Name: Enrolment No:	UPES	
	UM AND ENERGY STUDIES	
	nation, December 2019	
Programme Name: B.Tech., APE Gas	Semester : VI	[
Course Name : Reservoir Engineering - II	Time : 03	hrs
Course Code : PTEG 472	Max. Marks : 100	
Nos. of page(s) : 2		
SNo Answer all the q	uestions Mar	ks CO
SECT	TON A	
Q1 Define the following		CO-I
I. DU II. KS	111. Bg	
Q 2 Calculate the formation volume of gas (with Z=0 and temperature of 1800 psi & 200 °F respectivel	y. 3	CO-II
Q3 Write expressions to predict future production rat i. Exponential decline analysis ii. H		CO-III
Q4 Define coning and mobility ratio. Mention the sig	nificance of mobility ratio in coning. 5	CO-IV
	TON B	
 A gas field extended over 1500 acres with an a average porosity and connate water saturation or 23%. The formation volume factor of gas at the incalculated to be 0.00533 CF/SCF. The calculate the calculated to be 0.00533 CF/SCF. The calculate the infitial gas in the reservoir. ii. Recovery factor of the volumetric reservoir in the corresponding formation volume factor is the corresponding formation volume factor is pressure stabilizes at 1500 psia, where the reservoir wolume factor were respectively 24% and 0.00000000000000000000000000000000000	f the payzone are respectively 22% and nitial reservoir pressure of 3250 psi was he at an abandonment pressure of 500 psi if s 0.03623 CF/SCF. Deduced under water drive such that the idual gas saturation and the gas formation 01122 CF/SCF. ced under very active water drive with no	CO-I
A dry gas reservoir initially at a reservoir pressur has been producing for some time. The followin surveys made on the reservoir. $\mathbf{Q} 6$ $\mathbf{p/z} (\mathbf{psi})$ 460 $\mathbf{GP} (\mathbf{MMM SCF})$ 0 i.What will be the cumulative gas produced whe to 2000 psi, at which Z = 0.8?ii.Assuming the reservoir rock has a porosity of reservoir pay-zone thickness is 15ft, how mature	ng data has been reported from pressure $00 \ 3700 \ 2800$ $0 \ 1 \ 2$ 10 20 20 20 20 20 20 20 20 20 2	CO-II

 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°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. 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 							10 10	CO-III			
			S	ECTIC	DN-C						
SECTION-Ca. 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: $P_i - 5000 \text{ psi}$; $B_{ti} - 1.355 \text{ RB/STB}$; B_t at 3600 psi - 1.375 RB/STB; $N_p - 1.25 \text{ MM STB}$; Connate water saturation - 0.2; B_w at 3600 - 1.04 RB/STB; $W_p - 32,000 \text{ STB}$; $W_e - 0$; $c_w - 3.6 * 10^{-6} \text{ psi}^{-1}$; $c_f - 5.0 * 10^{-6} \text{ psi}^{-1}$. Also calculate original oil in place and the recovery factor neglecting formation compressibilities.							M STB; $W_e - 0;$ formation hed-drive herefore q_i ? Jan 2019 736	20	CO-III		
	sion for	maxim	num po	ossible	oil flov	v rate	through	ı a wel		20	CO-IV
	At Initial reservoir p formation volume fac At the depleted pressu is 900 SCF/STB, Z cumulative production Calculate the initial st Derive an expression in one dimension tilte Following is the data Porosity - 20%; oil sa pay thickness - 5 zone Calculate: i. Fractiona ii. Oil recov a. Calculate original saturated reservoir P_i - 5000 psi; B_{ii} -1 Connate water satu c_w - 3.6 * 10 ⁻⁶ psi ⁻¹ Also calculate ori compressibilities. b. Calculate original reservoir form the Volume of bulk zo Initial pressure - 2 Initial FVF -1.340 Reservoir pressure Oil produced durir Average produced Two-phase FVF at Gas volume factor Volume of water e Volume of water p a. Derive an expressi bbl of oil by expor b. Following is the oi Month Year Production (bbl) Based on the expor i. The