (iv.) All (C) As per the Anderson scheme of classification, an area as being characterized by normal fault depending on the condition (i.) Sv>SHmax>SHmin (ii.) Sv=SHmax>SHmin (iii.) Sv<SHmax>SHmin (iv.) SHmax>Sv>SHmin (D) As per the Anderson scheme of classification, an area as being characterized by reverse fault depending on the condition (i.) SHmax>SHmin>Sv (ii.) SHmax>Sv>SHmin (iii.) Sv>SHmax>SHmin (iv.) SHmax=Sv>SHmin	**4**	**CO1**
Q 2	(A) Rock mechanics deals with issues in geosciences related to (i.) Rock mass characterization (ii.) Rock mass mechanics (iii.) Rock drilling (iv.) All (B) The geomechanics deals with which of the following disciplines (i.) Soil mechanics (ii.) Rock mechanics	**4**	**CO1**

	(iii.) Both (iv.) None (C) Formation bulk density at any given depth is the combination of which of the following (i.) Rock grain density (ii.) Pore fluid density (iii.) Porosity of rock formation (iv.) All (D) Which of the following is/are the direct approach to measure in-situ stresses, as suggested by Hudson and Harrison (i.) Hydraulic fracture test (ii.) The flatjack test (iii.) The overcoring gauge test (iv.) All		
Q 3	(A) which of the following is true for the Blowout Preventer (i.) It is a large automatically operated safety valve at the top of a well that may be closed in case of loss of control over the formation fluids (ii.) The pressure below which a critical stress level is reached (iii.) A solid cylindrical sample or plug of rock cut from the location of the formation under study for use in laboratory tests and analyses (iv.) All (B) which of the following is true for the Effective Stress (i.) The pressure below which a critical stress level is reached, due to high shear stress causing the rock formation to collapse into the borehole (ii.) The average normal stress transmitted directly from particle to particle of a porous material (iii.) The maximum engineering stress, in compression, expressing the capacity of a material to withstand axially directed pushing forces without fracture (iv.) The elements of the stress tensor that cause distortion in the volume (C) Which of the following will take place due to the decrease in mud level in the wellbore annulus (i.) The flow of formation fluid into the wellbore (ii.) Underground cross-flow/blowout (iii.) Wellbore instability (iv.) All (D) After the borehole is fractured the hole strength consists of the following (i.) Stress bridge (ii.) Least in-situ stress (iii.) Both (iv.) None	**4**	**CO1**
Q 4	Briefly explain the application of drill stem test (DST) in petroleum operation	**4**	**CO2**

<table>
<tr><td>Q 5</td><td>A short post, constructed from a tube of concrete, supports a compressive load of 24.5 metric tonnes. The inner and outer diameters of the tube are 91 cm and 127 cm, respectively, and its length is 100 cm. The shortening of the post is measured as 0.056 cm. The effect of post's weight is neglected. It is also assumed that the post does not buckle under the load. Determine the axial compressive stress in the post.</td><td>4</td><td>CO3</td></tr>
<tr><td colspan="4">SECTION B</td></tr>
<tr><td>Q 6</td><td>Explain the following:
(a) Insitu stress
(b) Application of 2-D Mohr's Circle in rock evaluation
OR
Write detailed notes on the following with suitable examples?
(a) 3-D Geomechanical Earth Model
(b) 4-D Geomechanical Earth Model</td><td>10</td><td>CO1</td></tr>
<tr><td>Q 7</td><td>Discuss any two pore pressure prediction method with associated formulations</td><td>10</td><td>CO2</td></tr>
<tr><td>Q 8</td><td>Derive the formula to determine principal stresses and its orientation in two dimensions.</td><td>15</td><td>CO2</td></tr>
<tr><td>Q 9</td><td>It has been determined that a point in a load-carrying member is subjected to the following stress condition:
$\sigma x = 400$ MPa $\sigma y = -300$ MPa $\tau xy = 200$ MPa (CW)
Perform the following:
(a) Find maximum and minimum principal stress and maximum shear stress
(b) Draw the complete Mohr's circle, labeling critical points</td><td>15</td><td>CO3</td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 10</td><td>A core sample of 54 mm diameter and L/D ration 2.0 was obtained from the field for the determination of geomechanical properties as per the standard procedure. There was no confinement during the testing. The results of the testing are tabulated below. Draw stress-strain graph and determine the compressive strength, Elastic modulus and Poisson's ratio of the sample.
<table>
<tr><th>Load(kN)</th><th>Axial Displacement (mm)</th><th>Lateral displacement (mm)</th></tr>
<tr><td>227.1</td><td>0.26</td><td>0.014</td></tr>
<tr><td>293.5</td><td>0.3</td><td>0.053</td></tr>
<tr><td>376.7</td><td>0.34</td><td>0.014</td></tr>
<tr><td>391.4</td><td>0.35</td><td>0.029</td></tr>
<tr><td>415.5</td><td>0.38</td><td>0.048</td></tr>
<tr><td>414</td><td>0.42</td><td>0.054</td></tr>
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OR
(a) The matrix below defines a given stress state. Determine the principal stresses.</td><td>30</td><td>CO4</td></tr>
</table>

	$[\sigma] = \begin{bmatrix} 16 & 3 & 3 \\ 3 & 12 & 6 \\ 3 & 6 & 12 \end{bmatrix}$ (b) The following data is given for a vertical well drilled. $\sigma v = 10$ MPa $\sigma H = \sigma h = 9$ MPa $P0 = 5$ MPa $\mu = 0.3$ Determine the following (a) Fracture pressure for non-deviated well (b) Fracture pressure at the deviation $\Upsilon = 40^o$ and $\phi = 165^o$		