SET-A

Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Course: Production Engineering and Well Testing & Analysis **Semester: IInd**

Program: M.Tech (Petroleum Engineering) **Time 03 hrs.**

Course Code: PEAU 7006 **Max. Marks: 100**

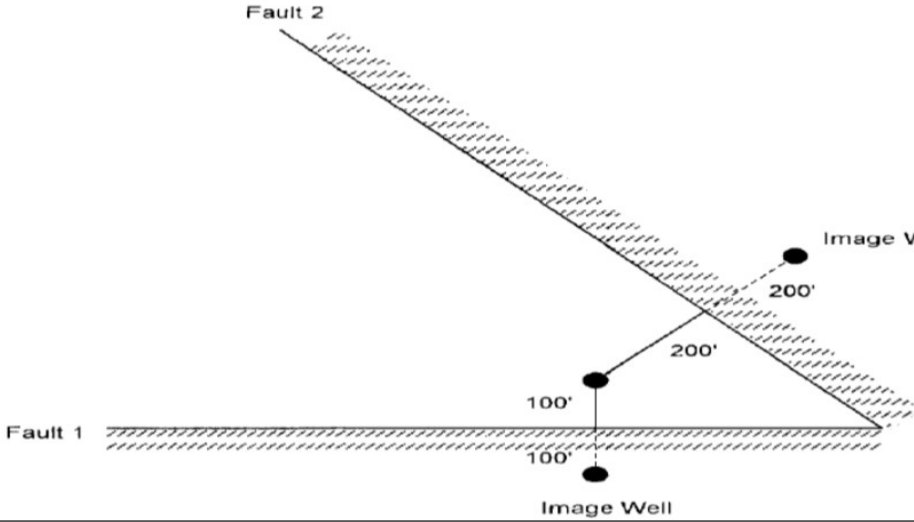
Instructions: All the questions are compulsory.

SECTION A

S. No.	Questions	Marks	CO
Q 1	A 0.5 ft. diameter hole has a damaged region 4ft. deep. The permeability in this region is one tenth that of the undamaged region. Estimate skin effect and effective wellbore radii.	**4**	**CO3**
Q 2	Construct IPR curve for given problem: Given data: $\acute{P}_r$= 2600 psi; P_{wf}= 1900 psi; q_o= 150 bpd Find: (q¿¿o)max¿ and q_o for P_{wf} = 1100 psi	**4**	**CO1**
Q 3	Illustrate the causes of sand production. Write the methods for control sand production.	**4**	**CO2**
Q 4	Differentiate between carryover and blowby for the storage of oil and gas.	**4**	**CO2**
Q 5	Illustrate how a typical Drill Stem Test is performed. Prepare and examine a schematic chart of pressure vs. time from a test with two flow periods and two shut in periods.	**4**	**CO4**

SECTION B

S. No.	Questions	Marks	CO
Q 6	Figure shows a well located between two sealing faults at 200 and 100 feet from the two faults. The well is producing under a transient flow condition at a constant flow rate of 200 STB/day. The following additional data is available: B =1.1 bbl/STB; μ = 2.0 cp; r_w = 3.0 ft; Ct = 25×10^{-6} psi^{-1}; k = 60 md; Φ = 17%; h = 25 ft; P_i = 5000 psi; Ei (0.537) = 0.514; Ei (2.15) = 0.0476. Calculate the sand face pressure after 10 hours.	**10**	**CO3**

			
Q 7	A new oil well with an infinite acting boundary produced 500 STB/D for 3 days, it then was shut in for a pressure buildup test, during which the following data were recorded. If the wellbore radius, r_w is 0.3 ft; net sand thickness, h is 22 ft; formation volume factor, B_o is 1.3 RB/STB; porosity, ϕ is 0.2; total compressibility, C_t is 20 × 10^{-6} psi^{-1}; and oil viscosity, μ_o is 1.0 cp. estimate Formation Permeability and Skin Factor.	**10**	**CO4**
Q 8	What are the parameters affecting the separation process of oil and gas. Describe the working procedure of vertical heater-treater with suitable diagram.	**10**	**CO2**
Q 9	Estimate the oil permeability, skin factor and additional pressure drop due to the skin from the following drawdown data: h = 130ft., ϕ = 20%, r_w = 0.25ft., p_i = 1154 psi, q_o = 348 stb/d, m = -22 psi/cycle, B_o = 1.14 bbl/STB, μ_o = 3.93 cp, C_t = 8.74 × 10^{-6} psi^{-1}, p_{1hr} = 954 psi. Assuming that the wellbore storage effect is not significant. **OR** Using Fetkovich's equation plot the IPR curve for a well in which Pi is 2500 psia and $J_i^{'}$ is 5 × 10^{-4} stb/day-psi^2. Predict the IPRs of the well at well shut in static pressures of 2000 and 1500 psia.	**10**	**CO5** **CO1**
SECTION-C			
Q 10	Predict the operating point to use an artificial lift in the gas well with the help of Nodal analysis graph. Data are given below: Gas specific gravity (γ_g) = 0.71, tubing inside diameter (D) = 2.259 in., tubing relative roughness (e/D) = 0.0006, Measured depth at tubing shoe (L) = 10000 ft., Inclination angle (θ) = 0 degrees, Wellhead pressure (p_{hf}) = 800 psia, Wellhead temperature (T_{hf}) = 150 °F, Bottom-hole Temperature (T_{wf}) = 200 °F, Reservoir Pressure = 2000 psia, C-constant in back pressure IPR model = 0.01 Mscf/d-psi^{2n}, n-exponent in back pressure IPR model = 0.8, Avg. temperature (T_{av}) = 635 °R, compressibility factor (Z_{av}) = 0.8626, skin factor (s) = 0.4861, moody friction factor (f_m) = 0.0174, absolute open flow (AOF) = 1912.705 Mscf/d.	**20**	**CO1**

