Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY 2025

Date: 26-05-2025 **Time:** 01:00 pm – 04:00 pm

School: SOE	**Program:** B. Tech.-PET	
Course Code: PET2004	**Course Name:** Fundamentals of Petroleum Reservoir Engineering	
Semester: IV	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**0**	**48**	**24**	**28**	**-**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Define Relative and Absolute Permeability.	**2 Marks**	**L1**	**CO2**
2.	State the meaning and reason of "Slippage of Gas" while measurement of permeability.	**2 Marks**	**L1**	**CO2**
3.	Define "Compressibility" and mention its unit	**2 Marks**	**L1**	**CO2**
4.	Recall any two assumptions of Darcy's law.	**2 Marks**	**L1**	**CO2**
5.	Match the following: Column A (Type of Fluid) – Column B (Description) A. Slightly Compressible Fluid – 4. Typically lies between compressible and incompressible idealizations B. Real Reservoir Fluid Behavior – 2. Fluids assumed to have constant volume under pressure C. Incompressible Fluid – 3. Fluids that exhibit minor volume change with pressure D. Compressible Fluid – 1. Fluids that change volume significantly under pressure	**2 Marks**	**L1**	**CO3**
6.	Memorize the Pressure time relationship for various Flow regimes with only a rough sketch.	**2 Marks**	**L1**	**CO3**

<table>
<tr><td>7.</td><td>List different types of secondary recovery mechanisms in reservoirs.</td><td>2 Marks</td><td>L1</td><td>CO4</td></tr>
<tr><td>8.</td><td>Order the following reservoir drive mechanisms based on their typical recovery percentages (from highest to lowest recovery):

A) Gas Cap Drive B) Water Drive C) Solution Gas Drive D) Gravity Drainage.</td><td>2 Marks</td><td>L1</td><td>CO4</td></tr>
<tr><td>9.</td><td>Match the following:

<table><tr><th>Column A (Drive Mechanism)</th><th>Column B (Description)</th></tr><tr><td>A. Water Drive</td><td>1. Gas expands above the oil zone and pushes oil downwards</td></tr><tr><td>B. Solution Gas Drive</td><td>2. Expansion of dissolved gas within oil as pressure drops</td></tr><tr><td>C. Rock and Liquid Expansion Drive</td><td>3. Minor contribution from pore space and fluid compressibility</td></tr><tr><td>D. Gas Cap Drive</td><td>4. Water encroaches from surrounding aquifer to displace hydrocarbons</td></tr></table></td><td>2 Marks</td><td>L1</td><td>CO4</td></tr>
<tr><td>10.</td><td>Arrange the following drive mechanisms in order of efficiency: Solution gas drive, Water drive, Gas cap drive, Gravity drainage.</td><td>2 Marks</td><td>L1</td><td>CO4</td></tr>
</table>

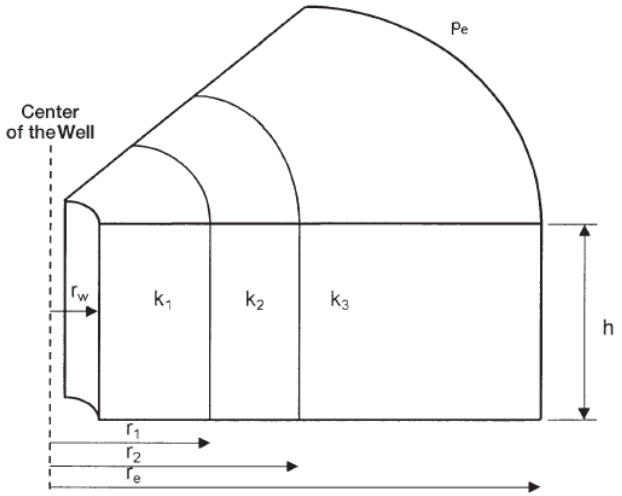
Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	Give examples of practical applications of Klinkenberg's correction in petroleum engineering. Paraphrase the concept of slip flow, infer its impact on permeability measurements, and defend the necessity of applying Klinkenberg's correction in laboratory and field studies.	**10 Marks**	**L2**	**CO2**
	b.	A brine is used to measure the absolute permeability of a core plug. The rock sample is 4 cm long and 3 cm2 in cross section. The brine has a viscosity of 1.0 cp and is flowing a constant rate of 0.5 cm3/sec under a 2.0 atm pressure differential. Compute the absolute permeability.	**10 Marks**	**L3**	**CO2**
Or					
12.	**a.**	Generalize the typical behavior of relative permeability curves for with respect to oil and water saturation.	**10 Marks**	**L2**	**CO2**
	b.	Given the following permeability data from a core analysis report, compute the average permeability of the reservoir.	**10 Marks**	**L3**	**CO2**

