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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 17 – 01- 2025 **Time:** 09:30 am – 12:30 pm |

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| **School:** SOE | **Program:** B.Tech in Petroleum | |
| **Course Code :** PET3011 | **Course Name :** Well Intervention Technologies | |
| **Semester**: V | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| **Marks** | **20** | **20** | **30** | **30** | **-** |

**Instructions:**

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

**Part A**

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| --- | --- | --- | --- | --- |
| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M** | | | | |
| **1** | Define the skin factor in an oil well and explain its significance in well performance. | **2 Marks** | **L1** | **CO3** |
| **2** | Draw diagrams for any two 2D fracturing models. | **2 Marks** | **L1** | **CO3** |
| **3** | Explain the two key steps that determine the productivity of fractured wells. | **2 Marks** | **L1** | **CO3** |
| **4** | Fill up the blanks   |  |  |  | | --- | --- | --- | | **Parameter** | **Oil Reservoir** | **Gas Reservoir** | | Hydrocarbon Saturation | - | - | | Water Cut | - | - |   *(w.r.t. screening criteria for hydraulic fracturing candidate well selection)* | **2 Marks** | **L1** | **CO3** |
| **5** | Match the following,   |  |  | | --- | --- | | **Column A** | **Column B** | | 1. Fracture Closure Stress | a. Reduce viscosity of gel after fracturing | | 2. Proppant Pack | b. Minimum pressure needed to fracture the rock | | 3. Fracture Gradient | c. Stress closing fractures when pressure is removed | | 4. Breakers | d. Sand, ceramic, or resin-coated particles | | **2 Marks** | **L1** | **CO3** |
| **6** | State the relationship between Sand production rate and Oil production rate. Show this relationship with a rough graph (mention the axis properly). | **2 Marks** | **L1** | **CO4** |
| **7** | Identify the shape of wires in Wire Wrapped Screens. Mention one advantage of Wire Wrapped Screen over Slotted liner. | **2 Marks** | **L1** | **CO4** |
| **8** | Identify the odd one out related to Sand Production and Control  a) Gravel Packing/ Sand Screens/ Chemical Consolidation/ Acidizing  b) High reservoir drawdown/Weak reservoir rock/Excessive perforations/Casing collapse  c) Slotted Liners/Wire-Wrapped Screens/Blowout Preventer/Gravel Pack Tool  c) Erosion of equipment/Plugging of flow lines/Enhanced hydrocarbon recovery/Loss of reservoir pressure | **2 Marks** | **L1** | **CO4** |
| **9** | Identify TRUE/FALSE statements:   1. Sand production can lead to enhanced reservoir permeability by naturally propping open fractures. 2. Chemical consolidation is unsuitable for high-temperature wells due to thermal degradation of bonding agents. 3. Slotted liners provide better sand retention than wire-wrapped screens in all reservoir conditions. 4. The use of resin-coated proppants in chemical consolidation eliminates the need for gravel packing. | **2 Marks** | **L1** | **CO4** |
| **10** | State the role of “Hole Opener” in gravel packing. State the Saucier criteria for gravel pack selection | **2 Marks** | **L1** | **CO4** |

