Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

Mid - Term Examinations – March 2026

Date: 12- 03- 2026 **Time:** 09:30am – 11.00am

School: SOE	**Program:** B.Tech.-PET	
Course Code: PET2108	**Course Name:** Fundamentals of Petroleum Reservoir Engineering	
Semester: IV	**Max Marks**: 50	**Weightage**: 25%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**24**	**26**	**-**	**-**	**-**

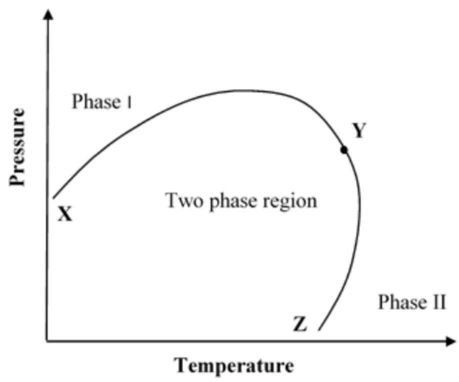
Instructions:

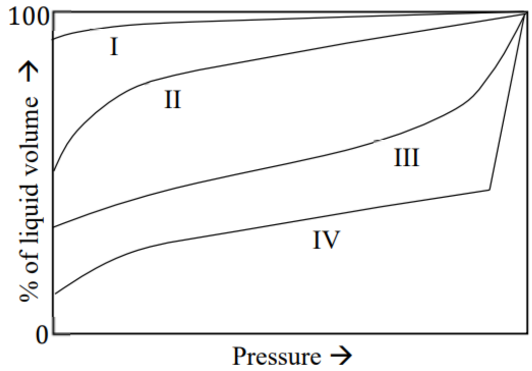
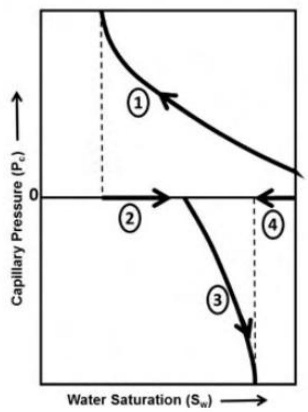
(i) Read all questions carefully and answer accordingly.

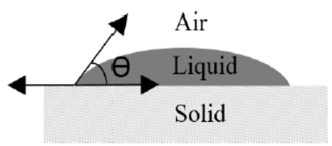
(ii) Do not write anything on the question paper other than roll number.

Part A

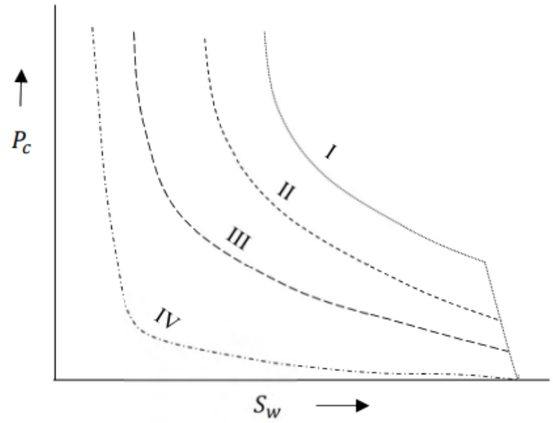
Answer ALL the Questions. Each question carries 2marks. **5Q x 2M=10M**

1	A phase diagram of a black oil is shown in the figure (Y is the critical point). Match (P, Q, R, S) with (I, II, III, IV)  (P) Curve XY — (I) Dew point curve (Q) Curve YZ — (II) Single phase liquid (R) Phase I — (III) Bubble point curve (S) Phase II — (IV) Single phase gas	**2 Marks**	**L1**	**CO1**
2	The liquid shrinkage curves for different types of crude oil are shown in the following figure. Identify I, II, III and IV.	**2 Marks**	**L1**	**CO1**

<table>
<tr><td></td><td>
</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>In the given Figure, from the following options identify the correct combination of drainage and imbibition processes for a water-wet rock in the subsurface, as indicated by number 1 to 4.


Option A: 1 – oil displacing water, 2 – spontaneous brine imbibition, 3 – water displacing oil, 4 – spontaneous oil imbibition
Option B: 1 – water displacing oil, 2 – spontaneous oil imbibition, 3 – spontaneous brine imbibition, 4 – oil displacing water
Option C: 1 – spontaneous oil imbibition, 2 – spontaneous brine imbibition, 3 – water displacing oil, 4 – oil displacing water
Option D: 1 – water displacing oil, 2 – spontaneous brine imbibition, 3 – oil displacing water, 4 – spontaneous oil imbibition</td><td>2 Marks</td><td>L1</td><td>CO2</td></tr>
<tr><td>4</td><td>Contact angle measurements are often performed on smooth surfaces to gain information about the wettability of a surface. The interfacial tensions between solid-liquid, liquid-air, and air-solid are $\gamma_{(SL)}$, $\gamma_{(LA)}$ and $\gamma_{(AS)}$, respectively. State the


expression to describe the contact angle, Θ.</td><td>2 Marks</td><td>L1</td><td>CO2</td></tr>
<tr><td>5</td><td>Capillary pressure (P_c) vs water saturation (S_w) curves for different sandstone reservoirs (I, II, III and IV) are given in the following figure.</td><td>2 Marks</td><td>L1</td><td>CO2</td></tr>
</table>

	 Label I, II, III and IV with respect to the uniformity of the pore size distribution.			

