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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 15 – 01- 2025 **Time:** 09:30 am – 12:30 pm |

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| **School:** SOE | **Program:** B. Tech-PET | |
| **Course Code :** PET2006 | **Course Name :** Fundamentals of oil and gas Production Technology | |
| **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** | Mention the primary function of a Gas Lift Valve in an artificial lift system. | **2 Marks** | **L1** | **CO3** |
| **2** | List out any two well bore conditions suitable for installation for Gas Lift in a producing well. | **2 Marks** | **L1** | **CO3** |
| **3** | State the significance of pressure differential in the operation of a Gas Lift Valve. | **2 Marks** | **L1** | **CO3** |
| **4** | State two difference between continuous and intermittent gas lift operations. | **2 Marks** | **L1** | **CO3** |
| **5** | List the different factors affecting injection gas breakthrough and liquid fallback. | **2 Marks** | **L1** | **CO3** |
| **6** | ***Question 1: Find the odd one out based on the type of energy used for operation.***  Sucker Rod Pump (SRP), Electrical Submersible Pump (ESP), Gas Lift, Progressing Cavity Pump (PCP), Plunger Lift  ***Question 2: Find the odd one out based on the well depth suitability.***  Sucker Rod Pump (SRP), Electrical Submersible Pump (ESP), Gas Lift, Progressing Cavity Pump (PCP), Plunger Lift | **2 Marks** | **L1** | **CO4** |
| **7** | **Find True/False statements:**   1. The Electrical Submersible Pump (ESP) is commonly used for deep wells with high fluid volumes and production rates. 2. Gas Lift systems are ideal for wells with high gas-to-oil ratios and require electrical power for operation. 3. The Sucker Rod Pump (SRP) is typically used in shallow wells with low to moderate production rates and operates with mechanical energy. 4. Progressing Cavity Pumps (PCP) are suitable for wells with high sand or abrasive content, but they are not effective in wells with high-viscosity fluids. | **2 Marks** | **L1** | **CO4** |
| **8** | **Match the following** | **2 Marks** | **L1** | **CO4** |
| **9** | List out any two similarities between Electrical Submersible Pumps (ESP) and Progressing Cavity Pumps (PCP) | **2 Marks** | **L1** | **CO4** |
| **10** | Fill up the blanks with the following options:  ***Gas Lift, Gas Lift Valve, ESP, PCP, and Plunger Lift***   1. The \_\_\_\_\_\_\_\_ system, which relies on the injection of gas at specific intervals in the wellbore, reduces the effective density of the fluid column and allows for increased production by reducing the load on the pump or lifting mechanism. 2. The primary function of a \_\_\_\_\_\_\_\_ in a Gas Lift system is to control the flow of injected gas into the tubing, regulating the gas-to-liquid ratio to optimize lift efficiency and well performance, especially in wells with fluctuating production rates. 3. An \_\_\_\_\_\_\_\_ is designed to handle high flow rates and deep well applications by employing multiple stages of centrifugal pumps, providing continuous lifting capacity for large volumes of fluids, and overcoming the limitations of gas lift in deep, high-pressure reservoirs. 4. The \_\_\_\_\_\_\_\_ is particularly suited for wells with varying gas-to-liquid ratios, as its rotor-stator design enables it to handle fluids with high viscosity, solids, and abrasives, making it efficient for challenging production environments where other artificial lift methods may not perform as effectively. | **2 Marks** | **L1** | **CO4** |

