Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

Programme: B. TECH GSE and GIE **Semester: VI**
Course: Geomechanics **Time: 2 hrs. + 24hrs.**
Course Code: PEAU 3003 **Max. Marks: 100**
Instructions: All questions are compulsory

SECTION A

S. No.		Marks	CO
Q 1	Rock mechanics deals with issues in geosciences related to a. Rock Mass Characterization b. Rock Mass Mechanics c. Rock Drilling d. All	**1**	**CO1**
Q 2	The data sourse for the pore pressure in GEM is a. Repeat Formation Tester b. Drill Stem Test c. Pressure while drilling d. All	**1**	**CO1**
Q 3	As per the Anderson scheme of classification, an area as being characterized by strike slip fault depending on the condition a. $S_{Hmin}>S_{Hmax}>S_v$ b. $S_{Hmax}>S_v>S_{Hmin}$ c. $S_v>S_{Hmax}>S_{Hmin}$ d. $S_{Hmax}=S_v>S_{Hmin}$	**1**	**CO1**
Q 4	The geomechanics deals with which of the following disciplines a. Soil Mechanics b. Rock Mechanics c. Both d. None	**1**	**CO1**
Q 5	The data sourse for the vertical stress in GEM is a. Repeat Formation Tester b. Drill Stem Test c. Integrated Density d. Leak-off Test	**1**	**CO1**
Q 6	The data sourse for the rock strength in GEM is a. Repeat Formation Tester b. Core Test c. Pressure while drilling d. Drill Stem Test	**1**	**CO1**
Q 7	As per the Anderson scheme of classification, an area as being characterized by normal fault depending on the condition a. $S_v>S_{Hmax}>S_{Hmin}$	**1**	**CO1**

	b. $S_v=S_{Hmax}>S_{Hmin}$ c. $S_v<S_{Hmax}>S_{Hmin}$ d. $S_{Hmax}>S_v>S_{Hmin}$		
Q 8	The data sourse for the least principal stress in GEM is a. Leak-off Test b. Extended leak-off Test c. Minifrac d. All	**1**	**CO1**
Q 9	As per the Anderson scheme of classification, an area as being characterized by reverse fault depending on the condition a. $S_{Hmax}>S_{hmin}>S_v$ b. $S_{Hmax}>S_v>S_{Hmin}$ c. $S_v>S_{Hmax}>S_{Hmin}$ d. $S_{Hmax}=S_v>S_{Hmin}$	**1**	**CO1**
Q 10	The elasticity of the material is defined as a. An ability to resist and recover from deformations produced by forces b. The ability to flow of material c. The ability to deform permanently d. The ability to break easily	**1**	**CO1**
Q 11	The theory of elasticity rests on which of the concepts a. Stress b. Strain c. Both d. None	**1**	**CO2**
Q 12	A circular solid piece of rock is tested in a compression testing rig to examine its stress/strain behavior. The sample is 6 inches in diameter and 12 inches in length, with the compression load cell imposing a constant load of 10000 lbf equally at both top and bottom of the rock sample. Assuming a measured reduction in length of 0.02 inches. The compressive stress in the rock is a. 353.7 lbf/in2 b. 250.9 lbf/in2 c. 265.5 lbf/in2 d. 365.9 lbf/in2	**2**	**CO2**
Q 13	Assuming the data given in the question number 11 the strain developed in the rock is a. 1645 μ b. 1667 μ c. 1620 μ d. 1605 μ	**2**	**CO2**
Q 14	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. The axial compressive stress in the post is a. 2.36 MPa	**2**	**CO2**

