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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 19IM3DCEES **Max Marks: 100**
Course: Elements of Energy Systems

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

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)	Discuss the various types of equilibrium present in a thermodynamic system.	*CO2*	*PO1*	**10**
	b)	Discuss the construction and working of a thermocouple with a neat diagram.	*CO3*	*PO2*	**10**
		OR			
2	a)	Two Celsius thermometers A and B agree at ice point and steam point. The thermometers are related by the equation is $T_A = L + MT_B + NT_B^2$, T_A and T_B are thermometer readings and where L, M and N are constants. When both are immersed in an oil bath, thermometer A indicates 11°C and B indicates 10°C. Determine the reading of A when thermometer B reads 37.4°C.	*CO2*	*PO1*	**10**
	b)	A spherical balloon of 1 m diameter contains gas at 1.5 bar. The gas in the balloon is heated until the pressure reaches 4.5 bar, during which the gas pressure is proportional to the diameter cube of the balloon. Determine the work done by the gas inside the balloon.	*CO3*	*PO2*	**10**
		UNIT - II			
3	a)	Discuss the First Law of Thermodynamics and its significance in energy conservation.	*CO2*	*PO1*	**10**
	b)	At the inlet to a certain nozzle the enthalpy of fluid passing is 2800 kJ/kg, and the velocity is 50 m/s. At the discharge end the enthalpy is 2600 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. (i) Find the velocity at exit of the nozzle. (ii) If the inlet area is 900 cm2 and the specific volume at inlet is 0.187 m^3/kg, find the mass flow rate. (iii) If the specific volume at the nozzle exit is 0.498 m^3/kg, find the exit area of nozzle	*CO2*	*PO2*	**10**
4		**OR**			
	a)	A closed system undergoes a cycle composed of four processes 1-2, 2-3, 3-4, 4-1. During a cycle, the sum of heat transfer is -170kJ. The system completes 100 cycles per minute. The energy transfer are tabulated as follows. (i) Compute the table and (ii)			**10**

			determine the rate of work output in kW. Process | Q (kJ/min) | W (kJ/min) | ΔU (kJ/min) 1-2 | 0 | 2170 | - 2-3 | 21000 | 0 | - 3-4 | -2100 | - | -36600 4-1 | - | - | -			
		b)	Air enters an adiabatic horizontal nozzle steadily at 400°C with a velocity of 50 m/s. The inlet area is 240 cm^2. The temperature of air at the exit is 80°C. The specific volume at inlet and exit are 0.2 m^3/kg and 1.02 m^3/kg. Determine (i) the exit velocity of the air (ii) the exit area of the nozzle and (iii) the exit diameter of the nozzle. Assume that enthalpy of air is a function of temperature only and take C_p = 1.005 kJ/kgK.			**10**
			UNIT-III			
	5	a)	A reversible heat engine operates between 700°C and 50°C. The engine drives a reversible refrigerator operating between reservoirs at temperatures between 50 deg. C and -25°C. Heat transfer to the engine is 2500 KJ and network output of combined engine refrigeration plant is 400 KJ. i) Determine Heat transfer to the refrigerant and heat transfer to the reservoir at 50 deg. C ii) recalculate i), if efficiency of Heat Engine and COP of Refrigerator are each 45 % of maximum possible values.	*CO3*	*PO2*	**10**
		b)	Derive the equation for an Air Standard Otto Cycle, with usual notations.	*CO2*	*PO2*	**10**
			OR			
	6	a)	A food factory uses 40 tons of refrigeration. Freezing temperature is -35 deg. *C*, while ambient temperature is 30°C. If performance of plant is 20 % of theoretical reversed Carnot Cycle with same temperature limits, calculate the power required. Take 1 ton = 210 Kj/min.	*CO3*	*PO2*	**10**
		b)	In an Air Standard diesel cycle, compression ratio is 16, and at the beginning of isentropic compression, temperature is 15°C and pressure is 0.1 MPa. Heat is added till temperature at the end of constant pressure process is 1480°C. Calculate i) Cut-off ratio ii) Cycle efficiency iii) m.e.p.	*CO3*	*PO2*	**10**
			UNIT - IV			
	7	a)	Derive Bernoulli's Equation of motion from Euler's equations. State the assumptions made clearly.	*CO2*	*PO2*	**10**
		b)	A 30 cm X 15 cm diameter venturimeter is provided in a vertical pipe carrying oil of sp.gr. Of 0.9 and the flow being upwards. The difference in elevation of throat section and entrance section of the venturimeter is 30 cm. The differential manometer shows a mercury gauge deflection of 25 cm. Calculate) the discharge of oil and ii) the pressure difference between the entrance and throat sections. Take Cd as 0.98.	*CO3*	*PO2*	**10**
			OR			

	8	a)	Derive the equation for Venturimeter flow rate.	*CO2*	*PO2*	**10**
		b)	Water is flowing through a pipe having diameters of 200 mm and 100 mm at section 1 and at section 2 respectively. The rate of flow through the pipe is 35 litres /s. The section 1 is 6 m above the datum and section 2 is 4 m above the datum. i) Draw a neat labeled diagram of the section ii) If the pressure at the section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2.	*CO3*	*PO2*	**10**
			UNIT - V			
	9	a)	Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using i) Darcy's Equation ii) Chezy's Formula. Take C = 60 and ν =0.01 stoke for water.	*CO3*	*PO2*	**10**
		b)	Estimate the loss of head when a pipe of diameter 200 mm is suddenly enlarged to 400 mm. The rate of flow of water through the pipe is 250 litres /second.	*CO3*	*PO2*	**10**
			OR			
	10	a)	Derive an expression for loss of head due to sudden enlargement			**10**
		b)	A horizontal pipe of diameter 0.4 m carrying water is suddenly reduced to a diameter of 0.2 m. The pressure at the larger and smaller diameter pipes are 150 kN/m^2 and 130 kN/m^2 respectively. Determine the loss of head due to sudden contraction and the volume flow rate of water. Assume the coefficient of contraction is 0.6.			**10**

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