BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B.TECH. **SEMESTER : VI**
BRANCH: Chemical/Plastic & Polymer **SESSION : SP/2023**

SUBJECT: CL326 RESERVOIR ENGINEERING

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
6. Variables have their usual meanings.

			CO	BL
Q.1(a)	Calculate average oil saturation and connate water saturation from the following measurements:	[6]	CO1	3

Sample	Thickness, ft	Φ, %	S_o, %	S_{wc}, %
1	1.0	10	75	25
2	1.5	12	80	20
3	1.4	15	76	24
4	2	13	74	26
5	1.8	16	77	23

Q.1(b)	What are the Allogenic minerals and Authigenic minerals? Explain briefly the effect of grain shape, grain size, grain packing, grain sorting and grain orientation on the permeability of reservoir.	[4]	CO1	1,3
Q.2(a)	How do you differentiate between dry and wet gas? Explain the phase behaviors of ordinary black oil, low shrinkage oil, volatile oil, and near-critical oil.	[5]	CO1	3
Q.2(b)	A crude oil system exists at an initial reservoir pressure of 4500 psi and 85°F. The bubble–point pressure is estimated at 2109 psi. The oil properties at the bubble-point pressure are as follows: B_{ob} = 1.406 bbl/STB, R_{sb} = 692 scf/STB, γ_g = 0.876, API = 41.9°. Calculate: a. Oil density at the bubble–point pressure b. Oil density at 4,500 psi c. B_o at 4500 psi, using Standing correlation:	[5]	CO1	3

$$B_o = 0.9759 + 0.000120\left[R_s\left(\frac{\gamma_g}{\gamma_o}\right)^{0.5} + 1.25(T-460)\right]^{1.2}$$

Q.3(a)	Derive the continuity equation for unsteady state radial flow from pay zone to single well.	[5]	CO2	3
Q.3(b)	The following data are available on a well in the Gulf 1 Field: p_e = 2500 psi, p_{wf} =1850 psi, r_e = 750 ft, r_w = 0.25 ft, B_o = 1.25 bbl/STB, μ_o = 2.5 cp, c_o = 25×10^{-6} psi^{-1}, k = 0.12 Darcy, h = 20 ft. Assuming a slightly compressible fluid, calculate the oil flow rate. Compare the result with that of incompressible fluid.	[5]	CO2	3
Q.4(a)	Briefly explain various drive mechanisms of primary recovery.	[5]	CO3	2
Q.4(b)	An unknown field is a combination-drive reservoir. The current reservoir pressure is estimated at 2500 psi. The reservoir production data and PVT information are given below:	[5]	CO4	3

Varibles	**Initial reservoir condition**	**Current reservoir condition**
P, psi	4000	3000
B_o, bbl/STB	1.35	1.33
R_s, scf/STB	600	500
N_p, MMSTB	0	6
G_p, MMMscf		5.5
B_w, bbl/STB	1.0	1.0
W_e, MMbbl	0	4
W_p, MMbbl	0	0.25
B_g, bbl/scf	0.0011	0.0015
c_f, c_w	0	0

Volume of bulk oil zone = 100,000 ac-ft
Volume of bulk gas zone = 20,000 ac-ft
The material balance equation is given as:

$$N = \frac{N_p\left[B_o + (R_p - R_s)B_g\right] - (W_e - W_p B_w) - G_{inj}B_{ginj} - W_{inj}B_{wi}}{(B_o - B_{oi}) + (R_{si} - R_s)B_g + m\,B_{oi}\left[\frac{B_g}{B_{gi}} - 1\right] + B_{oi}(1+m)\left[\frac{S_{wi}c_w + c_f}{1 - S_{wi}}\right]\Delta p}$$

Q.5(a)	How does the water flooding help in oil recovery? Briefly discus areal sweep efficiency and vertical efficiency. Calculate the water influx rate e_w in a reservoir whose pressure is stabilized at 3000 psi. Given: initial reservoir pressure = 3600 psi, dN_p/dt = 30,000 STB/day, B_o = 1.4 bbl/STB, GOR = 800 scf/STB, R_s = 750 scf/STB, B_g = 0.00082 bbl/scf, dW_p/dt = 0, B_w = 1.0 bbl/STB.	[3+ 2]	CO5	2,3
Q.5(b)	Explain various enhanced oil recovery processes including *in situ* combustion and steam injection	[5]	CO5	2

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