Name: **Enrolment No:**	

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

Course: Thermodynamics and Heat Engines **Semester : III**
Program: B Tech (Automotive Design Engineering) **Time : 03 hrs.**
Course Code: MEPD2006 **Max. Marks: 100**

Instructions: Use of Steam Table is allowed.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	What do you mean by thermodynamic equilibrium?	**4**	**CO1**
Q 2	Explain the concept of available and unavailable energy. When does the system become dead?	**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 are the causes of entropy increases?	**4**	**CO1**
Q 5	Give the following statements of second law of thermodynamics. (i) Clausius statement (ii) Kelvin-Planck statement.	**4**	**CO1**
	SECTION B **(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**	**CO4**
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	Wet steam at 165 ˚C and dryness fraction of 0.75 is heated at a constant pressure until it becomes superheated vapour at 300 ˚C. Find the change in specific volume, enthalpy, and entropy.	**10**	**CO3**
Q 9	Draw and explain the Rankine cycle and explain the working principle with all the components. **OR** Explain briefly Brayton cycle. Discuss all the process of the cycle with the help of pressure-volume diagram.	**10**	**CO2**

	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	10 kg of ice at -15°C is exposed to the atmospheric temperature of 30 °C. The ice melts and comes into thermal equilibrium. Determine the entropy increase of the universe. Take : c_p of ice = 2.093 kJ/kg°C, Latent heat of fusion of ice = 333.33 kJ/kg.	**20**	**CO3**
Q 11	A turbine receives steam at pressure 20 bar and superheated to a degree 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. (a) Heat rejected (b) Heat supplied, assuming that the feed pump supplies water to the boiler at 20 bar (c) Net work done (d) Work done by the turbine (e) Thermal efficiency **OR** 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. i) Find the heat supplied in the boiler per hour. ii) Determine the quality of steam after expansion. iii) What is the power generated by the turbine? Estimate the Ranking efficiency considering pump work.	**20**	**CO4**