Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Production Engineering **Semester: 5**
Programme: B.Tech APE gas **No. of Pages: 3**
Time: 03 hrs. **Max. Marks: 100**
Instructions: Scientific calculator usage is allowed

SECTION A 4*5=20

S.No		Marks	CO
Q 1	List various factors affecting the performance of well perforators	5	CO-1
Q 2	Explain in brief various types of formation damage during drilling and workover operations.	5	CO-2
Q 3	List various TPR models available for multiphase flow through wells	5	CO-3
Q 4	A sucker rod pump unit is rated as *C-229D-198-74*. Explain the significance of each term.	5	CO-4
SECTION B 4*10=40			
Q 5	A sandstone reservoir with porosity 20% containing 10% (by volume) $CaCO_3$ is to be acidized with HCl /HF mixture solution. A preflush of 15% HCl solution is to be injected ahead of the mixture to dissolve the carbonate minerals and establish a low pH environment. We have to remove all the carbonate in a region within 1 ft. beyond a 0.328 ft. radius wellbore, before the HCl/HF stage enters the formation. Specific gravity of HCL is 1.07. Density of $CaCO_3$ is 169 lb/ft^3 : - Calculate the minimum preflush volume of HCL required in gallon per ft. in the payzone?	10	CO-1
Q 6	(a) An oil well of wellbore radius 0.328 ft. drains from an area having drainage radius 2800 ft. and permeability of 20 mD. Calculate the well's skin factor due to formation damage at 5 feet distance from center of the wellbore with skin permeability of 16 mD. (b) Assume that this well has been fracture treated and a negative pseudo skin factor has been created: S_f = -5. By what factor will the Productivity Index increase with respect to the damaged well?	10	CO-2
Q 7	Construct Inflow Performance Relationship diagram of a vertical well in an under-saturated oil reservoir using generalised Vogel's equation. Following data is given: Porosity: 19%; Permeability: 8.2 mD; Pay zone thickness: 53 ft; Reservoir pressure: 5651 psi; Bubble point pressure: 3000 psi; B_o : 1.1 bbl/STB; Oil viscosity: 1.7 cP; C_t :0.0000129 psi^{-1}; Drainage area of the reservoir is 640 acres; Wellbore radius: 0.328 ft; Skin factor: zero; Assume pseudo steady state flow of oil.	10	CO-3
Q 8	A pump with 1 ¾″ plunger and ¾″ steel rod (spec: 1.63 lb/ft) is set at 4560 ft. The modulus of elasticity of steel is $30*10^6$ psi. The fluid level is low and tubing is anchored. The pump is operated at 20 SPM with a stroke length of 64″ producing 335 bpd of oil (specific gravity of oil = 0.87). Calculate	10	CO-4

	a. Maximum and minimum polished rod loads (4 marks) b. Effective plunger stroke length (3 marks) c. Volumetric pump efficiency (3 marks) **OR** Explain in detail the operation of intermittent gas lift in three different stages: -		
	SECTION-C 2*20=40		
Q 9	(a) Following data is given for a saturated oil reservoir: Average reservoir pressure : 3000 psi Test 1 data: Flowing bottom hole pressure : 2000 psi Flow rate: 500 bpd Test 2 data: Flowing bottom hole pressure : 1000 psi Flow rate: 800 bpd Construct IPR diagram of the well using Fetkovich's method. (b) Elaborate with suitable diagram various flow regimes obtained during vertical flow of produced reservoir fluids **OR** (a) Consider an oil reservoir producing at an average reservoir pressure P_r =2400 psi. The reservoir pressure is less than bubble point pressure. A single-point flow test conducted on a well at stabilized condition resulted in q=500 bbl/day and P_{wf} =250 psi. Measured GOR is 400 scf/stb. The well having total depth of 7000 feet is produced through 2.375-inch tubing. The additional data given is Flow Efficiency = 0.7 Compute the AOFP when the skin effect is removed (i.e. FE=1.0)? (b) Derive Poettmann Carpenter correlation for vertical lift performance: -	**12+8** **10*2**	**CO-3**
Q 10	(a) What are the three main types of gas-lift installation technique? Explain. What type of installation would you recommend for the wells specified in the following table?	**10+5+5**	**CO-4**

