Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Reservoir Engineering (PEAU 7002) **Semester: I**
Programme: M.Tech (Petroleum Engineering)
Time: 03 hrs. **Max. Marks: 100**
Instructions: Be brief and to the point. Use calculator, mention appropriate sign convention and unit. Draw diagrams using pencil and ruler, wherever necessary with proper labelling.

SECTION A

S. No.		Marks	CO
Q 1	State the mathematical correlation for the interrelationship of various petrophysical properties of reservoir rocks.	**4**	**CO1**
Q 2	Illustrate the various formation volume factors of reservoir fluids.	**4**	**CO2**
Q 3	State the various tools available with a Reservoir Engineer to estimate the total hydrocarbon volume present in the reservoir.	**4**	**CO3**
Q 4	Explain the various flow geometries encountered near a producing well.	**4**	**CO4**
Q 5	State the primary natural drive indices encountered in a typical petroleum reservoir with their expected range of percentage recovery.	**4**	**CO5**

SECTION B

S. No.		Marks	CO
Q 6	Define absolute, effective and relative permeability. State mathematical relationship and/or curves where necessary.	**8**	**CO1**
Q 7	Illustrate the concept of multi-phase multi-component diagram. Explain the liquid shrinkage curves of typical oil reservoirs with the help of a figure with all the shrinkage curves for crude oil systems.	**8**	**CO2**
Q 8	Using the tank model, explain the concept behind Material Balance Equation (MBE). Write an MBE for a hydraulically controlled oil reservoir with excellent aquifer support, and state the percentage contribution of Rock and Fluid Expansion Drive in this case.	**8**	**CO3**
	OR		
	State the utilization of Decline Curve Analysis. Shed light on the limitations and sources of error in calculations of desired results.		
Q 9	Discuss the various types of fluid based on their compressibility with proper mathematical representation and draw the pressure-volume and pressure density curves.	**8**	**CO4**
	OR		
	Explain with diagram, Darcy's Law with all the assumptions & derivation, mentioning the original units and sign convention.		
Q 10	An anticlinal oil reservoir initially above bubble point pressure, where the reservoir is volumetrically sealed by faults at the flanks. Illustrate the changes in the reservoir	**8**	**CO5**

	fluid levels, with the help of a time-lapse diagram. State the drive mechanisms active at each point of time.		
	SECTION-C		
Q 11	A combination-drive reservoir contains 20 MMSTB of oil initially in place. The ratio of the original gas-cap volume to the original oil volume, i.e., m, is estimated as 0.15. The initial reservoir pressure is 3000 psia at 150°F. The reservoir produced 2.2 MMSTB of oil, 1900 MMscf of 0.84 specific gravity gas, and 100,000 STB of water by the time the reservoir pressure dropped to 2900 psi. The following PVT is available: **3000 psi** **2900 psi** Bo, bbl/STB 1.58 1.48 Rs, scf/STB 1040 850 Bg, bbl/scf 0.00080 0.00092 Bt, bbl/STB 1.58 1.655 Bw, bbl/STB 1.000 1.000 The following data are also available: Swi = 0.20; cw = 1.5 × 10−6 psi−1; cf = 1 × 10−6 psi−1 Calculate: a. Cumulative water influx b. Net water influx c. Primary driving indexes at 2900 psi	**5+5+ 10 =20**	**CO3**
Q 12	An incompressible fluid flows in a linear porous media with the following properties: L = 2000 ft; h = 20′; width = 300′ k = 100 md; φ= 15%; μ = 2 cp P_1 = 2000 psi P_2 = 1990 psi Calculate: a. Flow rate in bbl/day b. Apparent fluid velocity in ft/day c. Actual fluid velocity in ft/day	**10+5+ 5 =20**	**CO4**
	OR		
	Assuming a slightly compressible liquid with average compressibility of 21×10^{-5} psi^{-1}. L = 1700 ft h = 18′ width = 200′ k = 30 md porosity = 10% μ = 2 cp P_1 = 2100 psi P_2 = 2070 psi Calculate: Flow rate at both ends of the linear system	**10+10 = 20**	**CO4**

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Instructions: Be brief and to the point. Use calculator, mention appropriate sign convention and unit. Draw diagrams using pencil and ruler, wherever necessary with proper labelling.

SECTION A

S. No.		Marks	CO
Q 1	State the petrophysical properties associated with reservoir rocks.	**4**	**CO1**
Q 2	Discuss the formation volume factors of reservoir fluids and derive a mathematical relation for total formation volume factor.	**4**	**CO2**
Q 3	State various the tools available to a Reservoir Engineer to estimate the total hydrocarbon volume present in the reservoir.	**4**	**CO3**
Q 4	Explain the various flow regimes encountered in fluid flow through porous media.	**4**	**CO4**
Q 5	State the primary natural drive indices encountered in a typical petroleum reservoir with their expected range of percentage recovery respectively.	**4**	**CO5**

SECTION B

Q 6	Define porosity and it types. State mathematical relationship and/or diagrams where necessary.	**8**	**CO1**
Q 7	Illustrate the concept of multi-phase multi-component diagram. Explain the liquid shrinkage curves of typical oil reservoirs with the help of a figure with all the shrinkage curves for crude oil systems.	**4+4 = 8**	**CO2**
Q 8	Using the tank model, explain the concept behind Material Balance Equation (MBE). Write an MBE for a dry gas reservoir with limited aquifer support. State its expected percentage recovery.	**8**	**CO3**
	OR		
	State the utilization of Decline Curve Analysis. Shed light on the limitations and sources of error in calculations of desired results.		
Q 9	Discuss the various types of fluid based on their compressibility. Write proper mathematical representation and draw the pressure-volume and pressure density curves.	**8**	**CO4**
	OR		
	Explain with diagram, Darcy's Law with all the assumptions & derivation, mentioning the original units and sign convention.		
Q 10	An anticlinal oil reservoir initially above bubble point pressure, where the reservoir is volumetrically sealed by faults at the flanks. Illustrate the changes in the reservoir fluid levels, with the help of a time-lapse diagram. State the drive mechanisms active at each point of time.	**8**	**CO5**

SECTION-C			
Q 11	The following data are available on a volumetric undersaturated-oil reservoir: Pi = 4000 psi Pb = 3000 psi N = 100 MMSTB cf = 5×10^{-6} psi^{-1} co = 15×10^{-6} psi^{-1} cw = 3×10^{-6} psi^{-1} Swi = 30% Boi = 1.40 bbl/STB The oil formation volume factor at 3500 psi is 1.414 bbl/STB. (hint: find effective compressibility) Estimate cumulative oil production when the reservoir pressure drops to 3500 psi.	**20**	**CO3**
Q 12	An incompressible fluid flows in a linear porous media with the following properties: (Draw representative diagram) L = 2000 ft; h = 20′; width = 300′ k = 100 md; φ= 15%; μ = 2 cp P_1 = 2000 psi P_2 = 1990 psi Calculate: a. Flow rate in bbl/day b. Apparent fluid velocity in ft/day c. Actual fluid velocity in ft/day	**10+5+ 5 = 20**	**CO4**
	OR		
	Assuming a slightly compressible liquid. The liquid has an average compressibility of 21×10^{-5} psi^{-1}. (Draw representative diagram) L = 1700 ft h = 18′ width = 200′ k = 30 md porosity = 10% μ = 2 cp P_1 = 2100 psi P_2 = 2070 psi Calculate: Flow rate at both ends of the linear system.	**10+10 =20**	**CO4**