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

Autonomous Institute Affiliated to VTU

August 2023 Semester End Make-Up Examinations

Programme: B.E. **Semester: III**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 22AS3ESTDN **Max Marks: 100**
Course: Thermodynamics **Date: 14.08.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Scientific calculator and steam data handbook are permitted to use.

UNIT - I

1	a)	Compare (i) Open and Closed system (ii) Intensive and Extensive properties	4
	b)	A house wife, on a warm summer day, decides to beat heat by closing the windows and doors in the kitchen and opening the refrigerator door. At first, she feels cool and refreshed, but after a while the effect begins to wear off. Evaluate the situation as it relates to first law of thermodynamics, considering the room including the refrigerator as the system.	6
	c)	Develop an expression for work done during polytropic process	5
	d)	A fluid at a pressure of 3 bar and specific volume of 0.18 m^3/kg, contained in a cylinder behind a piston expands reversibly to a pressure of 0.6 bar according to $p = C/v^2$, Where C is constant and v is specific volume. Evaluate the work done by the fluid on the piston.	5

UNIT - II

2	a)	Explain the first law of thermodynamics for a closed system undergoing a non-cyclic process	5
	b)	Derive SFEE for open system	8

c) In a gas turbine unit, the gases flow through the turbine is 15 kg/s and power developed by the turbine is 12 MW. The enthalpies of the gases at the inlet and outlet 1260 kJ/kg and 400 kJ/kg respectively. The velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate (i) heat rejected to the turbine (ii) the area of inlet pipe, given that specific volume at the inlet is 0.45 m^3/kg **7**

UNIT - III

3 a) Discuss the factors that makes the processes irreversible. **4**

b) Explain direct heat engine and reversed heat engine with schematic diagrams. **4**

c) Explain Kelvin-Plank and Clausius statements of second law of thermodynamics. Use necessary sketches. **6**

d) A house requires 2×10^5 kJ/h for heating in winter. Heat pump is used to absorb heat from cold air outside and send heat to the house. The work required to operate the pump is 3×10^4 kJ/h. Evaluate (i) Heat absorbed from outside (ii) COP **6**

OR

4 a) Define entropy and show that entropy a property of a system **6**

b) Explain principle of increase in entropy. **4**

c) Discuss available and unavailable energy. **4**

d) A rigid cylinder containing $0.004m^3$ of nitrogen at 1 bar and 300 K is heated reversibly until temperature becomes 400 K. Calculate **6**

(i) the heat supplied (ii) change in entropy. Assume nitrogen to be perfect gas (Molecular weight 28) and $\gamma = 1.4$

UNIT - IV

5 a) Compare Ideal and Real gases. **4**

b) Explain compressibility factor and compressibility chart. **4**

c) Explain Dalton's law of mixture of perfect gases. **5**

d) A vessel of $0.35m^3$ capacity contain 0.4 kg of carbon monoxide (molecular weight 28) and 1 kg of air at 20°C. Calculate **7**

(i) partial pressure of each constituent

(ii) total pressure in vessel. Gravimetric analysis of air is to be taken as 23.3 % oxygen (molecular weight 32) and 76.7 % of nitrogen (molecular weight 28)

OR

6 a) Explain phase diagram of pure substance **4**

b) Explain the terms (i) Triple point (ii) Sub-cooled liquid state **4**

c) Explain (i) Latent heat (ii) Dryness fraction **6**

d) Evaluate the amount of heat would be required to produce 4.4 kg of steam at a pressure of 6 bar and temperature 250°C from water at 30°C. Take specific heat of superheated steam as 2.2 kJ/kg K. **6**

UNIT - V

7 a) Explain the working of simple Rankine cycle with the help of line diagram and P-V & T-s diagram. **8**

b) Develop an expression for air standard efficiency of Otto cycle. **5**

c) The stroke and bore of a compression ignition engine are 250 mm and 150 mm respectively. If the clearance volume is 0.0004 m^3 and fuel injection takes place at 5% of the stroke volume. Determine the efficiency of the engine. **7**

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