Roll No.

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 08-12- 2025 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B.Tech. (PET)
Course Code: PET3006	**Course Name:** Advanced Petroleum Reservoir Engineering
Semester: V	**Max Marks**: 100 **Weightage**: 50%

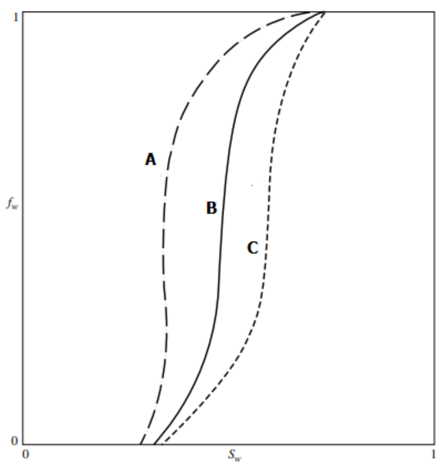
CO - Levels	CO1	CO2	CO3	CO4	CO5	CO6
Marks	02	04	30	20	22	22

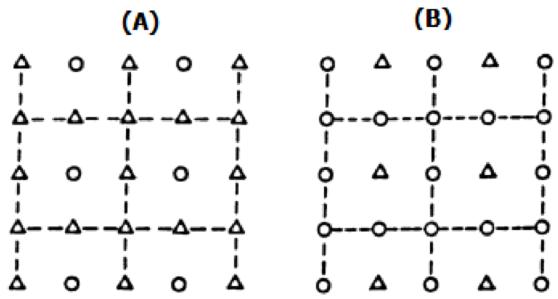
Instructions:

(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 2 marks. **10Q x 2M=20M**

1.	Define the term flooding efficiency in water flooding operations.	**2 Marks**	**L1**	**CO1**
2.	State the difference between areal sweep efficiency and vertical sweep efficiency.	**2 Marks**	**L1**	**CO2**
3.	Describe how mobility ratio affects the sweep efficiency in water flooding.	**2 Marks**	**L1**	**CO2**
4.	For the below fractions flow curve Identify Up-dip, Down-dip and No-Dip 	**2 Marks**	**L1**	**CO3**

5.	Identify TRUE/FALSE i. Water flooding patterns are selected solely based on reservoir thickness. False ii. Five-spot and nine-spot patterns are examples of areal sweep patterns. True iii. Pattern design has no effect on water breakthrough timing. **iv.** In direct line drive, production wells are located at the far end of the line from injection wells.	**2 Marks**	**L1**	**CO3**
6.	Identify these two pattern:  	**2 Marks**	**L1**	**CO3**
7.	In waterflooding calculations, the reservoir water cut fw and the water-oil ratio WOR are both traditionally expressed in two different units: bbl/bbl and STB/STB. Outline the interrelationships that exist between: i) Reservoir fw – Reservoir WORr Relationship ii) Reservoir fw – Surface WORs Relationship	**2 Marks**	**L1**	**CO3**
8.	A reservoir under water flooding has: Displacement efficiency =0.6 Areal sweep efficiency= 0.8 Vertical sweep efficiency =0.9 Identify the overall oil recovery factor	**2 Marks**	**L1**	**CO3**
9.	Define decline curve analysis in reservoir engineering.	**2 Marks**	**L1**	**CO5**
10.	List the main objectives of Reservoir management.	**2 Marks**	**L1**	**CO6**

Part B

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

11.	Use the relative permeability as shown in **ANNUXURE-1** to plot the fractional flow curve for a linear reservoir system with the following properties: Dip angle = 0 Absolute permeability = 50 md Bo = 1.20 bbl/STB; Bw = 1.05 bbl/STB Density of Oil = 45 lb/ft^3 ;Density of Water= 64.0 lb/ft^3 Viscosity of Water = 0.5 cp Cross-sectional area A = 25,000 ft^2 Perform the calculations for the following values of oil viscosity:= 3, 6, 9, and 12 cp. ***(Use Fractional Flow concept)***	**20 Marks**	**L4**	**CO3**

	Or			
12.	The linear system with following parameters Absolute permeability = 50 md Bo = 1.20 bbl/STB; Bw = 1.05 bbl/STB Density of Oil = 45 lb/ft^3;Density of Water= 64.0 lb/ft^3 Viscosity of Water = 0.5 cp Cross-sectional area A = 25,000 ft^2 is under consideration for a water flooding project with a water-injection rate of 1,000 bbl/day. The oil viscosity is considered constant at 1.0 cp. Calculate the fractional flow curve for the reservoir dip angles of 5, 10, and 15°, assuming (a) updip displacement and (b) downdip displacement. ***(Use Fractional Flow concept)***	**20 Marks**	**L4**	**CO3**

