Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Term Examination, December 2022

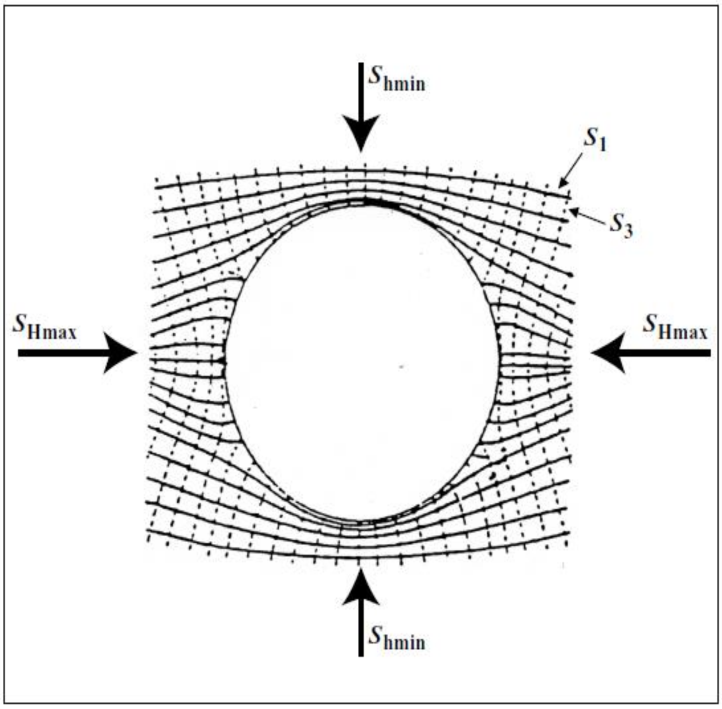
Programme Name: B.Tech (APE UP) **Semester : VII**
Course Name : Geomechanics **Time : 3 hours**
Course Code : PEAU 3003 **Max. Marks : 100**
Nos. of page(s) : 4

Instructions: Attempt all the questions. Carefully attempt the questions where choice is given. Attempt the questions in a serial order.

SECTION A

S. No.		Marks	CO
Q1.	Choose the most appropriate option (single choice) A. The safe mud window during drilling consists of a) Safety window of the personnel b) Lower Bound of mud weight c) Upper Bound of mud weight d) Both B&C e) None of the above B. The role of Geomechanics is becoming extremely essential to handle situations such as a) Deeper Drilling b) Geologically challenged Reservoirs c) Provide a safe drilling guide d) A, B, C & D e) None of the above	4	CO 1
Q2.	Choose the most appropriate option (single choice) A. Following stresses are present around the wellbore a) $S_{H\ max}$ b) $S_{h\ min}$ c) $\sigma_{\theta\theta}$ d) All of the above B. Following can occur owing to depletion in a reservoir rock a) Loss in Porosity b) Loss in Permeability c) Reduced In-situ stresses in depleted zone d) a & b e) a, b and c	4	CO 1

Q3.	Choose the most appropriate option (single choice) A. Which among the following is not a constitutive law for a reservoir rock a) Poroelastic b) Elastic c) Soft d) Hard e) c & d B. During drilling the mud weight must lie below a) Lower bound of mud window b) Upper bound of mud window c) Fracture pressure gradient d) Both b & c	**4**	**CO 1**
Q4.	Briefly discuss the different applications of Geomechanics in Petroleum industry?	**4**	**CO 2**
Q5.	In-situ stresses acting around a borehole converges and diverges at the point of a) SH max and Sh min occurring respectively b) Sh min and SH max occurring respectively c) Centre and bottom of borehole respectively d) All of the above	**4**	**CO 3**
SECTION B			
Q6.	Illustrate graphically the typical laboratory stress-strain behavior for an axial deformation of a well cemented rock?	**10**	**CO 3**
Q7.	Discuss the four constitutive laws for homogeneous and isotropic materials. Explain the stress strain curves diagrammatically?	**10**	**CO 2**
Q8.	Discuss and illustrate graphically the E.M. Andersons' classification scheme of a geologic area in terms of relative stress magnitudes in the following regions: a) Normal b) Strike-slip c) Reverse faulting regions	**10**	**CO 2**
Q9.	**Attempt any one question out of the two questions given below:** **A.** Give insights on the purpose of Mohr's failure envelope. Illustrate the Mohr's envelope for triaxial compression tests graphically and state the significance of the following: I. Significance of shear stress at failure line II. Coefficient of Internal Friction III. State Expressions for Linearized Mohr's envelope **OR**	**10**	**CO 3**