Q 7 data:

Shut-in Time, Δt (hrs.)	0	2	4	8	16	24	48
P_{ws} (psig)	1150	1794	1823	1850	1876	1890	1910

Q 11	Explain Ramey's type curve, Mckinley's type curve and Gringarten et al. type curve. Also write the uses of these type curves. **OR** A constant-rate pressure drawdown test was run in a well with the following characteristics: $q = 250$ STB/D (constant); $\Phi = 0.039$; $\mu = 0.8$cp; $C_t = 17 \times 10^{-6}$ psi^{-1}; $r_w = 0.198$ ft; $h = 69$ ft; $B_o = 1.136$ RB/STB; $A_{wb} = 0.0218$ sq ft; $\rho = 53$ lb/cu ft. From the test data in the following table, estimate formation permeability, skin factor, Liquid/gas interface and wellbore storage duration.	20	CO5

***t*, hrs**	***P_{wf}*, psia**	***t*, hrs**	***P_{wf}*, psia**	***t*, hrs**	***P_{wf}*, psia**	***t*, hrs**	***P_{wf}*, psia**
0	3000	0.164	2693	3.28	1712	38.2	1533
0.0109	2976	0.218	2611	3.82	1696	43.7	1525
0.0164	2964	0.273	2536	4.37	1684	49.1	1517
0.0218	2953	0.328	2469	4.91	1674	54.6	1511
0.0273	2942	0.437	2352	5.46	1665	65.5	1500
0.0328	2930	0.491	2302	6.55	1651	87.4	1482
0.0382	2919	0.546	2256	8.74	1630	109.2	1468
0.0437	2908	1.09	1952	10.9	1587	163.8	1440
0.0491	2897	1.64	1828	16.4	1568	218.4	1416
0.0546	2886	2.18	1768	27.3	1554	273.0	1393
0.109	2785	2.73	1734	32.8	1543	327.6	1370

SET-B

Name: **Enrolment No:**	UPES — UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Course: Production Engineering and Well Testing & Analysis **Semester: II**nd

Program: M.Tech (Petroleum Engineering) **Time 03 hrs.**

Course Code: PEAU 7006 **Max. Marks: 100**

Instructions: All the questions are compulsory.

SECTION A

S. No.	Questions	Marks	CO
Q 1	Explain the procedure of Drill Stem Test. Prepare and examine a schematic chart of pressure vs. time from a test with two flow periods and two shut in periods.	**4**	**CO4**
Q 2	In a well test analysis by Ramey's Type curve, a "match point" is obtained from the actual graph of log (ΔP) vs log t and Ramey's type curve of log P_D vs log t_D. Corresponding to the "match point" following data are obtained: $(\Delta P)_{MP}$ = 100 psig, $(P_D)_{MP}$ = 0.85, $(t)_{MP}$ = 1 and $(t_D)_{MP} = 1.93 \times 10^4$. Other reservoir properties are: OFVF (B_o) = 1.2 bbl/STB, viscosity (μ_o) = 0.8 cp, total compressibility (c_t) = 10×10^{-6} psi^{-1}, thickness (h) = 56 ft, initial reservoir pressure (p_i) = 3000 psi, flow rate (q) = 500 STB/day and wellbore radius (r_w) = 0.3 ft Calculate the permeability and porosity of the reservoir $\left[P_D=\frac{0.00708\,kh(P_i-P_{wf})}{q\mu B_0} \wedge t_D=\frac{0.0002637\,kt}{\varnothing \mu C_t r_w^2}\right]$	**4**	**CO3**
Q 3	What are the well stimulation jobs applicable to enhanced oil production and why do we need to perform well stimulation jobs?	**4**	**CO2**
Q 4	Classify the separators used in oil industry. What are parameters affects the separation process during oil and gas separation?	**4**	**CO2**
Q 5	A 12 inch diameter hole has a stimulated region 48 inch deep. The permeability in this region is one tenth that of the undamaged region. Estimate skin effect and effective wellbore radii.	**4**	**CO3**

