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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: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 23ME3PCETD **Max Marks: 100**
Course: Engineering 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. Students are permitted to use steam tables.

		UNIT - I	*CO*	*PO*	**Marks**
1	a)	Illustrate the following terms with appropriate examples: i) Quasi-static process, ii) Irreversible process, iii) Thermodynamic cycle, iv) Open System	*CO1*	*PO1*	**08**
	b)	A gas in the cylinder and piston arrangement comprises the system. It expands from 1.5 m^3 to 2 m^3 while receiving 200 kJ of work from a paddle wheel. The pressure on the gas remains constant at 600 kPa. Evaluate the net work done by the system.	*CO2*	*PO2*	**08**
	c)	Describe Zeroth law of thermodynamics with suitable diagram.	*CO1*	*PO1*	**04**
		UNIT - II			
2	a)	Derive the expressions for mass balance and SFEE for a single stream entering and leaving a control volume of a steady flow device.	*CO2*	*PO1*	**06**
	b)	State first law of thermodynamics and prove that energy is a property of the system.	*CO3*	*PO1*	**06**
	c)	A gas of mass 1.5 kg undergoes a quasi-static expansion which follows a relationship p = $a + b$V, where a and b are constants. The initial and final pressures are 1000 kPa and 200 kPa respectively and the corresponding volumes are 0.20 m^3 and 1.20 m^3. The specific internal energy of the gas is given by the relation u = l.5 pv – 35kJ/kg Where p is the kPa and v is in m^3/kg. Calculate, the net heat transfer along with direction and the maximum internal energy of the gas attained during the process.	*CO3*	*PO2*	**08**
		UNIT - III			
3	a)	State Clausius and Kelvin-Planck statements. Show that violation of Clausius statement leads to violation of Kelvin Planck statement.	*CO4*	*PO1*	**06**

		b)	A reversible engine operates between 3 heat reservoirs 1000 K, 800 K and 600 K and rejects heat to a reservoir at 300 K, the engine develops 10 kW and rejects 412 kJ/min. If heat supplied by the reservoir at 1000 K is 60% of heat supplied by the reservoir at 600 K, find the quantity of heat supplied by each reservoir.	*CO4*	*PO2*	**08**
		c)	Prove that for a reversible heat pump and refrigerator operating under same temperature level, $COP_{HP} = COP_R + 1$.	*CO4*	*PO1*	**06**
			OR			
	4	a)	State and prove Clausius inequality and also illustrate the significance of Clausius inequality.	*CO4*	*PO1*	**06**
		b)	Define entropy and prove that entropy is a property of the system.	*CO4*	*PO2*	**06**
		c)	An insulated rigid vessel is divided into two chambers of equal volumes. One chamber contains air at 500 K and 2 MPa. The other chamber is evacuated. If the two chambers are connected, what would be the entropy change?	*CO4*	*PO2*	**08**
			UNIT - IV			
	5	a)	Derive critical constants of the Van-der-Waals equation.	*CO5*	*PO2*	**10**
		b)	Explain the following: (i) Vander Waal's equation of state (ii) Compressibility factor (iii) Reduced Properties (iv) Compressibility chart	*CO5*	*PO1*	**10**
			UNIT - V			
	6	a)	Draw and explain all the different points in the phase equilibrium diagram of water on P-T Coordinates indicating triple and critical point	*CO5*	*PO1*	**10**
		b)	Steam initially at 1.5 MPa, 300°C expands reversibly in adiabatically in a steam turbine to 40°C. Evaluate the ideal work output of the turbine per kg of steam.	*CO5*	*PO2*	**10**
			OR			
	7	a)	Define pure substance With the help of neat sketch explain the phase change process of pure substance while heating.	*CO5*	*PO2*	**10**
		b)	A turbine takes dry steam at 20 bar and exhaust at 1.2 bar. The pressure at the release is 3 bar. Find: (a) theoretical loss of work per kg of steam due to incomplete expansion and (b) loss in Rankine efficiency due to restricted expansion of steam. (Neglect pump work)	*CO5*	*PO2*	**10**

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