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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 13- 01- 2025 **Time:** 09:30 am – 12:30 pm |

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| --- | --- | --- |
| **School:** SOE | **Program:** B. Tech in Petroleum Engineering | |
| **Course Code:** PET2019 | **Course Name:** Oil and Gas Well Test Analysis | |
| **Semester**: V | **Max Marks**: 100 | **Weightage**: 50% |

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| --- | --- | --- | --- | --- | --- |
| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| **Marks** | **24** | **22** | **26** | **28** | **NA** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M** | | | | |
| **1** | Recall the mathematical formula for Darcy's Law, define all terms, and state the assumptions of Darcy's Law. | **2 Marks** | **L1** | **CO1** |
| **2** | Name the different types of flow tests used in gas reservoirs. | **2 Marks** | **L1** | **CO4** |
| **3** | List the key characteristics of a modified isochronal test in gas flow analysis | **2 Marks** | **L1** | **CO4** |
| **4** | Define effective wellbore radius and state its significance in reservoir engineering. | **2 Marks** | **L1** | **CO3** |
| **5** | State the purpose of a two-rate test in reservoir performance evaluation. | **2 Marks** | **L1** | **CO3** |
| **6** | Define Principle of Superposition and describe its significance. | **2 Marks** | **L1** | **CO2** |
| **7** | Tell the significance of exponent "n" in back pressure equation**.** | **2 Marks** | **L1** | **CO4** |
| **8** | Define pseudo-steady state flow with respect to petroleum reservoir. | **2 Marks** | **L1** | **CO1** |
| **9** | Tell the fundamental theory governing gas flow in porous media. | **2 Marks** | **L1** | **CO4** |
| **10** | Recall the significance of multi-rate test. | **2 Marks** | **L1** | **CO3** |

**Part B**

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| --- | --- | --- | --- | --- | --- |
| **Answer the Questions Total 80 Marks.** | | | | | |
| **11.** | **a.** | Drive the diffusivity equation for radial flow in an ideal reservoir model. Explain the significance of the assumptions made during the derivation and their impact on reservoir performance predictions. | **20 Marks** | **L2** | **CO1** |
| **or** | | | | | |
| **12.** | **a.** | List the types of solutions used to solve the diffusivity equation in reservoir engineering. Provide a detailed explanation of each step involved in the solution. Discuss in detail the following scenarios:  (a) Bounded cylindrical reservoir solutions  (b) Infinite cylindrical reservoir with a line-source well  (c) Pseudo-steady-state solution | **20 Marks** | **L2** | **CO1** |
|  |  |  |  |  |  |
| **13.** | **a.** | Horner's plot, named after Ralph Horner, is a graphical technique employed in petroleum engineering for the examination of pressure transient data originating from oil and gas wells. Discuss in details Horner's Plot. | **20 Marks** | **L3** | **CO2** |
| **or** | | | | | |
| **14.** | **a.** | Comprehend the concept of Skin Factor and describe its physical significance in relation to well performance in the oil and gas industry. Explain how does the skin factor affect well productivity? Provide a detailed example of a scenario where a high positive skin factor negatively impacts production, and explain the methods that can be used to mitigate this effect. | **20 Marks** | **L3** | **CO2** |

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| --- | --- | --- | --- | --- | --- |
| **15.** | **a.** | Pressure drawdown tests provide crucial insights into reservoir behavior, helping operators optimize production strategies, enhance recovery efficiency, and plan for future reservoir management. As a reservoir engineer, provide insights and comments on the pressure drawdown plot for different reservoirs, discussing the distinctive characteristics and regions depicted in the graph (Region 1, 2, 3, C1, C2, S1, S2, S3, P, Q and R). | **20 Marks** | **L3** | **CO3** |
| **Or** | | | | | |
| **16.** | **a.** | The table below presents data acquired from a two-rate flow test, along with provided reservoir and well characteristics.  Solve for the following (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.   |  |  |  | | --- | --- | --- | | **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 | | **Reservoir and Well Data** | | | | | q1 | 250 STB/day | | | | q2 | 125 STB/day | | | | µ | 0.8 cp | | | | B | 1.136 RB/STB | | | | Ct | 17 X10^{-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 | | | | **20 Marks** | **L3** | **CO3** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **17.** | **a.** | Compare and contrast the conventional test (flow-after-flow), isochronal test, and modified isochronal test in gas well deliverability analysis. Discuss the key differences in their methodologies, including the Pressure and time graph relationship and flow rate vs. time. Highlight their significance in evaluating reservoir characteristics and production behavior. | **20 Marks** | **L3** | **CO4** |
| **Or** | | | | | |
| **18.** | **a.** | Determine n, C and AOF using the data from the below table for an Isochronal gas well test.   |  |  |  |  | | --- | --- | --- | --- | | Producing time (hrs.) | Duration (hrs.) | Sand face Pressure (Psia) | Flowrate (MMSCF/D) | | Initial shut in | 48 | 1,952 |  | | Flow 1 | 12 | 1,761 | 2.6 | | Shut in | 15 | 1,952 |  | | Flow 2 | 12 | 1,657 | 3.3 | | Shut in | 17 | 1,952 |  | | Flow 3 | 12 | 1,510 | 5.0 | | Shut in | 18 | 1,952 |  | | Flow 4 | 12 | 1,320 | 6.3 | | Extended flow | 72 | 1,151 | 6.0 | | Final shut in | 100 | 1,952 |  | | **20 Marks** | **L3** | **CO4** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***