Well	Depth (ft.)	Productivity Index	Separator pressure (psig)	Fluid gradient (psi/ft.)	Static BHP (psig)
A	7000	10	50	0.5	3000
B	2200	0.1	10	0.35	250
C	5000	2	30	0.4	200
D	6000	0.02	100	0.35	2500

E	1500	0.5	10	0.33	65
F	500	0.1	0	0.33	10

(b) A 10,000-ft-deep well having oil with density 7.20 ppg, is to be produced at a flowing bottom hole pressure of 2300 psi with an ESP. The average reservoir pressure is 4350 psi. The well is equipped with 2 7/8-in. tubing. The surface tubing pressure is 100 psi, and 7 in. casing is used for production. The pump is set at 9800 ft. Calculate the pump suction pressure (in psi) required to produce oil.

(c) A casing pressure operated gas lift value is installed at a depth of 1500 m and the bellow pressure of this value is 60 x 10^5 N/m^2 under operating conditions. The tubing pressure is 40 x 10^5 N/m^2 at the valve depth. The area of the bellow and the port are 8 and 0.8 cm^2 respectively. Calculate the opening pressure of the gas lift valve in N/m^2
(write answer up to one decimal place)

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Programme	:	**B.Tech APE gas**					
Semester	:	**5**					
Name of the Course	:	**Production Engineering**					
Course Code	:	**PTEG 328**					
Name of Question Paper Setter	:	**Amit Verma.**					
Employee Code	:	**40001668**					
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Note: Please mention additional Stationery to be provided, during examination such as Table/Graph Sheet etc. else mention "NOT APPLICABLE": **Graph sheet**							
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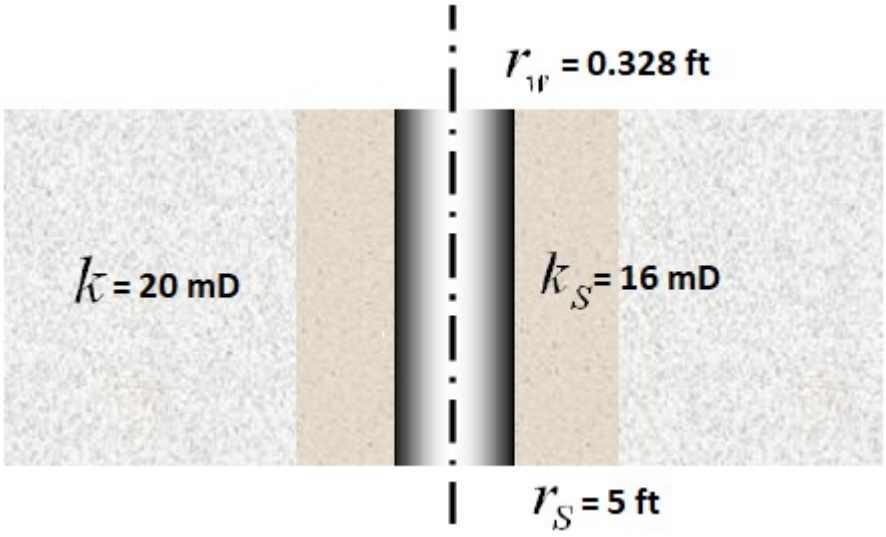
S.No		Marks	CO
Q 1	List various well activation methods: -	**5**	**CO-1**
Q 2	 From the above figure find out the ratio of wellbore radius to effective wellbore radius.	**5**	**CO-2**
Q 3	Define *sonic flow* through choke. State the expression for critical pressure ratio through choke	**5**	**CO-3**
Q 4	Assume a casing pressure operated valve is located at 7500 ft. The pressure in the dome is 750 psi at 9000 ft. Find the maximum limit of casing pressure required to close the valve, if area of bellows = 1.5 sq. in. and area of port = 0.3 sq. in.	**5**	**CO-4**
	SECTION B 4*10=40		
Q 5	Explain in detail the 3 different stages involved in hydraulic fracturing job and additives used in fracturing fluid: -	**10**	**CO-1**
Q 6	(a) An oil well of wellbore radius 0.328 ft. drains an area of radius 2800 ft. with permeability of 20 mD. Calculate the well's skin factor due to damage to a penetration distance of 5 feet (from center of the wellbore) with skin permeability of 16 mD. (b) Assume that this well has been fracture treated and a negative pseudo skin factor has been created: Sf = -5. By what factor will the Productivity Index increase with respect to the damaged well?	**10**	**CO-2**
Q 7	Explain nodal analysis of oil and gas well. Perform nodal analysis for an oil well using bottom-hole and well head nodes respectively as solution node **OR** Derive an expression for flowrate of multiphase reservoir fluid through a well located in single phase oil reservoir when the flowing bottom hole pressure below bubble point	**10**	**CO-3**

