Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
MID TERM EXAMINATION - OCT 2023

Semester : Semester V - 2021

Course Code : PET3001

Course Name : Sem V - PET3001 - Geomechanics for Wellbore Stability Analysis

Program : B. TECH

Date : 2-NOV-2023

Time : 9:30AM -11:00AM

Max Marks : 50

Weightage : 25%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART C

ANSWER ALL THE QUESTIONS **(5 X 2 = 10M)**

1. Define “Stress” and “Strain”.

(CO1) [Knowledge]

2. Describe “Mechanical Earth Model (MEM)”.

(CO1) [Knowledge]

3. Recall the four chief physical factors that control the type of deformation of rocks at depth.

(CO1) [Knowledge]

4. Fill in the blanks with appropriate word(s):
There is a direct linkage between Pore Pressure and Stress. The least principle stress always has to (a) _____ the Pore Pressure otherwise the Earth will (b) _____.

(CO2) [Knowledge]

5. Fill in the blanks with the appropriate answer:
During drilling, if (a) _____ is found to be increasing or (b) _____ is found to be decreasing, then that indicates the presence of an overpressure zone beneath the surface.

(CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(2 X 10 = 20M)**

6. The basis for understanding wellbore stability is understanding the geomechanical model. The geomechanical model begins by defining the principal stress tensor. When the horizontal stress is not equal (a frequent condition) a stress anisotropy is created and wellbore instability can be pronounced as well as direction and deviation sensitive. The pore pressure is a very important parameter in the geomechanical model and can be directly related to the fracture gradient, especially in depleted sands. Rock strength is also a major factor in the calculation of wellbore collapse. When these parameters are known, a geomechanical model can be created. On the basis of the above information, illustrate the possible areas of the oil and gas industry where the knowledge of Geomechanics can be applied.

(CO1) [Comprehension]

7. Figure XY display the variation of pore pressure with depth from observations in the Monte Cristo field along the Texas Gulf coast (after Engelder and Leftwich 1997). The way in which pore pressure varies with depth in this field is similar to what is seen throughout the Gulf of Mexico oil and gas province and many active sedimentary basins where overpressure is encountered at depth. Summarise the information that can be extracted from Figure XY.

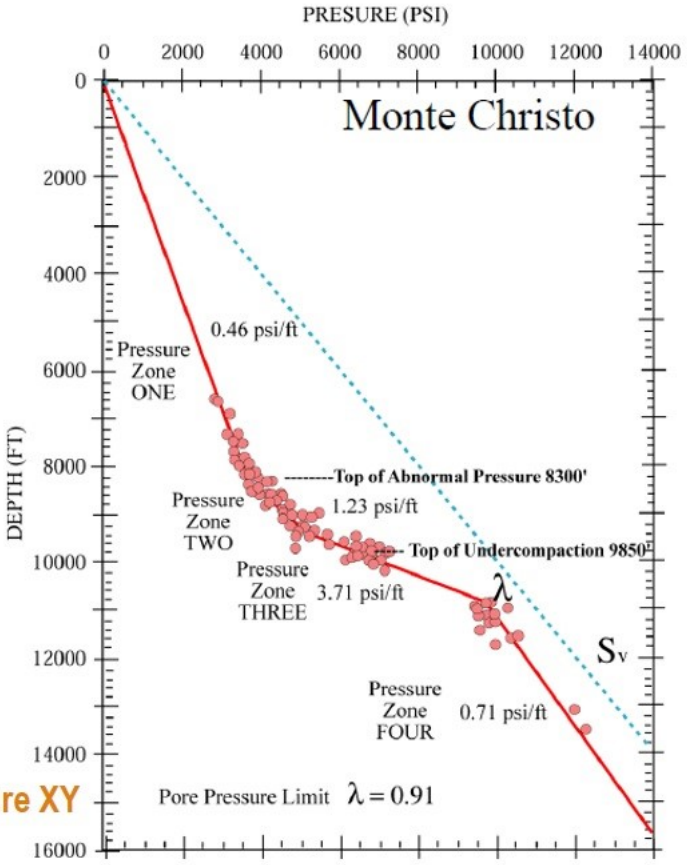

Figure XY

(CO2) [Comprehension]

PART C

ANSWER THE FOLLOWING QUESTION **(1 X 20 = 20M)**

8. Understanding of reservoir stress state has multifaceted applications in hydrocarbon exploration and development. Reservoir geomechanical characterization is crucial in achieving stable wellbore, optimum drilling, ideal horizontal well trajectories, perforation direction, stimulation, and completion schemes, which greatly impacts the reservoir production. This is also critical for the later stages of field development where the primary challenges are faced due to the reservoir depletion and necessary repressurization by water injection to maintain production targets as well as caprock integrity. The Density Log data presented in Table A is recorded in an onshore well located in Assam-Arakan Basin. Determine (a) Vertical Stress, (b) Vertical Stress Gradient, and (c) Porosity based on the available log data.

It is mandatory to write all equations which are applicable. Do not write the answers directly as it is mandatory to write the important steps used for computation. Use the following units in your calculation: ‘ft’ for depth, ‘g/cc’ for density, ‘psi’ for overburden stress, and ‘psi/ft’ for overburden stress gradient and pore pressure gradient. Use 9.8 m/s2 to approximate g, the acceleration due to gravity. Use the formula ρb = (1 - Ø) ρmatrix + Ø ρfluid to compute porosity assuming full saturation of 1.0 g/cm3 water in the pores. Here Ø is the porosity. For ρmatrix, assume 2.7 g/cm3, which is a reasonable value for a mixture of quartz, feldspar, mica, and clay.

Table A:

Depth (ft)	Density (g/cc)
3891.50	2.6594
3892.00	2.6426

[10 + 5 + 5]

(CO1) [Application]