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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

April 2024 Semester End Main Examinations

Programme: B.E **Semester: III**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 19AE3DCATD / 22AS3ESTDN **Max Marks: 100**
Course: Aero-Thermodynamics / Thermodynamics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Thermodynamics Steam Data handbook is permitted to use.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) Define the following with neat sketch. **6**
i) Closed system
ii) Isolated system
iii) Quasistatic process

b) Obtain an expression for displacement work for adiabatic process. **7**

c) The e.m.f in a thermocouple with the test junction at t° C on gas thermometer scale and reference junction at ice point is given by $\epsilon = 0.0367\ t - 1.33 \times 10^{-4}\ t^2$ mV. The milli-voltmeter is calibrated at ice point and steam point. What will be the reading on this thermometer when the gas thermometer reads 50°C? **7**

UNIT - II

2 a) In an air compressor air flows steadily at the rate of 15 kg/min. The air enters the compressor at 5 m/s with the pressure of 1bar and specific volume of 0.5 m^3/kg. It leaves the compressor at 7.5m/s with the pressure of 7 bar and specific volume of 0.15m^3/kg. The internal energy of the air leaving the compressor is 165 kJ/kg greater than that of air entering. The cooling water in the compressor jacket absorbs heat from the air at the rate of 125 kJ/s. Find the power required to drive the compressor. **6**

b) State Joule's law. Prove that Internal energy is property of the system. **7**

c) Classify the following into intensive and extensive properties. **7**
(i) Pressure (ii) Specific Volume (iii) Temperature
(iv) Enthalpy (v) Entropy (vi) Volume (vii) Density

UNIT - III

3 a) Define: **6**
i) Coefficient of Performance
ii) Thermal Reservoir
iii) Kelvin statement of II Law

b) Explain PMM1 and PMM2. **7**

	c)	A reversible heat engine operates between two reservoirs at temperature 700°C and 50°C. The engine drives a reversible refrigerator which operates between reservoir at temperature of 50°C and -25°C. The heat transferred to the engine is 2500 kJ and the net-work output of the combined engine refrigerator plant is 400 kJ. Predict the heat transfer of the refrigerant and the net heat transfer to the reservoir at 50°C.	**7**

OR

4	a)	Prove that Entropy is property of the system.	**6**
	b)	Explain the principle of increase of entropy.	**7**
	c)	Two kg of water at 80°C are mixed adiabatically with 3 kg of water at 30°C in a constant pressure process of 1 atmosphere. Find the increase in the entropy of the total mass of water due to mixing process. Cp of water = 4.187 kJ / kg K.	**7**

UNIT - IV

5	a)	A vessel of volume $0.04m^3$ contains a mixture of saturated water and saturated steam at a temperature of 240°C. The mass of the liquid present is 9kg. Find the pressure, mass, specific volume, enthalpy, entropy and internal energy.	**8**
	b)	1 kg of dry saturated steam at 227°C expands isothermally to 4 bar. Determine i) change in enthalpy ii) change in internal energy and heat transferred.	**6**
	c)	Explain the T-S diagram of water. Highlighting the different regions.	**6**

OR

6	a)	Define (i) Mass fraction (ii) mole fraction (iii) Dalton's law (iv) Partial pressures (v) Partial volumes (vi) Compressibility factor	**6**
	b)	Sketch the T-P phase diagram for water. Mark on it the following: solid region, liquid region, vapour phase, triple point and critical point.	**7**
	c)	Explain with a neat sketch the generalized compressibility chart.	**7**

UNIT - V

7	a)	With suitable P-V and T-S diagrams, Obtain an expression for the efficiency of Otto cycle. List the various assumptions made.	**10**
	b)	With the help of schematic diagram and T-S diagrams explain the working of Simple Rankine power cycle.	**10**

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