	of the fluid postulated by Vogel.		
Q 8	Design standard casing pressure operated gas lift valve using the following data: Depth of valve = 8000 ft; Surface operating gas pressure = 800 psia; Surface opening pressure = 800 psia; Specific gravity of injection gas = 0.7; Temperature at surface = 100°F; Temperature at 8000 ft = 180°F. Pressure in tubing at valve location = 655 psia Valve size = standard 1 1/2 " diameter; Port size = 1/2 " diameter (A_p/A_b = 0.2562) Valve charge with Nitrogen at 60°F in shop and spring with S_t = 600 psia Find: a. Opening pressure at valve depth, b. Closing pressure at valve depth, c. Tubing effect factor, d. Test rack opening pressure of thevalve, e. Valve Spread	**10**	**CO-4**
	SECTION-C 2*20=40		
Q 9	(a)The following production data has been reported for an oil producing well Reservoir pressure = 4000 psia; oil flow rate = 400 STB/day; flowing bottomhole pressure = 3000 psia; bubble point pressure = 2000 psia. Calculate (1) Maximum possible oil production rate (2)Oil production rate at a flowing bottom hole pressure of 1000 psia (b) A 0.6 specific gravity gas with a viscosity of 0.0125 cp flows from a 2-in. pipe through a 1-in. orifice-type choke. The upstream pressure and temperature are 800 psia and 75°F, respectively. The downstream pressure is 200 psia (measured 2 ft from the orifice). The gas-specific heat ratio is 1.3. Assume C_D = 0.62. What is the expected daily flow rate? What is the expected pressure at the orifice outlet?	**20**	**CO-3**
Q 10	(a) Explain with a neat diagram the working of electrical submersible pumps. (b) Design the gas lift valves for the following gas injection data: Depth = 8000 ft; Desired rate = 1000 bbl/d (100% oil); Tubing size 2 " O.D. (1.995" ID); Flowing well-head pressure = 100 psig (Pwh); Static bottom hole pressure = 2650 psig (PR); Flowing gradient = 0.541psi/ft; Productivity index = 2 (assume constant); Solution gas-oil ratio = 200 scf/B (Rs); Specific gravity of injection gas = 0.70 (γg); Surface operating pressure = 900 psig (Pso); °API = 40; Bottom hole temperature = 200°F; Flowing surface temperature = 120°F; Kick-off pressure = 950 psi; Well 'kill' fluid gradient = 0.5 psi/ft **OR** (a) Classify various artificial lift techniques used to improve oil recoveries. Explain each in brief with working principle.	**20**	**CO-4**

	(b) A pump with 1 ¾″ plunger is set at 4560 ft of ¾″ rod weighing 1.63 lb/ft with modulus of elasticity is $30*10^6$. The fluid level is known to be low and tubing is anchored. The pump is operated at 20 SPM with a stroke length of 64″ producing 335 BPD of oil (γ_o=0.87). Calculate a. Maximum and minimum polished rod loads b. Effective plunger stroke length c. Counter balance load d. Theoretical pump displacement and volumetric efficiency of pump		