13.	**a.**	The production of a gas well was found to decline exponentially. The observed production rate on 1st January, 2014 was 0.6×10^{10} SCF/month and on 1st January, 2017, it was 0.4×10^{10} SCF/month. The economic production limit for the well is estimated to be 0.003×10^{10} SCF/month. Calculate the remaining reserves for the well as on 1st January, 2017 in SCF.	**10 Marks**	**L3**	**CO4**
	b.	Exponential decline curve is to be used to estimate the oil reserves of a well. The current oil production rate is 2000 m^3 per day and yearly decline rate is 6.6% per year. If the minimum oil flow rate economically sustainable for the well is 2 m^3 per day, then calculate the reserves (economically producible) associated with the well in m^3. (rounded-off to two decimal places. Use 1 year = 365 days)	**10 Marks**	**L3**	**CO4**
		Or			
14.		A gas well has an initial production rate of qi=212 MMscf on 1 Jan 2020. After 1.5 years, the production rate falls to q=145 MMscf/day. The well is following exponential decline. The economic limit is: qe=0.6 MMscf/day **Calculate:** a) The exponential decline rate D (per year) b) The production rate after 4 years c) Remaining reserves from 1 Jan 2021 (t = 1 year) d) Time to reach economic limit qe e) Total recoverable reserves (EUR)	**20 Marks**	**L3**	**CO4**

15. The following data are available for a linear-reservoir system: — **20 Marks** — **L3** — **CO5**

S_w	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75
k_{ro}/k_{rw}	30.23	17.00	9.56	5.38	3.02	1.70	0.96	0.54	0.30	0.17	0.10

Oil formation volume factor Bo = 1.25 bbl/STB
Water formation volume factor Bw = 1.02 bbl/STB
Formation thickness h = 20 ft

Cross-sectional area A = 26,400 ft
Porosity = 25%
Injection rate iw = 900 bbl/day
Distance between producer and injector L = 600 ft
Oil viscosity = 2.0 cp
Water viscosity= 1.0 cp
Dip angle= 0°
Connate water saturation Swc = 20%
Initial water saturation Swi = 20%
Residual water saturation Sor = 20%
Assume, a=537.5 & b=-11.51
Calculate and plot the water saturation profile after 120 days.
Use expression for relative permeability correction:

$$\frac{k_{ro}}{k_{rw}} = a\ e^{bS_w}$$

$$\left(\frac{df_w}{dS_w}\right)_{S_w} = \frac{-\left(\frac{\mu_w}{\mu_o}\right) a\ b\ e^{bS_w}}{\left[1+\left(\frac{\mu_w}{\mu_o}\right) a\ e^{bS_w}\right]^2}$$

(Use Frontal Advanced Theory)

Or

16. The following data are available for a linear-reservoir system: **20 Marks** **L3** **CO5**

S_w	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75
k_{ro}/k_{rw}	30.23	17.00	9.56	5.38	3.02	1.70	0.96	0.54	0.30	0.17	0.10

Oil formation volume factor Bo = 1.25 bbl/STB
Water formation volume factor Bw = 1.02 bbl/STB
Formation thickness h = 20 ft
Cross-sectional area A = 26,400 ft
Porosity = 25%
Injection rate iw = 1200 bbl/day
Distance between producer and injector L = 700 ft
Oil viscosity = 2.0 cp
Water viscosity= 1.0 cp
Dip angle= 0°
Connate water saturation Swc = 20%
Initial water saturation Swi = 20%
Residual water saturation Sor = 20%
Assume, a=537.5 & b=-11.51
calculate:

1) Time to breakthrough
2) Cumulative water injected at breakthrough
3) Total pore volumes of water injected at breakthrough

(Use Frontal Advanced Theory)

Use expression for relative permeability correction:

	$\dfrac{k_{ro}}{k_{rw}} = a\ e^{bS_w}$ $\left(\dfrac{df_w}{dS_w}\right)_{Sw} = \dfrac{-\left(\dfrac{\mu_w}{\mu_o}\right) a\ b\ e^{bS_w}}{\left[1+\left(\dfrac{\mu_w}{\mu_o}\right) a\ e^{bS_w}\right]^2}$			

17.	Explain how effective teamwork and collaboration across multiple disciplines enhance reservoir management. Discuss the roles of geologists, reservoir engineers, production engineers, and other professionals in decision-making, problem-solving, and optimizing reservoir performance. Include examples of how such collaboration improves field development planning and production efficiency.	**20 Marks**	**L2**	**CO6**
	Or			
18.	Describe the reservoir management process as a continuous, life-cycle approach. Highlight the key stages from data acquisition and reservoir modeling to production monitoring and optimization. Explain how this integrated approach helps in maximizing hydrocarbon recovery, minimizing risks, and ensuring sustainable reservoir performance.	**20 Marks**	**L2**	**CO6**

Annexure-1