dec ii. The pro iii. The pro	At Initial reservoir pressure formation volume factor is 1.5At the depleted pressure and te is 900 SCF/STB, Z is 0.87 cumulative production is 1.48Calculate the initial stock tank Derive an expression describin in one dimension tilted reserverFollowing is the data of immig Porosity - 20%; oil saturation pay thickness - 5 zones of 1 m Calculate: i. Fractional flow o ii. Oil recovery by sa. Calculate original oil in p saturated reservoir at aboby P _i - 5000 psi; B _{ti} -1.355 RE Connate water saturation - c_w - 3.6 * 10 ⁻⁶ psi ⁻¹ ; c _f - 5.0 Also calculate original oil in p reservoir form the followind Volume of bulk zone - 112 Initial pressure - 2710 psi Initial FVF -1.340 RB/STE Reservoir pressure at the et Oil produced during the im Average produced GOR - 7 Two-phase FVF at 2000 psi Gas volume factor at 2000 Volume of water produced a. Derive an expression for p bbl of oil by exponential de to oil by exponential de i. The decline per ii. The production iii. The cumulative	 At Initial reservoir pressure of 350 formation volume factor is 1.572 RB, At the depleted pressure and temperat is 900 SCF/STB, Z is 0.87, oil for cumulative production is 1.486 MM SCalculate the initial stock tank oil in TDerive an expression describing fract in one dimension tilted reservoir block. Following is the data of immiscible d Porosity - 20%; oil saturation – 65% pay thickness - 5 zones of 1 m each; p Calculate: i. Fractional flow of water ii. Oil recovery by stile's m a. Calculate original oil in place an saturated reservoir at abobe bubble Pi - 5000 psi; Bii -1.355 RB/STB; Connate water saturation - 0.2; Bw cw - 3.6 * 10⁻⁶ psi⁻¹; cf - 5.0 * 10⁻⁶ pti - 5000 psi; Bii -1.355 RB/STB; Connate water saturation - 0.2; Bw cw - 3.6 * 10⁻⁶ psi⁻¹; cf - 5.0 * 10⁻⁶ pti - 5000 psi; Bii -1.350 RB/STB; Connate water saturation - 0.2; Bw cw - 3.6 * 10⁻⁶ psi⁻¹; cf - 5.0 * 10⁻⁶ pti - 5000 psi; Bii -1.350 RB/STB; Connate water saturation - 0.2; Bw cw - 3.6 * 10⁻⁶ psi⁻¹; cf - 5.0 * 10⁻⁶ pti - 5000 psi; Bii - 1.350 RB/STB; Connate water saturation - 0.2; Bw cw - 3.6 * 10⁻⁶ psi⁻¹; cf - 5.0 * 10⁻⁶ pti - 5000 psi - 1.4900 ac Initial pressure - 2710 psi; Initial Initial FVF - 1.340 RB/STB; Initial Reservoir pressure at the end of th Oil produced during the interval - Average produced GOR - 700 SCT Two-phase FVF at 2000 psi - 1.4900 Gas volume factor at 2000 psi - 0.0000 volume of water produced - 1.0500000000000000000000000000000000000	At Initial reservoir pressure of 3500 psi, formation volume factor is 1.572 RB/STB. At the depleted pressure and temperature of 2 is 900 SCF/STB, Z is 0.87, oil formatio cumulative production is 1.486 MM STB wi Calculate the initial stock tank oil in place an Derive an expression describing fractional fl in one dimension tilted reservoir block with Collowing is the data of immiscible displace Porosity - 20%; oil saturation – 65%; residu pay thickness - 5 zones of 1 m each; permeal Calculate: i. Fractional flow of water ii. Oil recovery by stile's method i Sa. Calculate original oil in place and hence saturated reservoir at abobe bubble point Pi - 5000 psi; B _{ii} -1.355 RB/STB; B _i at 360 Connate water saturation - 0.2; B _w at 360 Cw - 3.6 * 10 ⁻⁶ psi ⁻¹ ; cj - 5.0 * 10 ⁻⁶ psi ⁻¹ . Also calculate original oil in place and hence reservoir form the following data: Volume of bulk zone – 112000 ac-ft; Vol Initial pressure - 2710 psi; Initial gas vo Reservoir pressure at the end of the intervo Oil produced during the interval - 20 MM Average produced GOR - 700 SCF/STB; Two-phase FVF at 2000 psi - 1.4954 RB Gas volume factor