Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Petroleum Production System Design (Prog Ele 1) **Semester : V**
Program: B.Tech. APE Upstream **Time : 03 hrs.**
Course Code: CHCE3008P **Max. Marks: 100**
No of pages: 04
Instructions: Assume suitable data, if necessary.

SECTION A
(5Qx4M=20Marks)

S. No.	Short answer type questions.	Marks	CO
Q 1	Recall and write any four objectives of well testing.	4	CO1
Q 2	Define and explain the term 'Inflow-Performance Relationship (IPR)'.	4	CO2
Q 3	Illustrate horizontal well drainage area. (Only a schematic diagram is expected.)	4	CO3
Q 4	Remember and write when artificial lift is needed in oil wells.	4	CO4
Q 5	Analyze and list any four consequences of sand production.	4	CO5

SECTION B
(4Qx10M= 40 Marks)

S. No.	Medium answer type questions.	Marks	CO
Q 6	A well producing from a saturated reservoir with an average reservoir pressure, $\overline{p}_r$ of 2500 psig. Stabilized production test data indicated that the stabilized rate, Q_o and wellbore pressure, p_{wf} are 350 STB/day and 2000 psig respectively. Construct IPR using p_{wf} as 2500, 2200, 1500, 1000, 500, 0 psig. Plot p_{wf} vs Q_o using a simple graph paper. Hint: Use a constant productivity index approach.	10	CO2
Q 7	In order to lift an oil from a well using Gas-lift technique, a gas is injected at a rate of 1.2 X 10^5 SCF/d. The gas-lift compressor inlet pressure, P_{in} is 100 psi while the surface pressure, P_{surf} is 1330 psi. Estimate the power required by the compressor in hydraulic horse power (hhp) unit. Following equation may be used: $$P = 2.23 \times 10^{-4} q_g \left[\left(\frac{p_{surf}}{p_{in}} \right)^{0.2} - 1 \right]$$ Where, P = Power required in hhp	10	CO4

	q_g = Gas injection rate in SCF/d P_{surf} = surface pressure in psi P_{in} = compressor inlet pressure Estimate the power required if the surface pressure reduces by 50% while the gas injection rate increased by 100%. Rest is unchanged.		
Q 8	Discuss sand production control using gravel pack completions. (Diagram is not expected.)	**10**	**CO5**
Q 9	Identify and discuss the applications of smart wells. **OR** Identify and describe the main components of smart wells.	**10**	**CO6**

SECTION-C
(2Qx20M=40 Marks)

S. No.	**Long answer type questions.**	**Marks**	**CO**
Q 10	Illustrate with diagrams, gas-liquid flow regimes at high flow rate of continuous phase in vertical pipes. (Both description and diagram are expected). **OR** Illustrate with diagrams, gas-liquid flow patterns in horizontal pipes. (Both description and diagram are expected).	**20**	**CO3**
Q 11	**a)** Calculate the solution gas to oil ratio (R_s) at the pump inlet under these conditions. Bubble point pressure (P_b) = 147 bar, Specific gravity of gas (Y_g) = 0.75, Temperature at the pump inlet (T) = 260 ^oC, API gravity of oil(^{o}API) = 40. Following equation may be used: $$R_s = 0.342 Y_g \times \left[\frac{P_b}{10^{0.0091 \times (1.8T+32)}} \times 10^{0.0125 \times {}^\circ\text{API}} \right]^{1.2048}$$	**10**	**CO4**

	b) An oil well is in a reservoir where height/depth (H) is 8000 ft and GLR is 200 SCF/STB. Find out the working GLR using pressure gradient curves generated with the modified Hagedorn and Brown correlation **(Fig. 1)**. Indicated bottomhole pressure is 1500 psi. Calculate the volumetric flow rate of gas in SCF/d to be injected at the bottom of the well. Use following equation. $$q_l(\mathrm{GLR}_2 - \mathrm{GLR}_1) = q_g$$ Where, q_l = volumetric flow rate of liquid (oil & water) in STB/d q_g = volumetric flow rate of injection gas in SCF/d GLR_1 = Natural, gas to liquid ratio GLR_2 = Working, gas to liquid ratio The volumetric flow rate of liquid is 800 STB/d. Other data given below. • Condition of liquid : 50% Oil & 50% water • Tubing size: 2.5 in ID • Production rate: 800 bbl/d • Average flowing temperature: 140 ^oF	**10**	**CO4**