	B. Illustrate graphically and discuss the purpose of Mohr's envelope in reservoir geomechanics. Mark the principal stresses, normal stresses, UCS and line of failure. Discuss Linearized Mohr's envelope and discuss the effect of confining pressure on Mohr's envelope?		
SECTION C			
Q10.	Below shown is a vertical well drilled and the associated stress orientation and concentration. The formation surrounding the wellbore wall is subject to a stresses varying strongly with the position around the well and distance from the wellbore wall. The stresses act radially and vertically (Hoops). The schematic of the stress concentration surrounding the wellbore is shown in the Figure 1. Figure 2 exhibits the behaviour of Hoops stress with distance from the wellbore (i.e. Normalized Radial distance r/R). Analyze the behaviour carefully and provide your insights regarding the stress behaviour in the Figure 1 and 2, and detail the information obtained from these figures?  **Figure 1. Principal stress trajectories around a cylindrical opening (wellbore)**	**20**	**CO 4**

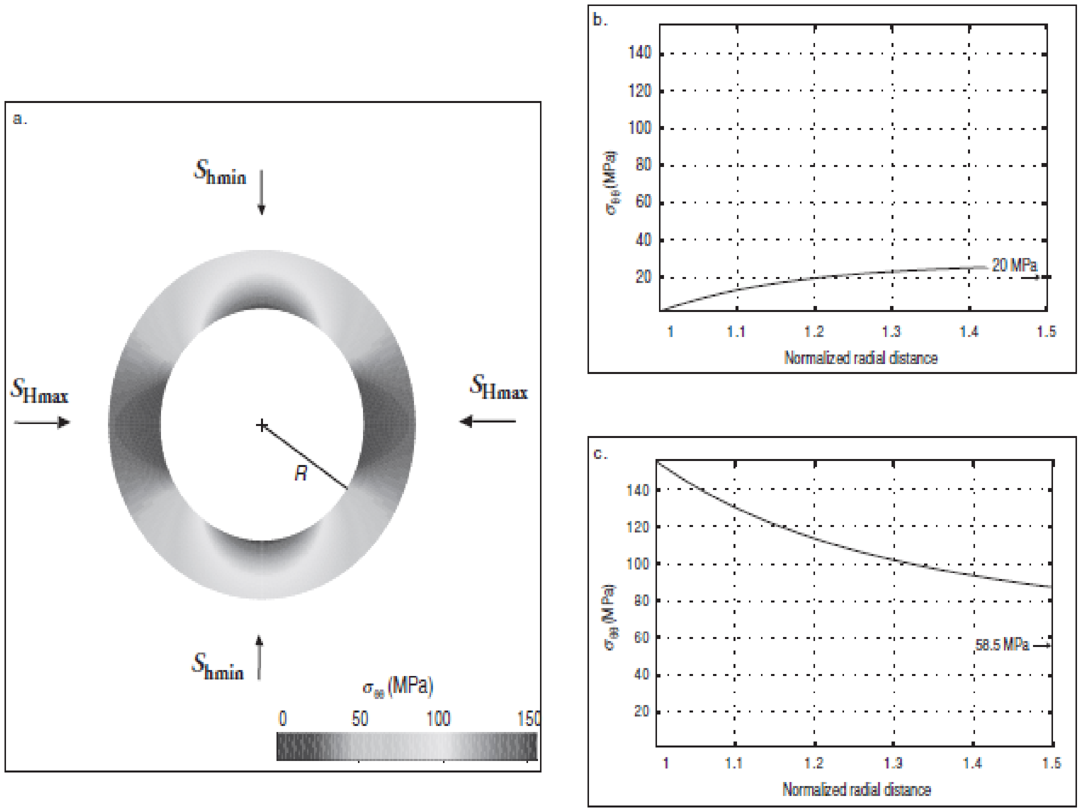


Figure 2. Variation of effective hoop stress around a vertical well of radius R . Hoops Stress (σΘΘ) varies strongly with both position around the wellbore and distance from the wellbore wall. These figures represent the variation of hoops stress at the point of maximum horizontal compression (i.e. at $S_{h\,min}$) and minimum horizontal compression ($S_{H\,max}$) around the wellbore.

Q11.	**Attempt any one question out of the two questions given below:** **A.** Provide your analysis on the following applications of Geomechanics using diagrammatic approach I. Wellbore breakout and mud weight impact the wellbore stability during drilling II. Impact on wellbore stability due to stress changes after reservoir depletion **OR** **B.** I. Illustrate the schematic representation of breakout growth when the initial breakout size is relatively small (< 60°) and when it is relatively larger (~120°). Provide your insights as how does this indicates a stable well and unstable well. II. b) Provide your interpretation of breakout width plotted against the depth in terms of wellbore stability. How to maintain the wellbore stability in zones with the breakout width less than 90°. Is it still possible to drill a stable well in the case of wellbore failure?	**20**	**CO 4**