at 2000 psi - 1.4954 RB Gas volume factor at 2000 psi - 0.08479 Volume of water encroached - 11.58 MM Volume of water produced - 1.05 MM ST . Derive an expression for production 'q' b bbl of oil by exponential decline analysis i. The decline percentage ii. The production rate in Jan 202 iii. The roumulative oil productior	At Initial reservoir pressure of 3500 psi, the gas formation volume factor is 1.572 RB/STB. At the depleted pressure and temperature of 2800 psi is 900 SCF/STB, Z is 0.87, oil formation voluu cumulative production is 1.486 MM STB with a gas Calculate the initial stock tank oil in place and the r Derive an expression describing fractional flow of v in one dimension tilted reservoir block with uniform OR Following is the data of immiscible displacement in Porosity - 20%; oil saturation – 65%; residual oils pay thickness - 5 zones of 1 m each; permeability of Calculate: i. Fractional flow of water ii. Oil recovery by stile's method if the water saturated reservoir at abobe bubble point form th Pi - 5000 psi; B _{ii} -1.355 RB/STB; B _i at 3600 - 1.04 c _w - 3.6 * 10 ⁻⁶ psi ⁻¹ ; c _f - 5.0 * 10 ⁻⁶ psi ⁻¹ . Also calculate original oil in place and hence the reservoir form the following data: Volume of bulk zone – 112000 ac-ft; Volume of Initial pressure - 2710 psi; Initial dissolved GO Initial FVF -1.340 RB/STB; Initial gas volume f Reservoir pressure at the end of the interval – 20 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 – 1.4954 RB/STB; Gas volume factor at 2000 psi – 1.05 MM STB; FVI Volume of water encroached - 11.58 MM bbl; Volume of water produced - 1.05 MM STB; FVI Volume of water produced - 1.05 MM STB; FVI OR a. Derive an expression for production 'q' bbl at tir bbl of oil by exponential decline analysis. b. Following is the oil production data recorded fro Month Jan Jul Dec Jul Year 2015 2015 2015 2016 Production (bbl) 1700 1511 1405 1240 Based on the exponential decline analysis estima i. The decline percentage ii. The cumulative oil production from J	At Initial reservoir pressure of 3500 psi, the gas-oil rat formation volume factor is 1.572 RB/STB. At the depleted pressure and temperature of 2800 psi and 90' is 900 SCF/STB, Z is 0.87, oil formation volume fact cumulative production is 1.486 MM STB with a gas oil rati Calculate the initial stock tank oil in place and the recovery Derive an expression describing fractional flow of water in in one dimension tilted reservoir block with uniform cross s OR Following is the data of immiscible displacement in a reser Porosity - 20%; oil saturation – 65%; residual oil saturation pay thickness - 5 zones of 1 m each; permeability of zones - Calculate: i. Fractional flow of water ii. Oil recovery by stile's method if the water bree section of 1 m each; permeability of zones - Calculate original oil in place and hence the recovery saturated reservoir at abobe bubble point form the follow P_i - 5000 psi; B_i -1.355 RB/STB; B_i at 3600 psi - 1.375 Connate water saturation - 0.2; B_w at 3600 - 1.04 RB/ST c_w - 3.6 * 10 ⁶ psi ⁻¹ ; c_f - 5.0 * 10 ⁶ psi ⁻¹ . Also calculate original oil in place and hence the recovery compressibilities. b. Calculate original oil in place and hence the recovery reservoir form the following data: Volume of bulk zone - 112000 ac-ft; Volume of bulk ga Initial pressure a 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 - 0.08479 ft ³ /STft ³ . Volume of water produced - 1.05 MM STB; FVF of wat OR a Derive an expression for production 'q' bbl at time 't' fr bbl of oil by exponential decline analysis. b. Following is the oil production data