**Part B**

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| **Answer the Questions Total 80 Marks.** | | | | | |
| **11.** | Construct IPR of a vertical well in a saturated oil reservoir using Vogel’s equation. The following data are given:  Porosity: 0.19  Effective horizontal permeability: 8.2 md  Pay zone thickness: 53 ft  Reservoir pressure: 5,651 psia  Bubble point pressure: 5,651 psia  Fluid formation volume factor: 1.1  Fluid viscosity: 1:7 cp  Total compressibility: 0:0000129 Psi-1  Drainage area: 640 acres  Wellbore radius: 0.328 ft  Skin factor: 0  Consider The pseudo–steady-state flow prevails in the two phase reservoir, | | **20 Marks** | **L2** | **CO1** |
| **or** | | | | | |
| **12.** | Given Data:  Average Reservoir Pressure= 2400 Psi  Productivity Index= 1.5  Well Depth= 4500 ft  Tubing Size= 2”  GOR=200 scf/STB  Construct Well Head Performance Curve (WPH) for the well considering gradient curves for the flow rates 100 bpd, 200 bpd, 300 bpd, 400 bpd, 600 bpd, 800 bpd, 1000 bpd, 1500 bpd. Tabulate all the values. Don’t attached the gradient curves with the solution set. Take the exact values. | | **20 Marks** | **L2** | **CO1** |
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| **13.** | Explain the design process of a counterbalance system for a Sucker Rod Pump (SRP) to ensure balanced pumping cycles and maximize energy efficiency. Include a well-labeled diagram to illustrate the process. | | **20 Marks** | **L2** | **CO2** |
| **or** | | | | | |
| **14.** | In a Sucker Rod Pump (SRP) system, it has been observed that there is a considerable difference between the stroke length of the polished rod at the surface and the actual plunger stroke length downhole. This discrepancy is suspected to be caused by tubing stretch, rod stretch and plunger overtravel, which are influenced by various factors such as the weight of the fluid column, dynamic forces during pumping, and material properties.  Derive the equations to calculate the stretch in the tubing, rod and plunger. Consider axial stress, material elasticity, and operational loads in your derivation. Explain how these stretches affect the overall system efficiency and fluid production, and why understanding these factors is critical for optimizing pump performance. | | **20 Marks** | **L2** | **CO2** |

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| **15.** | Refer to the given details to answer the questions listed below.  Depth = 8000 ft  Desired rate = 2000 B/D  Tubing size 2 ” O.D (1.995” I.D)  Flowing well- head pressure = 100 psig  Static bottom hole pressure = 2300 psig  Productivity index = 4  Solution gas-oil ratio = 200 scf/B  Specific gravity of injection gas = 0.70  Surface operating pressure = 800 psig  °API = 35  Bottom hole temperature = 190 ℉  Flowing surface temperature = 120 ℉   1. Determine the point of gas injection. 2. Find out the balanced point. 3. Volume or amount of gas injected.   Describe the steps involved in identifying the optimal gas injection point in a continuous gas lift system, including a relevant sketch to illustrate the process. | **20 Marks** | **L3** | **CO3** |
| **Or** | | | | |
| **16.** | In an oil field, all gas lift has casing pressure operated charged valve. The operating valve is located at 7000 ft depth. The pressure in the bellow is 800 psi and the tubing pressure is 600 psi at 7000 ft valve depth, the bellow area is 1 sq. inch & port size is 0.1 sq inch. The bellow pressure at 60℉ is 650 psi.   1. Casing pressure at valve depth required to open the valve. 2. Tubing effect factor. 3. Tubing effect. 4. Valve spread. 5. Test rack opening pressure of valve.   Explain the five components of a gas lift valve, accompanied by a relevant diagram to illustrate each component. | **20 Marks** | **L3** | **CO3** |

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| **17.** | Compare the operational principles, efficiency, and suitability of Positive Cavity Pumps, Jet Pumps, and Electrical Submersible Pumps (ESP) for artificial lift applications, focusing on the production rate, Casing Size, impact of depth, well inclination, dog leg severity, and temperature. (Answer it in a tabular format only). | **20 Marks** | **L2** | **CO4** |
| **Or** | | | | |
| **18.** | Provide a detailed explanation of the operational principles of Electrical Submersible Pump (ESP) systems, highlighting their role in artificial lift stages and their ability to handle varying gas-liquid ratios. Discuss the critical interaction between surface and downhole equipment, including the motor, pump, protector, power cable, and other components. Supplement your explanation with a well-labeled illustration and elaborate on the function and importance of each ESP component in ensuring optimal performance. | **20 Marks** | **L2** | **CO4** |

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