Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2020

Programme Name: B.Tech., APE Gas **Semester :** VII

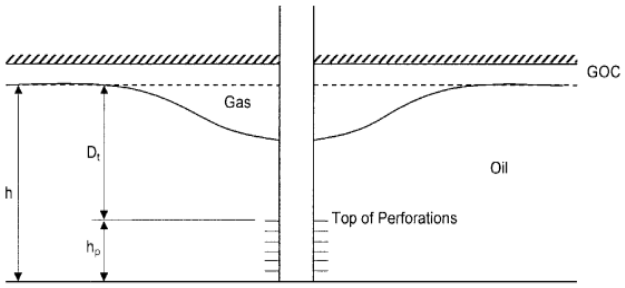
Course Name : Reservoir Engineering - II **Time :** 03 hrs

Course Code : PEAU 4104 **Max. Marks :** 100

Nos. of page(s) : 2

Instructions: 1. Assume any data missing.
2. Attach any graphs and/or data sheets (if any) used to the answer sheets for evaluation

SNo	SECTION A (6*5=30M)	Marks	CO
Q 1	State the two methods for determining the hydrocarbon in place. What is the fundamental difference between the two methods?	5	CO1
Q 2	Define the following and mention their significance i. Formation volume factor ii. Gas oil ratio	5	CO2
Q 3	List various types of decline curves used to analyze production rates	5	CO3
Q 4	Compare between exponential and hyperbolic decline approaches	5	CO3
Q 5	Define coning and mobility ratio. Mention the significance of mobility ratio in coning.	5	CO3
Q 6	Define fractional flow and comment on its significance	5	CO4
	SECTION B (5*10=50M)		
Q 7	The PVT data from volumetric depletion of an under-saturated reservoir is as follows: At Initial reservoir pressure of 3500 psi, the gas-oil ratio is 1100 SCF/STB and oil-formation volume factor is 1.572 RB/STB. At the depleted pressure and temperature of 2800 psi and 90^{o}F respectively, the gas-oil ratio is 900 SCF/STB, Z is 0.87, oil formation volume factor is 1.520 RB/STB and the cumulative production is 1.486 MM STB with a gas oil ratio of 3300 SCF/STB. Calculate the initial stock tank oil in place and the recovery factor at 2800 psi.	10	CO1
Q 8	A gas field extended over 1500 acres with an average payzone thickness of 40 ft. The average porosity and connate water saturation of the payzone are respectively 22% and 23%. The formation volume factor of gas at the initial reservoir pressure of 3250 psi was calculated to be 0.00533 CF/SCF. Calculate the i. Initial gas in the reservoir. ii. Recovery factor of the volumetric reservoir at an abandonment pressure of 500 psi if the corresponding formation volume factor is 0.03623 CF/SCF. iii. Recovery factor of the reservoir if it is produced under water drive such that the pressure stabilizes at 1500 psia, where the residual gas saturation and the gas formation volume factor were respectively 24% and 0.01122 CF/SCF. iv. Recovery factor of the reservoir if it is produced under very active water drive with no decline in reservoir pressure resulting in a residual gas saturation of 24%.	10	CO2
Q 9	The general form of all decline curves is given by the hyperbolic relationship: $$D = -\frac{dq/dt}{q} = K\,q^{n}$$ Using the above equation, derive general expressions for production rate versus time and	10	CO3

<table>
<tr><td></td><td>production rate versus cumulative production. Having derived these two general expression for any value of n, show their form when n = 1.</td><td></td><td></td></tr>
<tr><td>Q10</td><td>Derive an expression for maximum possible oil flow rate through a well, which penetrates a depth 'D_t' into a oil zone of thickness 'h' during gas coning
 
</td><td>10</td><td>CO3</td></tr>
<tr><td>Q11</td><td>Derive an expression for velocity of a plane of constant water saturation displacing oil through linear system by Buckley-Leverett approach.</td><td>10</td><td>CO4</td></tr>
<tr><td colspan="4">SECTION-C (1*20=20M)</td></tr>
<tr><td>Q12</td><td>The following data are available for a linear-reservoir system:
<table>
<tr><td>S_w</td><td>0.2</td><td>0.25</td><td>0.3</td><td>0.35</td><td>0.4</td><td>0.45</td><td>0.5</td><td>0.55</td><td>0.6</td><td>0.65</td><td>0.7</td><td>0.75</td><td>0.8</td></tr>
<tr><td>K_{rw}</td><td>0.0</td><td>0.002</td><td>0.009</td><td>0.02</td><td>0.033</td><td>0.051</td><td>0.075</td><td>0.100</td><td>0.132</td><td>0.17</td><td>0.208</td><td>0.251</td><td>0.3</td></tr>
<tr><td>K_{ro}</td><td>0.8</td><td>0.610</td><td>0.470</td><td>0.37</td><td>0.285</td><td>0.220</td><td>0.163</td><td>0.120</td><td>0.081</td><td>0.05</td><td>0.027</td><td>0.01</td><td>0</td></tr>
</table>
Oil formation volume factor Bo = 1.25 bbl/stb; Water formation volume factor Bw = 1.02 bbl/stb; Formation thickness h = 40 ft; Cross-sectional area A = 26400 ft^2; Porosity = 0.18; Injection rate i_w = 900 bbl/day; Distance between producer and injector L = 600 ft; Oil viscosity = 5.0 cp; Water viscosity = 0.5 cp; Dip angle = 0^0; Connate water saturation S_{wc} = 0.2; Initial water saturation S_{wi} = 0.20; Residual water saturation S_{or} = 0.2.
Calculate and plot the water saturation profile after 120 days.</td><td>20</td><td>CO4</td></tr>
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