Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2019

Programme Name: B.Tech., APE Gas **Semester** : VII
Course Name : Reservoir Engineering - II **Time** : 03 hrs
Course Code : PTEG 472 **Max. Marks :** 100
Nos. of page(s) : 2

SNo	Answer all the questions	Marks	CO
	SECTION A		
Q 1	Define the following i. Bo ii. Rs iii. Bg	**5**	**CO-I**
Q 2	Calculate the formation volume of gas (with Z=0.8) produced from a reservoir at pressure and temperature of 1800 psi & 200 ^{o}F respectively.	**5**	**CO-II**
Q 3	Write expressions to predict future production rates by i. Exponential decline analysis ii. Hyperbolic decline analysis	**5**	**CO-III**
Q 4	Define coning and mobility ratio. Mention the significance of mobility ratio in coning.	**5**	**CO-IV**
	SECTION B		
Q 5	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. The 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**	**CO-I**
Q 6	A dry gas reservoir initially at a reservoir pressure of 4200 psi and temperature of 180^{o}F, has been producing for some time. The following data has been reported from pressure surveys made on the reservoir. <table><tr><td>**p/z (psi)**</td><td>4600</td><td>3700</td><td>2800</td></tr><tr><td>**G_P (MMM SCF)**</td><td>0</td><td>1</td><td>2</td></tr></table>i. What will be the cumulative gas produced when the average reservoir pressure dropped to 2000 psi, at which Z = 0.8? ii. Assuming the reservoir rock has a porosity of 12%, the water saturation is 30%, and the reservoir pay-zone thickness is 15ft, how many acres does the reservoir cover?	**10**	**CO-II**

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^oF 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**	**CO-III**
Q 8	Derive an expression describing fractional flow of water in displacement of oil by water, in one dimension tilted reservoir block with uniform cross sectional area. **OR** Following is the data of immiscible displacement in a reservoir of 200 m X 200 m pattern: Porosity - 20%; oil saturation – 65%; residual oil saturation - 25%; mobility ratio - 1.32; pay thickness - 5 zones of 1 m each; permeability of zones - 310, 187, 432, 187 and 64 md. Calculate: i. Fractional flow of water ii. Oil recovery by stile's method if the water break through is in 2^{nd} layer	**10**	**CO-IV**
	SECTION-C		
Q 9	a. Calculate original oil in place and hence the recovery factor in a volumetric, under-saturated reservoir at abobe bubble point form the following data at 3600 psi: P_i - 5000 psi; B_{ti} -1.355 RB/STB; B_t at 3600 psi - 1.375 RB/STB; N_p - 1.25 MM STB; Connate water saturation - 0.2; B_w at 3600 - 1.04 RB/STB; W_p - 32,000 STB; W_e - 0; c_w - 3.6 * 10^{-6} psi^{-1}; c_f - 5.0 * 10^{-6} psi^{-1}. Also calculate original oil in place and the recovery factor neglecting formation compressibilities. b. Calculate original oil in place and hence the recovery factor in a combined-drive reservoir form the following data: Volume of bulk zone – 112000 ac-ft; Volume of bulk gas zone – 19600 ac-ft; Initial presssure - 2710 psi; Iinitial dissolved GOR – 562 SCF/STB; Initial FVF -1.340 RB/STB; Initial gas volume factor - 0.006266 $ft^3/STft^3$; Reservoir pressure at the end of the interval – 2000 psi; Oil produced during the interval - 20 MM STB; Average produced GOR - 700 SCF/STB; Two-phase FVF at 2000 psi – 1.4954 RB/STB; Gas volume factor at 2000 psi - 0.008479 $ft^3/STft^{3.}$ Volume of water encroached - 11.58 MM bbl; Volume of water produced - 1.05 MM STB; FVF of water - 1.028 RB/STB. **OR** a. Derive an expression for production 'q' bbl at time 't' from well initially producing 'q_i' bbl of oil by exponential decline analysis. b. Following is the oil production data recorded from well opened in Jan 2015. <table><tr><th>Month</th><td>Jan</td><td>Jul</td><td>Dec</td><td>Jul</td><td>Jan</td><td>Jul</td><td>Feb</td><td>Jun</td><td>Jan</td></tr><tr><th>Year</th><td>2015</td><td>2015</td><td>2015</td><td>2016</td><td>2017</td><td>2017</td><td>2018</td><td>2018</td><td>2019</td></tr><tr><th>Production (bbl)</th><td>1700</td><td>1511</td><td>1405</td><td>1240</td><td>1100</td><td>1003</td><td>890</td><td>831</td><td>736</td></tr></table>Based on the exponential decline analysis estimate i. The decline percentage ii. The production rate in Jan 2020 iii. The cumulative oil production from Jan 2015 through Jan 2020	**20**	**CO-III**
Q 10	a. Derive an expression for maximum possible oil flow rate through a well, which penetrates a depth 'D' into a horizontal oil zone oh thickness 'h' during gas coning.	**20**	**CO-IV**

	b. Derive an expression for velocity of a plane of constant water saturation displacing oil through linear system by Buckley-Leverett approach		