		<table><tr><th>Depth, ft</th><th>Permeability, md</th></tr><tr><td>3998-4002</td><td>200</td></tr><tr><td>4002-4004</td><td>130</td></tr><tr><td>4004-4006</td><td>170</td></tr><tr><td>4006-4008</td><td>180</td></tr><tr><td>4008-4010</td><td>140</td></tr></table>			

13.		Explain the relationship between gas solubility and reservoir pressure, as well as the relationship between oil formation volume factor (Bo) and reservoir pressure. Use appropriate diagrams to illustrate how gas solubility decreases with a decrease in reservoir pressure and how the oil formation volume factor (Bo) changes under the same conditions. Discuss how these properties are affected during production when the reservoir pressure declines, emphasizing the role of pressure depletion on both gas dissolution and the expansion of oil volume in the reservoir. Provide clear, labeled diagrams to aid in understanding these relationships and their impact on reservoir performance.	**20 Marks**	**L2**	**CO2**
		Or			
14.	**a.**	Infer the expressions for gas compressibility for the following cases by deriving the final equations: (a) Ideal Gas: Derive the equation for gas compressibility in terms of pressure and temperature for an ideal gas, and clearly state the assumptions involved (e.g., the gas obeys the ideal gas law). (b) Real Gas: Derive the equation for gas compressibility for a real gas, incorporating the compressibility factor (Z), and state the assumptions (e.g., deviations from ideal behavior due to intermolecular forces and non-ideal conditions). In both cases, provide the final expressions for gas compressibility, ensuring to include the necessary assumptions and conditions for each type of gas.	**10 Marks**	**L2**	**CO2**
	b.	Express the average permeability for the rock system shown below. The notations used represent the usual standard nomenclature.	**10 Marks**	**L2**	**CO2**

15.		An incompressible fluid flows in a linear porous media with the following properties: L = 2000 ft h = 20′ width = 300′ k = 100 md Porosity = 15% μ = 2 cp p1 = 2000 psi p2 = 1990 psi Assume that the porous media is tilted with a dip angle of 5° and the incompressible fluid has a density of 42 lb/ft^3. Compute: a. Flow rate in bbl/day b. Absolute difference of Apparent fluid velocity in ft/day for 0° and 5° tilt. c. Absolute difference of Actual fluid velocity in ft/day for 0° and 5° tilt.	**20 Marks**	**L3**	**CO3**
		Or			
16.	**a.**	Distinguish between Steady State, Unsteady State, and Pseudo-Steady State flow of fluids through porous media. In your answer, explain the physical significance of each flow regime, list the typical conditions under which each occurs, and illustrate your explanation with appropriate diagrams.	**09 Marks**	**L2**	**CO3**
	b.	Express the conversion of the general Darcy's equation to the modified Darcy's equation for linear, steady-state, incompressible flow, and describe the assumptions that govern the modification.	**04 Marks**	**L2**	**CO3**
	c.	An incompressible fluid is flowing through a linear porous medium of length 2500 ft, height 25 ft, and width 400 ft. The permeability of the porous medium is 150 millidarcies (md), and	**07 Marks**	**L3**	**CO3**

		the porosity is 18%. The fluid has a viscosity of 1.5 centipoise (cp). The pressure at the inlet (p_1) is 2500 psi and at the outlet (p_2) is 2470 psi. Using this information, compute the following: (a) Flow rate in barrels per day (bbl/day), (b) Apparent fluid velocity in feet per day (ft/day), (c) Actual fluid velocity in feet per day (ft/day).			

17.	Classify the different natural drive mechanisms in petroleum reservoirs. For each type, describe the working principle, associated reservoir characteristics, typical production behavior, and examples of fields where such mechanisms dominate. Your answer should include detailed explanations of the following types: a. Rock and Liquid expansion drive b. Solution Gas Drive c. Gas Cap Drive d. Water Drive	**20 Marks**	**L2**	**CO4**
	Or			
18.	Convert the general law of conservation of mass into a material balance equation applicable to a petroleum reservoir system. Clearly outline all assumptions made during the derivation process.	**20 Marks**	**L2**	**CO4**