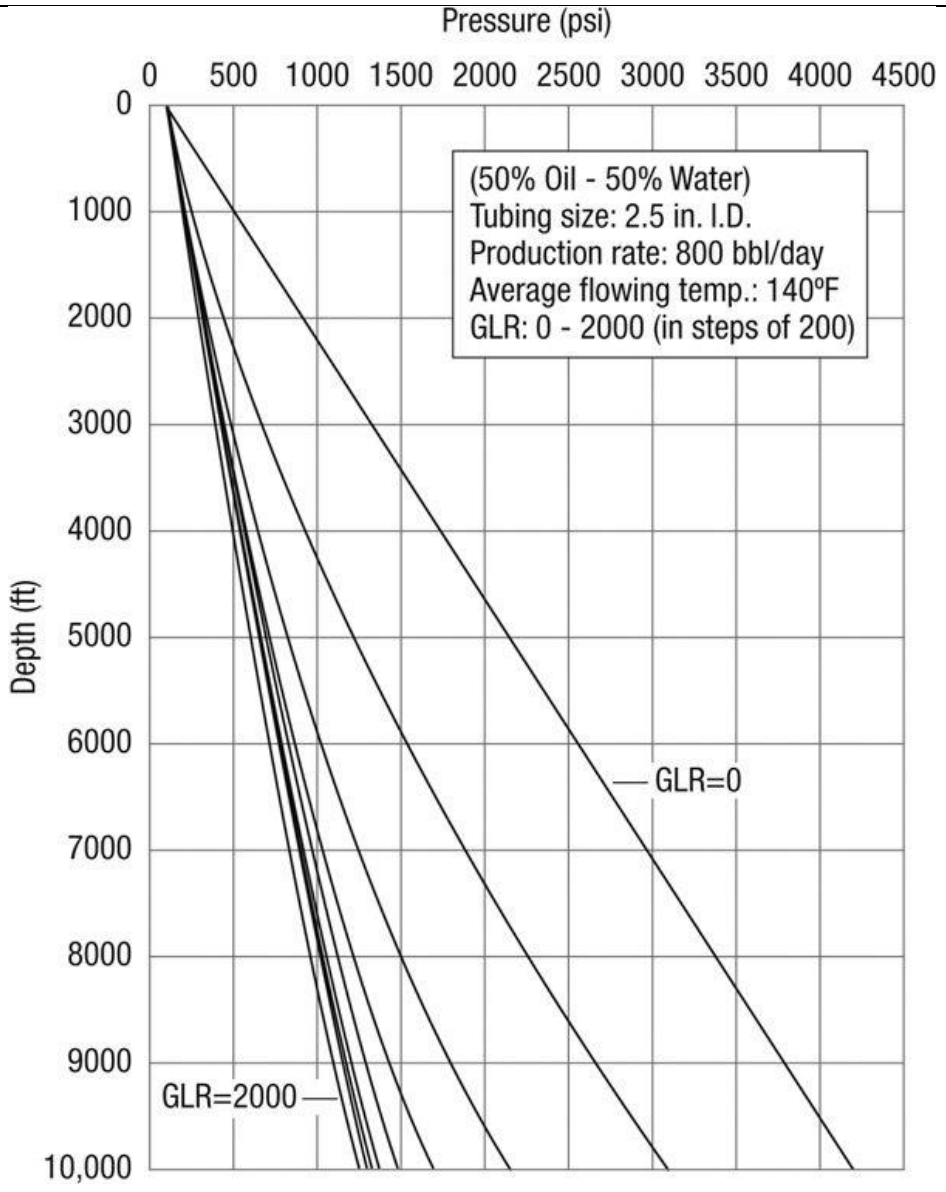

Fig. 1 Pressure gradient curves generated with the modified Hagedorn and Brown correlation.