SECTION B

S. No.	Questions	Marks	CO
Q 6	A new oil well with an infinite acting boundary produced 800 STB/D for 3 days, it then was shut in for a pressure buildup test, during which the following data were recorded. If the wellbore radius, r_w is 0.3 ft; net sand thickness, h is 22 ft; formation volume factor, B_o is 1.3 RB/STB; porosity, ϕ is 0.2; total compressibility, C_t is $20 \times 10^{-6} psi^{-1}$; and oil viscosity, μ_o is 1.0 cp. estimate Formation Permeability and Skin Factor.	**10**	**CO4**

Shut-in Time, Δt (hrs.)	0	2	4	8	16	24	48
P_{ws} (psig)	1150	1794	1823	1850	1876	1890	1910

Q 7	Predict future IPR curves for given problem. Given data: 45 - acre spacing. Residual oil saturation = 16% J = 0.90. Interstitial water saturation = 21% q = 500bpd $\bar{P}_r$ = 2500 psig	**10**	**CO1**

Parameters	Present	Future
$\bar{P}_r$	2500 psig	2100 psig
P_{wf}	1200 psig	-
μ_o at $\bar{P}_r$	3.12 cp	3.60 cp
B_o at $\bar{P}_r$	1.273	1.250
Avg. oil saturation	0.868	0.841
K_{ro}	0.805	0.625

Q 8	Differentiate between carryover and blowby for the storage of oil and gas. Describe the working procedure of horizontal heater-treater with suitable diagram.	**10**	**CO2**

Q 9 (**10**, **CO5 CO1**)

A constant rate drawdown test was run in a well with following characteristics: wellbore radius (r_w) = 0.198 ft, total compressibility (c_t) = 17×10^{-6} psi^{-1}, Oil compressibility ($c_0 ¿= 10\times10^{-6}$ psi^{-1}, production rate (q_o) = 250 STB/D, thickness (h) = 69 ft, viscosity (μ_o) = 0.8 cp, porosity (φ) = 0.039, OFVF (B_o) = 1.136 bbl/STB, initial reservoir pressure P_i = 4412 psia. The Annulus cross-sectional area is 0.0218 sq ft, the density of the fluid in the wellbore is 53 lbm/cu ft and volume of the fluid in wellbore is 200 bbl. The wellbore has falling liquid/gas interface.

Following data are obtained from semi-logarithmic plot of flowing BHP (P_{wf}) vs time (t): Slope of middle time region (MTR) = 70 psi/cycle and pressure at one hour (P_{1h}) = 3652 psia.

Calculate: (i) Formation permeability (ii) Skin factor (iii) Pressure drop due to skin (iv) Time to end wellbore storage effect

$$\left(t_{wbs} = \frac{(200000 + 12000\, s)\, C_s}{\frac{kh}{\mu}},\ where\ C_s\ is\ wellbore\ storage\ constant \right)$$

OR

A 1640 ft long horizontal well is drilled in the lowest zone of an oil reservoir. The reservoir has a gas cap. Calculate critical oil production rates for horizontal and vertical wells using Joshi Method. The well is placed at 160 acres well spacing. The vertical well is perforated in the bottom 8 ft. to minimize gas coning.

The following data are given:

$K_h = k_v$ = 70 md, h = 80 ft., $2X_e$ = 2640 ft., B_o = 1.1 RB/STB, μ_o = 0.42 cp, r_w = 0.328 ft., $\rho_o - \rho_g$ = 0.48 gm/cc, h_p = 8 ft. for vertical wells.

SECTION-C

Q 10	Explain Ramey's type curve, Mckinley's type curve and Gringarten et al. type curve. Also write the uses of these type curves.	**20**	**CO5**

Q 11 (**20**, **CO1**)

Derive an expression for determining future IPR with the help of Fetkovich's method with proper assumptions. Using Fetkovich's method, plot the IPR curve for a well in which P_i is 3000 psia and $J_o^i = 4 \times 10^{-4}$ stb/day-psia^2. Predict the IPRs of the well at well shut in static pressures of 2500 psia, 2000 psia, 1500 psia and 1000 psia.

OR

Predict the operating point to use an artificial lift in the gas well with the help of Nodal analysis graph. Data are given below:

Gas specific gravity (γ_g) = 0.71, tubing inside diameter (D) = 2.259 in., tubing relative roughness (e/D) = 0.0006, Measured depth at tubing shoe (L) = 10000 ft., Inclination angle (θ) = 0 degrees, Wellhead pressure (p_{hf}) = 800 psia, Wellhead

	temperature (T_{hf}) = 150 °F, Bottom-hole Temperature (T_{wf}) = 200 °F, Reservoir Pressure = 2000 psia, C-constant in back pressure IPR model = 0.01 Mscf/d-psi^{2n}, n-exponent in back pressure IPR model = 0.8, Avg. temperature (T_{av}) = 635 °R, avg. compressibility factor (Z_{av}) = 0.8626, skin factor (s) = 0.4861, moody friction factor (f_m) = 0.0174, absolute open flow (AOF) = 1912.705 Mscf/d.		