	b. 3.46 MPa c. 5.36 MPa d. 4.46 MPa		
Q 15	Assuming the data given in the question number 14 the strain developed in the post is a. 0.0056 b. 0.056 c. 0.00056 d. 0.56	**2**	**CO2**
Q 16	A plane stress condition exists at a point on the surface of a loaded rock, where the stresses have the magnitudes and directions as given below (where in this case, minus implies a tension and plus a compression): σx = -6600 psi, σy = 1700 psi and τxy = -2700 psi. The normal stresses acting on an element that is oriented at a clockwise angle of 45 degree with respect to the original element is. a. 300 psi and -2550 psi b. 250 psi and -5150 psi c. 150 psi and 500 psi d. 700 psi and 4900 psi	**3**	**CO2**
Q 17	Assuming the data given in the question number 16 the shear stress in psi acting on an element that is oriented at a clockwise angle of 45 degree with respect to the original element is. a. 4050 b. -5150 c. -4150 d. 5050	**2**	**CO2**
Q 18	Determine the principal stresses for the given stress state in MPa and choose the correct option. [14 2 2 2 11 5 2 5 11] a. 6 MPa, 8 MPa, 12 MPa b. 24 MPa, 12 MPa, 6 MPa c. 18 MPa, 12 MPa, 6 MPa d. 6 MPa, 10 MPa, 12 MPa	**3**	**CO2**
Q 19	Formation bulk density at any given depth is the combination of which of the following a. Rock grain density b. Pore fluid density c. Porosity of rock formation d. All	**1**	**CO2**
Q 20	Rock with higher Poisson's ratio will have a. Higher horizontal stress b. Lower horizontal stress	**1**	**CO2**

	c. Moderate horizontal stress d. No horizontal stress		
Q 21	Which of the following is/are the direct approach to measure in-situ stresses, as suggested by Hudson and Harrison a. Hydraulic fracture test b. The flatjack test c. The overcoring gauge test d. All	**1**	**CO3**
Q 22	Which of the following is/are the indirect approach to measure in-situ stresses a. Acoustic emission b. Fault plane solutions c. Both d. None	**1**	**CO3**
Q 23	Which of the following is the most effective technique for obtaining the magnitude of the minimum horizontal in-situ stress in a wellbore a. Core discing b. Differential strain analysis c. Hydraulic fracture testing d. All	**1**	**CO3**
Q 24	Which test is oftenly used to estimate the magnitude of in-situ minimum horizontal stress and the fracture pressure capacity of the wellbore. a. The flatjack test b. Leak-off Test c. Acoustic emission d. Inelastic strain relaxation	**1**	**CO3**
Q 25	For a vertical borehole, oriented in a principal stress direction, the fracture pressure for a normal fault stress state is given by a. $Pwf = 3\sigma h-\sigma H-P0$ b. $Pwf = 6\sigma h+\sigma H-P0$ c. $Pwf = \sigma h-P0$ d. $Pwf = 3\sigma h+\sigma H-P0$	**2**	**CO3**
Q 26	In an oil field the pore pressure has declined to 0.6 s.g. Assuming the Poisson's ratio as 0.25, the changes in horizontal stress and fracture pressure are a. 0.3 s.g. and 0.5 s.g. b. 0.4 s.g. and 0.2 s.g. c. 0.6 s.g. and 0.8 s.g. d. 0.4 s.g. and 0.8 s.g.	**2**	**CO3**
Q 27	Which of the following is correct fo the Mohr-Coulomb failure criteria a. An envelope of all mohr circle represents the basis of the failure criteria b. The criterion relates the shearing resistance to the contact forces and friction c. Both d. None	**1**	**CO3**
Q 28	A firm whose judgement has been questioned on a previous occasion has been entrusted with the strength testing of rock in a site investigation project. During	**3**	**CO3**

