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PRESIDENCY UNIVERSITY BENGALURU

 SCHOOL OF ENGINEERING

 SUMMER SMESTER END TERM EXAMINATION – AUGUST 2024

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| **Semester: Summer** | **Date: 07-08-2024** |
| **Course Code: PET2009** | **Time: 9:30AM -12:30PM** |
| **Course Name: Thermodynamics of Reservoir Fluids** | **Max Marks: 100** |
| **Program: B. Tech.**  | **Weightage: 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *The question paper consists of 3 parts.*
3. *Scientific and non-programmable calculators are permitted.*
4. *Do not write any information on the question paper besides Roll Number.*
5. *Use Graph Paper wherever needed. Write the Question No. on the graph paper with a pen.*

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| **PART A** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 2M=10M** |
| 1 | Outline the difference between Microscopic and Macroscopic approach of Thermodynamics.  | (CO 1) | [Knowledge] |
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| 2 | Define thermodynamics system and list the types of system | (CO 1) | [Knowledge] |
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| 3 | State Intensive and Extensive property with examples | (CO 1) | [Knowledge] |
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| 4 | List the condition satisfy for thermodynamic equilibrium.  | (CO 1) | [Knowledge] |
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| 5 | State the solution gas oil ratio. | (CO 2) | [Knowledge] |
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| 6 | Define oil and gas formation volume factor with expression | (CO 2) | [Knowledge] |
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| 7 | State the Bubble and dew point pressure. | (CO 3) | [Knowledge] |
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| **PART B** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** |
| 8 | The Pressure-Temperature diagram is a fundamental tool in the exploration, production, and processing of reservoir fluids. It provides valuable insights into the behavior of fluids under different conditions, guiding engineering decisions and ensuring the safe and efficient operation of oil and gas facilities. A pressure-temperature (P-T) diagram representing a multi-component mixture, as seen in natural gas or intricate hydrocarbon systems, is more complicated compared to a straight forward P-T diagram for a single-component fluid. Explain the P-T diagram for a multicomponent mixture with a clear illustration. | (CO2) | Comprehension |
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| 9 | The significance of PMM in thermodynamics lies in illustrating the principles and limitations set by the laws of thermodynamics, particularly the First and Second Laws. Explain PMM-1 and PMM-2. If a reversible heat engine operating in a cycle between a source and sink temperature of 666℃ and 20℃ respectively. Predict the work done per KJ heat supplied to the engine. | (CO 1) | Comprehension |
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| 10 | State Raoult’s law. What is the vapor pressure of a solution at 25℃C containing 78.0 grams of glucose (MM = 180.16 g/mol) in 500 grams of water? The vapor pressure of pure water at this temperature is 23.8 mm Hg.Solve for XH2O | (CO3) | Comprehension |
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| 11 | Flash expansion and differential expansion are important considerations in the oil and gas industry. Flash expansion is relevant in the context of fluid separation and processing, while differential expansion is crucial for designing and operating equipment exposed to varying temperatures to ensure the reliability and safety of oil and gas facilities. Laboratory experiments are carried out under precise conditions to replicate the characteristics of reservoir fluids in actual reservoirs. Discuss in detail with a well-drawn illustration of laboratory experiments for Flash Expansion and Differential Expansion. | (CO3) | Comprehension |
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| 12 | The laws of thermodynamics are fundamental principles that govern the behavior of energy and matter in physical systems. Discuss in detail about the Zeroth, First and Second law of thermodynamics. | (CO1) | Comprehension |
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| 13 | An imaginary engine receives heat and performs work on a slowly moving piston at such a rate that the cycle of operation of 1 kg of fluid can be represented as a circle of 10cm diameter on PV diagram. The scale is 1cm= 300kpa on Y axis and 1cm =0.1 m3 on X axis. Find the net work done. | (CO1) | Comprehension |
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| 14 | Derive the expression for work done in an isochoric, isobaric and isothermal process. | (CO1) | Comprehension |
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| **PART C** |
|  **ANSWER ANY 2 QUESTIONS 2Q X 20M=40M** |
| 15 | A pressure-temperature (P-T) diagram, commonly known as a phase diagram or phase envelope, visually depicts the phases and boundaries of reservoir fluids (usually oil and gas) across various pressure and temperature scenarios. In the oil and gas sector, this diagram is essential for comprehending and forecasting the actions of reservoir fluids. Show and Outline the P-T diagrams of different reservoir fluids along with an analytical approach. | (CO3) | [Application] |
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| 16 | For the gas composition given below, compute the pseudocritical pressure and pseudocritical temperature of gas.

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| --- | --- | --- | --- | --- |
| Components | Mole Fractions | Molecular weight | Critical Pressure | Critical Temperature |
| C1 | 0.775 | 16.04 | 673 | 344 |
| C2 | 0.083 | 30.07 | 709 | 550 |
| C3 | 0.021 | 44.10 | 618 | 666 |
| i-C4 | 0.006 | 58.12 | 530 | 733 |
| n-C4 | 0.002 | 58.12 | 551 | 766 |
| i-C5 | 0.003 | 72.15 | 482 | 830 |
| n-C5 | 0.008 | 72.15 | 485 | 847 |
| C6 | 0.001 | 86.18 | 434 | 915 |
| C7+ | 0.001 | 114.23 | 361 | 1024 |
| N2 | 0.050 | 28.02 | 227 | 492 |
| CO2 | 0.030 | 44.01 | 1073 | 548 |
| H2S | 0.020 | 34.08 | 672 | 1306 |

 | (CO2) | [Application] |
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| 17 | The refrigerating effect is a crucial parameter in the field of refrigeration and air conditioning systems. The refrigerating effect serves as a foundational parameter in the planning, functioning, and enhancement of refrigeration and air conditioning systems. It furnishes essential data for evaluating system performance, guaranteeing energy efficiency, and dealing with economic and environmental factors. Estimate the cooling effect of the refrigerator. If a reversible heat engine operating between thermal reservoirs at 800℃ and 30℃ derives a reversible refrigerator which operated between -15℃ (minus 15℃) and 30℃. The heat supplied to the engine is 1900KJ and there is a net work output of 290KJ. | (CO1) | [Application] |
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