Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

END Semester Examination, May 2019

Programme Name: B.Tech., APE UP **Semester : VI**
Course Name : Well Log Analysis and Well Testing **Time : 03 hrs**
Course Code : PTEG 323 **Max. Marks : 100**
Nos. of page(s) : 2

Instructions: Answer All Questions

SNo	SECTION A	Marks	CO
Q 1	Illustrate the typical relative resistivity conditions expected in wire line logging through oil-saturated, permeable sandstone formation invaded by fresh mud filtrate.	5	CO1
Q 2	Enumerate the uses of Neutron Density Log.	5	CO2
Q 3	A well with 0.198 ft radius produced 250 STB/D of oil for an effective time of 13,630 hours and indicated a skin factor, S of 6.37 in a pressure build-up test. Estimate the effective well bore radius, r_{wa}.	5	CO3
Q 4	A flow test run on an exploratory well for a period of 75.8 hours suggests the following data: k = 100 md; Φ =0.2; C_t = 2x10-5 psi^{-1}; and μ = 0.5 cp. Estimate the radius of investigation.	5	CO4
	SECTION B		
Q 5	Following is the is data gathered form electrical log operation in clean sand stones: R_m = 1.6 Ω-m; R_w = 0.16 Ω-m; R_{mc} = 1.57 Ω-m; R_{mf} = 1.33 Ω-m; $R_{induction}$ =23 Ω-m; R_{xo} = 25.08 Ω-m. Calculate the porosity and water saturation of the formation if the residual oil saturation in the flushed zone is 30%.	10	CO1
Q 6	Demonstrate with neat diagram the working principle of Formation Density log tool.	10	CO2
Q 7	A well located in a reservoir of 3000 ft is producing oil at a constant rate of 200 STB/Day. The following is the data describing well abd formation: μo = 0.72cp; Bo = 1.475 RB/STB; k = 0.1 md; Ct = 1.5*10-5/psi; rw = 0.5ft; h = 150ft; Φ = 0.23; Pi = 3000psi; S=0. Calculate the reservoir pressure at a radius of 1 ft after 3 hours of production.	10	CO3
Q 8	Estimate the skin factor from the following data available from a gas well pressure buildup test. T = 199°F = 659°R; h = 34 ft; μ = 0.023 cp; S_W = 0.33 (water is immobile); C_t = 0.000315 psi^{-1}; Φ = 0.22; Z = 0.87; and r_w = 0.3 ft. The well produced 6,068 Mcf/D before the test. A plot of BHP P_{ws} vs. log $(t_p+\Delta t)/\Delta t$ gave a middle-time line with a slope of 66 psi/cycle. Analysis of the buildup curve showed that static drainage-area pressure was 3,171 psia. Pressure on the middle-time line at Δt = 1 hour, $P_{1\ hr}$, was 2,745 psia and flowing pressure at shut-in, p_{wf}, was 2,486 psia. **OR** Explain in detail about the Iso-Chronal test for gas wells.	10	CO4
	SECTION-C		
Q 9	Derive for the diffusivity equation describing the one-dimensional flow of slightly compressible fluid with a constant compressibility, C_t and viscosity, μ through an iso-tropic	20	CO3

	radial porous medium with constant pore volume. **OR** 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. **Time after shut-in, Δt (hrs)** 0 2 4 8 16 24 48 **P_{ws} (psig)** 1,150 1,794 1,823 1,850 1,876 1,890 1,910 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}; and oil viscosity, μ_o is 1.0 cp, then, estimate the formation permeability, k: the skin factor, S: and the initial reservoir pressure, Pi.		
Q10	A Flow-After-Flow test in a gas well reported the following data. **P_{wf} (psig)** 403 394 379 363 **q_g (MMscf/D** 4.288 9.265 14.552 20.177 At each rate, pseudo-steady state was reached. Initial shut-in bottom hole pressure was determined to be 408 psi. Estimate the Absolute Flow Potential (AOF) of the tested well using (a) the empirical plot method and (b) the theoretical flow equation method	**20**	**CO4**

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Instructions: Answer All Questions