	their first uniaxial compression test, the equipment failed to measure the peak axial load, but the technician did record that the specimen failed by the formation of a single fracture inclined at 20 degree to the loading axis. In a subsequent triaxial test, as the confining pressure was being increased before application of the axial stress, the specimen failed prematurely when the confining pressure in the Hoek cell was 85 MPa. On the basis of these results, find a and b and choose the correct option in the equation given below for the rock. $\sigma 1 = a\sigma 3 + b$ a. 1.55 and 95 MPa b. 1.85 and 95 MPa c. 7.55 and 25 MPa d. 7.55 and 85 MPa		
Q 29	laboratory tests on specimens of a limestone have produced unconfined compressive and tensile strengths of 80 MPa and 10 MPa, respectively. Using the Hoek-Brown criteria, estimate the maximum principal stress at failure for the tests in which $\sigma 2 = 20$ MPa. Choose the correct option. a. 157.8 MPa b. 197.8 MPa c. 187.8 MPa d. 127.8 MPa	**2**	**CO3**
Q 30	The fracture angle of the rock specimen β and the angle of internal friction φ obtained from Mohr-Coulomb model are related to one another by the following relation a. $\beta = \pi/4+\varphi/2$ b. $\beta = \pi/2+\varphi/4$ c. $\beta = \pi/4-\varphi/2$ d. $\beta = \pi/8+\varphi/3$	**2**	**CO3**
Q 31	Which of the following is the parameter calibration method in GEM a. Optimizing model performances b. Expert knowledge c. Both d. None	**1**	**CO4**
Q 32	Which of the following is one of the basic step in performing a conventional I D pore pressure analysis a. Caliberate pore pressure to credible information as it becomes available b. Expert knowledge c. Optimizing model performances d. All	**1**	**CO4**
Q 33	Which of the following is a parameter used by drilling engineers to investigate pore pressure trends when drilling into over-pressurized zones a. Miller's parameter b. Eaton's parameter c. d-Exponent d. All	**1**	**CO4**

Q 34	Which of the following is/are correct about Lost circulation in drilling operation Increase in non-productive time a. Decrease in mud level in the wellbore annulus b. The bottom hole pressure may become insufficient to balance fluid pressure from the formation c. All	**1**	**CO4**
Q 35	Using the data given below determine the wellbore fracture pressure and choose the correct answer. σv = 100 bar $\sigma h = \sigma H$ = 90 bar P0 = 50 bar Υ = 0 degree φ = 0 degree a. 135 bar b. 220 bar c. 130 bar d. 230 bar	**2**	**CO4**
Q 36	Using the data of question number 35 and assuming Cohesion strength = 60 bar and angle of internal friction 30 degree, determine the borehole collapse pressure and choose the correct answer a. 91.6 bar b. 21.14 bar c. 31.14 bar d. 61.64 bar	**2**	**CO4**
Q 37	The Kirsch equation for the fracture pressure of a filter cake barrier in a drilling operation is given by a. Pwf = 3σh-σH-P0 b. Pwf = 2σh-P0 c. Pwf = σh-P0 d. Pwf = 3σh+σH-P0	**2**	**CO4**
Q 38	After the borehole is fractured the hole strength consists of the following a. Stress bridge b. Least in-situ stress c. Both d. None	**1**	**CO4**
Q 39	The data below are obtained from the leak-off tests of a vertical well in North Sea. PLOT = 1.90 s.g. P0 = 1.08 s.g. σt = 0:1 s.g. The caliper logs of the well shows washouts over large depth intervals, but basically circular shape. Calculate the horizontal in-situ stresses and choose the correct answer a. 1.44 s.g. b. 1.24 s.g. c. 1.34 s.g.	**2**	**CO4**

	d. 1.54 s.g.		
Q 40	Assume a block of impermeable, zero porosity, quartz sandstone with a density of 2.67 g/cm3 rests on a horizontal surface. What is the total normal stress and effective stress at the base of a 10 m tall block of pure quartz. a. 261.9 kPa and 261.9 kPa b. 251.9 kPa and 261.9 kPa c. 241.9 kPa and 271.9 kPa d. 221.9 kPa and 231.9 kPa	**2**	**CO4**
SECTION B			
Q 41	Derive the formula to determine principal stresses and its orientation in two dimensions.	**8**	**CO1**
Q 42	Describe the stress invariant and derive the formula to determine stress invariant.	**8**	**CO1**
Q 43	Describe the strain tensor and the strain invariants and derive the formula to determine the strain invariants. Also, describe the use of strain tensor and the strain invariants in well bore stability.	**8**	**CO2**
Q 44	Describe the Lost circulation in details with associated formulation.	**8**	**CO3**
Q 45	Describe Sand Production and its classification in details. Also, describe necessary and sufficient conditions for sand production and forces on a sand grain with associated formulations.	**8**	**CO4**