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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

MAKE UP EXAMINATION - JULY 2024

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| **Semester : V& VI** | **Date :11.07.2024** |
| **Course Code : PET2019** | **Time : 9.30AM TO 12.30PM** |
| **Course Name : Oil and Gas Well Test Analysis** | **Max Marks : 100** |
| **Program: B.Tech. in Petroleum Engineering** | **Weightage : 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 2M=10M** | | | |
| 1 | Write down the mathematical formula for Darcy’s law describing all terms with field units. Also, state assumptions for Darcy’s Law. | (CO 1) | [Knowledge] |
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| 2 | Define Skin factor. Write down its mathematical expression. | (CO 2) | [Knowledge] |
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| 3 | Define pseudo-steady state flow with respect to petroleum reservoir. | (CO 1) | [Knowledge] |
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| 4 | Describe the effective wellbore radius. | (CO 1) | [Knowledge] |
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| 5 | Describe two-rate test. | (CO 3) | [Knowledge] |
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| 6 | Describe the significance of exponent "n" in back pressure equation. | (CO 4) | [Knowledge] |
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| 7 | Write down the diffusivity equation for slightly compressible fluid. Also, list assumptions of diffusivity equation for slightly compressible fluid. | (CO 4) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 8 | As a reservoir engineer, discuss the insights and comments regarding the pressure drawdown plot for various reservoirs, highlighting the distinct characteristics and regions shown on the graph (Region 1, 2, 3, C1, C2, S1, S2, S3, P, Q, and R). Explain how these plots provide crucial information about reservoir behavior, aiding operators in optimizing production strategies, improving recovery efficiency, and planning future reservoir management. | (CO 2) | [Comprehension] |
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| 9 | As a petroleum engineer, you've noticed two distinct flow rates in the figure, which are crucial for conducting precise pressure build-up tests. Establish the mathematical adjustment you would recommend to the ideal pressure build-up test formula for these varying flow rates. | (CO 3) | [Comprehension] |
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| 10 | Pressure Build-Up Test is a fundamental method in well testing that provides essential insights into reservoir properties and well performance. Discuss Pressure Build-up Test and its significance in well test analysis. | (CO 1) | [Comprehension] |
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| 11 | As a Petroleum Engineer, you've been furnished with the following attributes of a well and reservoir. Specifically, the well exclusively yields oil and it is producing at a constant rate of 20 barrels per day. Here is the data delineating the well and reservoir:  µ = 0.72 cp; k = 0.1 md; Pi = 3000 psi; re = 3000 ft; rw = 0.5 ft; B = 1.475 rb/STB; h = 150 ft; φ = 23%; S = 0; if x < 0.02, then Ei(-x) = ln (1.781x); ct = 1.5 X 10-6  Estimate the reservoir pressure at a radius of 1 ft after 3 hours. | (CO 1) | [Comprehension] |
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| 12 | The skin factor is a critical parameter in reservoir engineering that quantifies near-wellbore effects on well productivity. Explain the concept of the skin factor and provide its formula. Additionally, discuss the significance of skin factor values being positive, negative, or zero. | (CO 2) | [Comprehension] |
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| 13 | As a petroleum engineer, you have been assigned to perform a gas well test analysis for a formation with low permeability. Identify the appropriate test to conduct and provide a detailed explanation of the steps involved in evaluating the back pressure equation. | (CO 4) | [Comprehension] |
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| 14 | A conventional three-point deliverability test, specifically a flow-after-flow test, was conducted on a gas well, as illustrated in the accompanying graph. The slope of the linear segment is calculated to be 1.2495, the performance coefficient is 0.017006, and the average reservoir pressure is recorded at 1975 psi. Estimate the absolute open flow (AOF). | (CO 4) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 20M=40M** | | | |
| 14 | The table below presents data acquired from a two-rate flow test, along with provided reservoir and well characteristics. Calculate (a) the slope of the two-rate test in the middle time region (MTR), (b) permeability (k), (c) skin factor (s), and (d) pressure drop attributable to skin.   |  |  | | --- | --- | | **Reservoir and Well Data** | | | q1 | 250 STB/day | | q2 | 125 STB/day | | µ | 0.8 cp | | B | 1.136 RB/STB | | Ct | 17 X 10^(-6) | | Awb | 0.0218 sq ft | | rw | 0.198 ft | | h | 69 ft | | ρ | 53 lb/cu ft | | φ | 0.039 | | tp1 | 184.7 hours |  |  |  | | --- | --- | | **Two-Rate Test Data** | | | **Δt' (Hours)** | **Pwf (psi)** | | 0 | 3490 | | 0.151 | 3564 | | 0.313 | 3627 | | 0.648 | 3717 | | 1.344 | 3810 | | 2.788 | 3868 | | 5.78 | 3891 | | 12 | 3903 | | 24.9 | 3912 | | 51.5 | 3918 | | 89.1 | 3918 | | 128 | 3916 | | 184.7 | 3910 |   (*Provide Normal Graph paper for this Question*) | (CO 3) | [Application] |
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| 15 | Figure shows the rate history of a well that is producing under transient flow condition for 15 hours. Given the following data: pi = 5000 psi; h = 20’; B = 1.1 bbl/STB; φ= 15%; µ= 2.5 cp; rw = 0.3ft; ct = 20 X 10-6 psi-1; s = 0; k = 40 md. Calculate the sand face pressure after 15 hours.    Figure: Production and pressure history of a well | (CO 1) | [Application] |
|  | | | |
| 16 | The following data are recorded for pressure drawdown in the table given below along with the reservoir data. Reservoir data: h = 130 ft; rw = 0.25; q = 348 STB/day; B = 1.14 bbl/day; µ = 3.93 cp; Ct = 8.74 X 10-6; φ = 20%; Pi = 1154;  Assume that wellbore storage effects are not significant, calculate:   1. Permeability 2. Skin Factor 3. Pressure drops due to skin.  |  |  |  |  | | --- | --- | --- | --- | | **Time**  **(hr)** | **Pwf**  **(psi)** | **Time**  **(hr)** | **Pwf**  **(psi)** | | 2 | 950 | 11 | 931 | | 3 | 947 | 12 | 930 | | 4 | 942 | 13 | 929 | | 5 | 939 | 15 | 928 | | 6 | 937 | 16 | 927 | | 7 | 936 | 20 | 923 | | 8 | 934 | 30 | 915 | | 10 | 932 | 40 | 907 |   (*Provide Semi-Log Graph paper for this Question*) | (CO 3) | [Application] |
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