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

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Aerospace Engg **Duration: 3 hrs.**
Course Code: 23AS3ESTDN **Max Marks: 100**
Course: 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. Use of 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	*CO*	*PO*	Marks
1	a)	Explain the types of systems with schematic diagram.	*CO 1*	*PO 2*	**5**
	b)	Whether heat and work are point functions or path functions? Justify your answer.	*CO 1*	*PO 3*	**5**
	c)	To a closed system 150 kJ of work is supplied. If the initial volume is 0.6 m^3 and pressure of the system changes as p = 8 – 4V, where p is in bar and V is in m^3, determine the final volume and pressure of the system.	*CO 2*	*PO 3*	**10**
		UNIT - II			
2	a)	Air enters an adiabatic nozzle steadily at 300 kPa, 200ºC and 30 m/s and leaves at 100 kPa and 180 m/s. Inlet area of nozzle is 80 cm^2. Find i) mass flow rate through the nozzle ii) exit temperature of air iii) exit area of nozzle	*CO2*	*PO3*	**10**
	b)	A gas undergoes a thermodynamic cycle consisting of the following processes: (i) Process 1–2: Constant pressure p = 1.4 bar, V1= 0.028 m^3, W_{12}= 10.5 kJ (ii) Process 2–3: Compression with PV= constant, U_3= U_2 (iii) Process 3–1: Constant volume, U_1–U_3= –26.4 kJ. There are no significant changes in KE and PE. (a) Sketch the cycle on a p–V diagram (b) Calculate the net work for the cycle in kJ (c) Calculate the heat transfer for process 1–2 (d) Show that $\sum Q_{cycle} = \sum W_{cycle}$	*CO 2*	*PO 3*	**10**
		UNIT - III			
3	a)	Define the following i) Heat engine ii) Thermal reservoir iii) Kelvin-Planck statement iv) Clausius statement v) Reversible process.	*CO 1*	*PO 2*	**10**

		b)	Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine A receives 200kJ at a temperature of 421°C from a hot source, while engine B is in communication with a cold sink at a temperature of 4.4°C. If the work output of A is twice that of B, find (a)The intermediate temperature between A and B (b)The efficiency of each engine (c)The heat rejected to the cold sink	*CO 2*	*PO 3*	**10**
			OR			
	4	a)	A heat source at 800 K loses 2000 kJ of heat to a sink at (*i*) 500 K and (*ii*) 750 K. Determine which heat transfer process is more irreversible.	*CO 2*	*PO 3*	**10**
		b)	A completely reversible heat pump produces heat at a rate of 300kW to warm a house maintained at 24°C. The exterior air, which is at 7°C, serves as the source. Calculate the rate of entropy change of the two reservoirs and determine if this heat pump satisfies the second law according to the increase of entropy principle.	*CO 2*	*PO 3*	**10**
			UNIT - IV			
	5	a)	A rigid closed tank of volume $3m^3$ contains 5kg of wet steam at a pressure of 200kPa. The tank is heated until the steam becomes dry saturated. Determine the final pressure and the heat transfer to the tank.	*CO 2*	*PO 3*	**10**
		b)	A vessel of volume $0.04m^3$ contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy, and the internal energy.	*CO3*	*PO 1*	**10**
			OR			
	6	a)	Explain the following i) Compressibility factor (Z) ii) Law of corresponding states iii) Compressibility chart	*CO1*	*PO2*	**6**
		b)	A mixture of ideal gas (3 kg N_2 + 5 kg CO_2) at P = 300 kPa and T = 20°C. Find i) mole fraction ii) molecular weight of mixture iii) gas constant of mixture iv) partial pressure and partial volume v) volume and density	*CO3*	*PO1*	**10**
		c)	Write the TS plot of pure substance highlighting the different regions.	*CO1*	*PO2*	**4**
			UNIT - V			
	7	a)	In an air standard Diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15°C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure is 1480°C. Determine the following parameters: (a) the cut-off ratio, (b) the heat supplied per kg of air, (c) the cycle efficiency, and (d) the MEP.	*CO 4*	*PO 2*	**10**
		b)	What are the ways to increase the cycle efficiency of an ideal Rankine cycle and explain them with T-s diagram?	*CO 2*	*PO 2*	**10**

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