SNo	SECTION A	Marks	CO
Q 1	Illustrate the typical relative resistivity conditions expected in wire line logging through water-saturated, permeable sandstone formation invaded by fresh mud filtrate.	5	CO1
Q 2	Enumerate the uses of Gamma Ray Log.	5	CO2
Q 3	From the following production data calculate pseudo-producing time, t_p by Horner's approximation. **Production Time (hours)**: 25, 12, 26, 72 **Total Production (STB)**: 52, 0, 46, 68	5	CO3
Q 4	A flow test run on an exploratory well for a period of 75.8 hours suggests the following data: k = 100 md; Φ =0.2; C_t = 2x10-5 psi^{-1}; and μ = 0.5 cp. Estimate the radius of investigation.	5	CO4
	SECTION B		
Q 5	Following is the is data gathered form electrical log operation in clean sand stones: R_m = 1.6 Ω-m; R_w = 0.16 Ω-m; R_{mc} = 1.57 Ω-m; R_{mf} = 1.33 Ω-m; $R_{induction}$ =23 Ω-m; R_{xo} = 25.08 Ω-m. Calculate the porosity and water saturation of the formation if the residual oil saturation in the flushed zone is 30%.	10	CO1
Q 6	Demonstrate with neat diagram the working principle of Drill Stem Testing (DST).	10	CO2
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. **Time after shut-in, Δt (hrs)**: 0, 2, 4, 8, 16, 24, 48 **P_{ws} (psig)**: 1,150, 1,794, 1,823, 1,850, 1,876, 1,890, 1,910 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 20x10^{-6}/psi; and oil viscosity, μ_o is 1.0 cp, then, estimate the initial reservoir pressure, Pi.	10	CO3
Q 8	Explain in detail about the Iso-Chronal test for gas wells. **OR** Estimate skin factor from the following data available from a gas well pressure buildup test. T = 199°F = 659°R; h = 34 ft; μ = 0.023 cp; S_W = 0.33 (water is immobile); C_t = 0.000315 psi^{-1}; Φ = 0.22; Z = 0.87; and r_w = 0.3 ft. The well produced 6,068 Mcf/D before the test. A plot of *BHP* P_{ws} vs. log $(t_p+\Delta t)/\Delta t$ gave a middle-time line with a slope of 66 psi/cycle.	10	CO4

	Analysis of the buildup curve showed that static drainage-area pressure was 3,171 psia. Pressure on the middle-time line at Δt = 1 hour, $P_{1\,\mathrm{hr}}$, was 2,745 psia and flowing pressure at shut-in, p_{wf}, was 2,486 psia.		
	SECTION-C		
Q 9	Derive for the diffusivity equation describing the flow of slightly compressible fluid with a constant compressibility C_t and viscosity μ through an iso-tropic three-dimensional cartesian porous medium with constant pore volume. **OR** The following data were recorded during constant-rate pressure drawdown test of a well located within infinite acting boundaries. The wellbore had a falling liquid/gas interface throughout the drawdown test.	**20**	**CO3**

t (hrs)	Pwf (psia)	t (hrs)	Pwf (psia)	t (hrs)	Pwf (psia)	t (hrs)	Pwf (psia)	t (hrs)	Pwf (psia)
0	4412	5.78	3607	20.7	3561	61.8	3526	185	3490
0.12	3812	6.94	3600	24.9	3555	74.2	3521	222	3481
1.94	3699	8.32	3593	29.8	3549	89.1	3515	266	3472
2.79	3653	9.99	3586	35.8	3544	107	3509	319	3460
4.01	3636	14.4	3573	43.0	3537	128	3503	383	3446
4.82	3616	17.3	3567	51.5	3532	154	3497	460	3429

Other pertinent data include, q = 250 STB/D; B = 1.136 bbl/STB; μ = 0.8 cp; r_w = 0.198 ft; h = 69 ft; Φ = 0.039, and C_t = 17x10^{-6} psi^{-1}. The tubing area is 0.0218 sq ft and the density of the liquid in the wellbore is 53 lbm/cu ft. Determine the formation permeability, k and the skin factor, S.

Q10	A Flow-After-Flow test in a gas well reported the following data. **P_{wf} (psig)** 403 394 379 363 **q_g (MMscf/D** 4.288 9.265 14.552 20.177 At each rate, pseudo-steady state was reached. Initial shut-in bottom hole pressure was determined to be 408 psi. Estimate the Absolute Flow Potential (AOF) of the tested well using (a) the empirical plot method and (b) the theoretical flow equation method	**20**	**CO4**