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| **Name:**<br>**Enrolment No:** | |

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, December 2022**

**Course: Engineering Thermodynamics** **Semester: III**
**Program: B Tech (Mechatronics Engineering)** **Time : 03 hrs.**
**Course Code: MECH2014** **Max. Marks: 100**

**Instructions: Use of Steam Table is allowed.**

**SECTION A**
**(5Qx4M=20Marks)**

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| Q 1 | What do you mean by thermodynamic equilibrium? | **4** | **CO1** |
| Q 2 | Discuss the conditions which must be fulfilled by a reversible process. Give some examples of ideal reversible processes. | **4** | **CO1** |
| Q 3 | In a cyclic process, heat transfers are + 14.7 kJ, – 25.2 kJ, – 3.56 kJ and +31.5 kJ. What is the network for this cyclic process? | **4** | **CO2** |
| Q 4 | Define entropy. What do you understand by entropy principle? What are the causes of entropy increases? | **4** | **CO1** |
| Q 5 | Give the following statements of second law of thermodynamics.<br>(i) Clausius statement<br>(ii) Kelvin-Planck statement. | **4** | **CO1** |
| **SECTION B**<br>**(4Qx10M= 40 Marks)** | | | |
| Q 6 | A flow rate of 0.42 kg/s is maintained in a steam turbine under steady flow conditions as it receives steam with an enthalpy 3240 kJ/kg, velocity 35 m/s and elevation 4 m. The outlet of steam from the turbine has enthalpy of 2450 kJ/kg, velocity 125 m/s, and elevation 1 m. In the entire process the heat lost takes place at the rate of 0.25 kJ/s. Determine the power output of the turbine in kW? | **10** | **CO2** |
| Q 7 | A mass of gas is compressed in a quasi-static process from 70 kPa, 0.1 $m^3$ to 0.4 MPa, 0.03 $m^3$. Assuming that the pressure and volume are related by $PV^n$ =constant, find the work done by the gas system. | **10** | **CO2** |
| Q 8 | A refrigerator having a COP of 5 is driven by an engine having 30% thermal efficiency. What is the heat supplied to the engine for 1 MJ of heat removed from the cold body by the refrigerator? If this system is used as a heat pump, how many MJ of heat would be available for heating for each MJ of heat input to the engine? | **10** | **CO2** |
| Q 9 | Draw and explain the Rankine cycle and explain the working principle with all the components.<br>**OR** | **10** | **CO3** |

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| | Discuss the working of a four stroke Diesel engine. With the help of pressure-volume diagram, explain the thermodynamic processes involved. | | |
| **SECTION-C<br>(2Qx20M=40 Marks)** | | | |
| Q 10 | Derive an expression of thermal efficiency of an Otto cycle. List down the assumptions made in an Otto cycle. | **20** | **CO3** |
| Q 11 | A steam boiler generates steam at 30 bar, 300 °C at the rate of 2 kg/s. This steam is expanded isentropically in a turbine to a condenser pressure of 0.05 bar, condensed at constant pressure and pumped back to boiler.<br>i) Find the heat supplied in the boiler per hour.<br>ii) Determine the quality of steam after expansion.<br>iii) What is the power generated by the turbine?<br>Estimate the Ranking efficiency considering pump work.<br><br>**OR**<br><br>A steam turbine receives steam at pressure 20 bar and degree of superheat of 88.6°C. The exhaust pressure is 0.07 bar and the expansion of steam takes place isentropically Using steam table, calculate the following:<br>i) Heat supplied (feed pump supplies water to the boiler at 20 bar)<br>ii) Work done by the turbine. | **20** | **CO4** |