recorded from well Month Jan Jul Dec Jul Jan Year 2015 2015 2016 2017 Production (bbl) 1700 1511 1405 1240 1100 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	At Initial reservoir pressure of 3500 psi, the gas-oil ratio is 1 formation volume factor is 1.572 RB/STB. At the depleted pressure and temperature of 2800 psi and 90°F respet is 900 SCF/STB, Z is 0.87, oil formation volume factor is 1 cumulative production is 1.486 MM STB with a gas oil ratio of 33 Calculate the initial stock tank oil in place and the recovery factor. Derive an expression describing fractional flow of water in displac in one dimension tilted reservoir block with uniform cross sectiona OR Following is the data of immiscible displacement in a reservoir of 1 Porosity - 20%; oil saturation - 65%; residual oil saturation - 259 pay thickness - 5 zones of 1 m each; permeability of zones - 310, 18 Calculate: i. Fractional flow of water ii. Oil recovery by stile's method if the water break throu SECTION-C a. Calculate original oil in place and hence the recovery factor saturated reservoir at abobe bubble point form the following dat P_i - 5000 psi; B_{ii} -1.355 RB/STB; B_i at 3600 psi - 1.375 RB/STB Connate water saturation - 0.2; B_w at 3600 - 1.04 RB/STB; $W_p \cdot$ c_w - 3.6 * 10 ⁻⁶ psi ⁻¹ ; c_f - 5.0 * 10 ⁻⁶ psi ⁻¹ . Also calculate original oil in place and hence the recovery factor compressibilities. b. Calculate original oil in place and hence the recovery factor reservoir form the following data: Volume of bulk zone – 112000 ac-ft; Volume of bulk gas zone - Initial pressure - 2710 psi; linitial dissolved GOR - 562 SCF/S Initial FVF -1.340 RB/STB; Initiag as volume factor - 0.00626 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 - 0.484 RB/STB; Gas volume factor at 2000 psi - 0.484 RB/STB; Gas volume factor at 2000 psi - 0.08479 ft ³ /STft ³ . Volume of water encroached - 11.58 MM bbl; Volume of water encroached - 11.58 MM bbl; Volume of water encroached - 11.58 MM bbl; Volume of water encroached - 1.05 MM STB; FVF of water - 1.0 OR a. Derive an expression for	At Initial reservoir pressure of 3500 psi, the gas-oil ratio is 1100 SC formation volume factor is 1.572 RB/STB. At the depleted pressure and temperature of 2800 psi and 90°F respectively is 900 SCF/STB, Z is 0.87, oil formation volume factor is 1.520 R cumulative production is 1.486 MM STB with a gas oil ratio of 3300 SCF Calculate the initial stock tank oil in place and the recovery factor at 2800 Derive an expression describing fractional flow of water in displacement oi no edimension tilted reservoir block with uniform cross sectional area. OR Following is the data of immiscible displacement in a reservoir of 200 m 2 Porosity - 20%; oil saturation – 65%; residual oil saturation - 25%; mobi pay thickness - 5 zones of 1 m each; permeability of zones - 310, 187, 432. Calculate: i. Fractional flow of water ii. Oil recovery by stile's method if the water break through is in SECTION-C a. Calculate original oil in place and hence the recovery factor in a vo saturated reservoir at abobe bubble point form the following data at 360 P _l - 5000 psi; B _{ul} -1.355 RB/STB; B _l at 3600 psi - 1.375 RB/STB; N _p - Connate water saturation -0.2; B _w at 3600 - 1.04 RB/STB; W _p - 32,000 c _w - 3.6 * 10 ⁶ psi ⁻¹ ; c _f - 5.0 * 10 ⁻⁶ psi ⁻¹ . Also calculate original oil in place and hence the recovery factor negle compressibilities. b. Calculate original oil in place and hence the recovery factor in a reservoir form the following data: Volume of bulk zone - 112000 ac-ft; Volume of bulk gas zone - 19600 Initial pressure - 2710 psi; Initial dissolved GOR - 562 SCF/STB; Initial FVF -1.340 RB/STB; Initial gas volume factor - 0.006266 ft ³ /ST Reservoir pressure at the end of the interval - 2000 psi; Oil produced during the interval - 200 MS STB; Average produced GOR - 700 SCF/STB; Two-phase FVF 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/ Month Jan Jul Dec Jul Jan Jul Feb Year 2015 2015 2015 2016 2017 2017 2018	At Initial reservoir pressure of 3500 psi, the gas-oil ratio is 1100 SCF/STB formation volume factor is 1.572 RB/STB. At the depleted pressure and temperature of 2800 psi and 90°F respectively, the gas is 900 SCF/STB, Z is 0.87, oil formation volume factor is 1.520 RB/STB 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. Derive an expression describing fractional flow of water in displacement of oil by 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 Porosity - 20%; oil saturation - 65%; residual oil saturation - 25%; mobility rati pay thickness - 5 zones of 1 m each; permeability of zones - 310, 187, 432, 187 an Calculate : I. Fractional flow of water ii. Oil recovery by stile's method if the water break through is in 2 nd lay SECTION-C a. Calculate original oil in place and hence the recovery factor in a volumetrix saturated reservoir at abobe bubble point form the following data at 3600 psi: P _i - 5000 psi; B _i - 1.355 RB/STB; B _i at 3600 - 1.04 RB/STB; W _p - 32,000 STB; C _w - 3.6 * 10° psi ⁻¹ ; C _f - 5.0 * 10° psi ⁻¹ . Also calculate original oil in place and hence the recovery factor neglecting for compressibilities. b. Calculate original oil in place and hence the recovery factor in a combir reservoir form the following data: Volume of bulk zone – 112000 ac-ft; Volume of bulk gas zone – 19600 ac-ft; Initial pressure - 2710 psi; I; Initial dissolved GOR – 562 SCF/STB; Initial PF + 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 – 200 MM STB; Average produced GOR - 700 SCF/STB; Two-phase FVF at 2000 psi - 0.008479 ft ³ /STft ³ . Volume of water produced - 1.05 MM STB; FVF of water - 1.028 RB/STB. OR a. Derive an expression for production 4' bibl at time 't' from well in	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°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. 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 SECTION-C 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 _{ii} -1.355 RB/STB; B _i at 3600 = 1.04 RB/STB; W _p - 32,000 STB; W _e - 0; c _w - 3.6 * 10° psi ⁻¹ ; c _y - 5.0 * 10° psi ⁻¹ . Also calculate original oil in place and hence the recovery factor neglecting formation compressibilities. b. Calculate original oil in place and hence 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 pressure - 2710 psi; Initial 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 - 200 MSTB; Average produced GOR - 700 SCF/STB; Ini	At Initial reservoir pressure of \$200 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°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. 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 SECTION-C 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 3600 psi: P ₁ - 5000 psi; B _n - 1.355 RB/STB; B _n 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; e _w - 3.6 t 10° psi ¹ ; - 2.0 s [±] 10° psi ¹]. Also calculate original oil in place and hence 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 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 - 2000 MSTB; Volume of water encroaked - 11.58 MM bbl; Volume of water encroaked - 11.58 MM bbl; Volume of water encroaked - 11.58 MM bbl; Volume

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