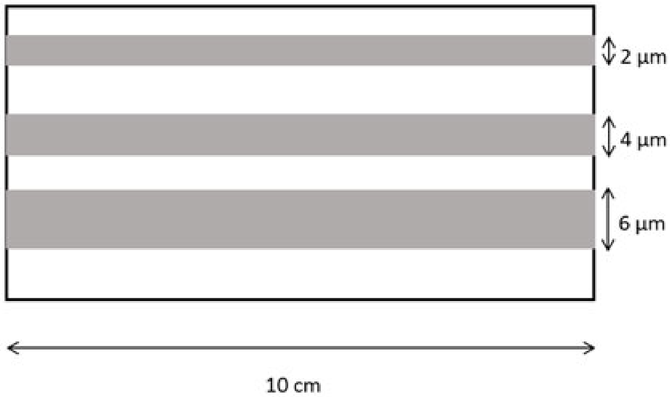
Part B

Answer the Questions. **Total Marks 40M**

6.	**a.**	A hydrocarbon reservoir is initially at single-phase conditions and is produced under natural depletion. Using a Pressure–Temperature (P–T) phase diagram, (a) Locate the initial reservoir condition on the diagram. (b) Illustrate the pressure decline path during production. (c) Demonstrate the phase changes that occur as the reservoir pressure crosses the bubble point or dew point. (d) Predict the impact of these phase changes on production performance and fluid properties.	**10 Marks**	**L3**	**CO1**
Or					
7.	**a.**	Draw and compare the P–T phase diagrams of the following reservoir fluids: A. Black oil B. Volatile oil C. Gas condensate On each diagram, clearly distinguish the location of the reservoir temperature and illustrate how the relative position of the temperature line influences fluid behavior during depletion. Specify the properties of the each type of fluid.	**10 Marks**	**L3**	**CO1**

8.	**a.**	Demonstrate the Restored Capillary Pressure experiment used for measuring capillary pressure in reservoir rocks. Illustrate the experimental procedure involved and summarize how the drainage capillary pressure curve is obtained from the test results.	**10 Marks**	**L3**	**CO1**
Or					
9.	**a.**	Explain the relationship between wettability, surface tension, and capillary pressure in porous media, and illustrate this relationship in the context of reservoir engineering and soil science.	**10 Marks**	**L3**	**CO1**

10.	**a.**	A porous medium of 10 cm length is made of tree horizontal, cylindrical capillaries of inside diameter 2μm, 4 μm, 6μm as shown in the figure.	**10 Marks**	**L3**	**CO2**

		Oil is being injected in this porous medium that was initially filled completely with water. The interfacial tension between oil and water is 0.025 N/m. Consider water as the completely wetting phase, i.e., contact angle is 0°. When the pressure drop across the porous medium is 20 kPa, the maximum saturation of oil in the porous medium is 0.643. When the pressure drop is increased to 30 kPa, determine the maximum oil saturation (rounded off to two decimal places).			
		Or			
11.	**a.**	A heterogeneous porous medium is composed of four sediment fractions (A, B, C, and D) arranged from coarsest (A) to finest (D). Each finer fraction completely fills the pore space of the immediately coarser fraction. Fraction A occupies 45% of the total bulk volume and has a porosity of 40%. This means that 40% of Fraction A's volume is pore space, which becomes available for the next finer fraction to occupy. The pore space of Fraction A is fully filled by Fraction B, which has a porosity of 35%, so only 35% of the volume occupied by B remains as pore space. Similarly, Fraction C fills the pore space remaining after Fraction B and has a porosity of 30%, and finally Fraction D fills the pore space of Fraction C, with a porosity of 25%. (a) At each stage, clearly calculate the pore volume available for the next fraction. (b) Show all intermediate steps and justify each calculation (single-step or final-answer-only solutions will not receive marks). Using proper reasoning, determine the total porosity of the entire system.	**10 Marks**	**L3**	**CO2**

12.	**a.**	A laboratory air-oil capillary pressure of 1.2×10^5 N/m^2 has been measured in a reservoir core sample at residual water saturation. Given that the air-oil surface tension is 0.07 N/m and the brine-oil interfacial tension for the reservoir fluid is 0.025 N/m, determine the height of the water-oil transition zone (up to the point where connate water saturation is reached) from the free water level. Assume identical wetting performance between the core sample and the reservoir, and use the following data: Density of brine = 1080 kg/m^3, Density of oil = 780 kg/m^3 Acceleration due to gravity = 9.81 m/s^2, Calculate the required transition zone height in meters.	**10 Marks**	**L3**	**CO2**
		Or			
13.	**a.**	I. Calculate the pressure difference, i.e., capillary pressure, and capillary rise in an oil-water system from the following data: θ =15° Density of Water = 1.0 gm/cm^3 Density of Oil = 0.85 gm/cm^3 Radius of capillary = 10^{-4} cm; Oil water Surface Tension= 35 dynes/cm II. Predict the surface tension of liquid A at room temperature (in dyne/cm) when it is measured using the capillary rise method in	**10 Marks**	**L3**	**CO2**

			the laboratory. The capillary radius is 100 μm, the height of the liquid column is 10 cm, and the contact angle is 38°. Density of air may be neglected, and liquid A is assumed to have the same density as water			