**Part B**

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| **Answer the Questions Total 80 Marks.** | | | | | |
| **11.** | **a.** | Considering a case study of a reservoir with varying permeability zones and potential challenges like high pressure and temperature, how would you evaluate the suitability of open hole, cased hole, and liner completion methods? What factors, such as formation characteristics, operational complexity, and economic considerations, should be prioritized in selecting the optimal well completion strategy? | **20 Marks** | **L3** | **CO1** |
| **or** | | | | | |
| **12.** | **a.** | In an era of increasing complexity in oil and gas exploration, how can the integration of advanced well completion equipment be leveraged to overcome challenges such as zonal isolation, sand production, and high-pressure environments, while simultaneously ensuring cost-efficiency, operational reliability, and minimal environmental impact? | **20 Marks** | **L3** | **CO1** |
|  |  |  |  |  |  |
| **13.** | **a.** | For a sandstone formation with a porosity of 0.18 containing 8 v% calcite, calculate the gravimetric and volumetric dissolving power of a 20 wt% HCl solution (SG = 1.07) for reacting with calcite (Density = 169 pcf). A preflush of the same HCl solution is to be injected to dissolve carbonate minerals and establish a low-pH environment before an HF/HCl mixture stage. Determine the minimum preflush volume (in gallons per foot of pay zone) required to completely remove all carbonates in a region within 1.5 ft beyond a 0.328-ft-radius wellbore before the HF/HCl stage enters the formation. | **20 Marks** | **L3** | **CO2** |
| **or** | | | | | |
| **14.** | **a.** | Summarize the minimum screening matrix treatment and selection criteria for the choice of technique in matrix stimulation.  The Stimulation Cycle involves several critical steps, from identifying formation damage to evaluating treatment success. Understanding how each stage—such as selecting treatment fluids, determining injection rates, and assessing stimulation economics—affects well productivity can significantly enhance the effectiveness of stimulation treatments in varying reservoir conditions. Elucidate the key technical factors that guide these decisions.  Also give a brief overview of Organic acids used in matrix treatment. (6+10+4) | **20 Marks** | **L3** | **CO2** |

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| **15.** | **a.** | In a sandstone reservoir of permeability 1 mD located at a depth of 8,000 feet, with a Poisson’s ratio of 0.275 and a poro-elastic constant of 0.70, a vertical well with a radius of 0.328 ft is drilled, drawing from an area of 160 acres. The average density of the overburden formation is 162 pcf, and the pore pressure gradient in the sandstone is 0.36 psi/ft. The tectonic stress in the formation is 1,000 psi, while the tensile strength of the sandstone is 800 psi. To begin the hydraulic fracturing process, the breakdown pressure of the sandstone must first be predicted to understand the pressure required to initiate the fracture. Once the fracture is created, the well is hydraulically fractured to form a 2,800-ft long and 0.12-in. wide fracture with a permeability of 250,000 md. This fracture enhances the productivity of the well by increasing the flow capacity of the formation. The task is to determine the fold increase in well productivity resulting from the fracture, which would help in assessing the impact of hydraulic fracturing on gas or oil recovery. The challenge is to calculate both the breakdown pressure and the fold increase in productivity in order to assess the efficiency of hydraulic fracturing in this sandstone reservoir.  (Take the approximate values wherever required) | **20 Marks** | **L3** | **CO3** |
| **Or** | | | | | |
| **16.** | **a.** | Study the image below, which illustrates the impact of formation damage on the pressure profile in the reservoir. The pressure drop caused by formation damage can significantly affect the flow within the wellbore. In the context of well stimulation, understanding how this damage alters the pressure distribution is crucial for selecting the right treatment methods. Strategies such as targeted fluid selection, optimized injection rates, and treatment design must be employed to counteract the damage and restore efficient production from the well.    Plot a graph and explain the bottom hole pressure recorded during a micro or mini frac, highlighting the key pressure changes observed during the fracture initiation and propagation stages, and how these data points are used to assess fracture behavior and reservoir properties. (8+12) | **20 Marks** | **L3** | **CO3** |

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| **17.** | **a.** | In a sandstone reservoir prone to sand production, mitigating sand-related issues without relying on sand screens or chemical treatments requires a comprehensive reservoir management approach. Discuss the various methods that can be implemented to control sand production while maintaining reservoir performance. Provide a detailed explanation of how these methods work, their impact on sand production and reservoir performance, and propose an optimized strategy for effective reservoir management under such conditions. Sand production in reservoirs can lead to various operational challenges at completion interval, tubing and surface equipments. List out the specific problem and their effect due to sand production in the said locations in a tabular format. (14+6) | **20 Marks** | **L2** | **CO4** |
| **Or** | | | | | |
| **18.** | **a.** | Factors influencing the stability and reformation of sand arches around perforation cavities, along with the optimization of production strategies, play a critical role in minimizing sand production while maintaining well efficiency. Elaborate how these factors can be effectively managed. Discuss the ways in which water production contributes to sand production, including its effects on reservoir stability, sand particle cohesion, and hydrocarbon recovery efficiency, while highlighting the underlying mechanisms involved. (10+10) | **20 Marks** | **L2** | **CO4** |

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