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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**

Branch: Aerospace Engineering **Duration: 3 hrs.**

Course Code: 23AS3ESTDN / 22AS3ESTDN **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 steam data hand book 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)	Discuss Microscopic and Macroscopic approaches with examples.	*CO1*	*PO1, 2*	**06**
	b)	Explain (i) Quasi-static process (ii) Cyclic and Non-cyclic process (iii) Thermodynamic properties (iv) Zeroth law of thermodynamics	*CO1*	*PO1, 2*	**08**
	c)	A temperature scale of certain thermometer is given by the relation, $t = a \ln(p) + b$ where a and b are constants and p is the thermometric property of the fluid in the thermometer. If at the ice point and steam point the thermometric properties are found to be 1.5 and 7.5 respectively. Evaluate the temperature corresponding to the thermometric property of 3.5 on Celsius scale.	*CO1*	*PO1, 2*	**06**
		OR			
2	a)	Describe work according to mechanics and thermodynamics.	*CO1*	*PO1, 2*	**06**
	b)	Develop an expression for work done during constant temperature process.	*CO1*	*PO1, 2*	**04**
	c)	Air initially at 60 kPa pressure, 800K temperature, volume 0.1 m^3 is compressed isothermally until the volume is reduced by half. It undergoes further cooling at constant pressure till the volume is half again. Calculate the total work done during the process. Sketch the PV diagram.	*CO1*	*PO2*	**10**
		UNIT - II			
3	a)	Explain first law of thermodynamics for a closed system undergoing cyclic process.	*CO1*	*PO1*	**06**

		b)	Prove Total Energy (E) a property of system.	*CO2*	*PO1*	**06**
		c)	A fluid system, contained in a piston and cylinder machine, passes through a complete cycle of four processes. The sum of all heat transferred during a cycle is – 340 kJ. The system completes 200 cycles per minute. Complete the following table showing the method for each item, and compute the net rate of work output in kW. Process | Q (kJ/min) | W (kJ/min) | ΔE (kJ/min) 1—2 | 0 | 4340 | …… 2—3 | 42000 | 0 | …… 3—4 | –4200 | …… | – 73200 4—1 | ..... . | …… | …….	*CO2*	*PO1*	**08**
			OR			
	4	a)	Explain the following i) Specific heat at constant volume ii) Enthalpy iii) Specific heat at constant pressure.	*CO1*	*PO1*	**06**
		b)	Derive an expression for SFEE for open system.	*CO2*	*PO1*	**08**
		c)	In a gas turbine unit, the gases flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of gases at the inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate:(i) the rate at which heat is rejected to the turbine, and (ii) the area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m^3/kg.	*CO2*	*PO1*	**06**
			UNIT - III			
	5	a)	Explain thermal energy reservoirs.	*CO1*	*PO1*	**06**
		b)	Discuss PMM I and PMM II.	*CO2*	*PO1*	**08**
		c)	A fish freezing plant requires 40 tons of refrigeration. The freezing temperature is – 35°C while the ambient temperature is 30°C. If the performance of the plant is 20% of the theoretical reversed Carnot cycle working within the same temperature limits, calculate the power required. Take: 1 ton of refrigeration = 210 kJ/min	*CO2*	*PO1*	**06**
			OR			
	6	a)	Explain Clausius Inequality.	*CO2*	*PO1*	**06**
		b)	Discuss i) Principle of increase of entropy ii) Available and Unavailable energy	*CO2*	*PO1*	**08**
		c)	0.04 m^3 of nitrogen contained in a cylinder behind a piston is initially at 1.05 bar and 15°C. The gas is compressed isothermally and reversibly until the pressure is 4.8 bar. Calculate: i) the change of entropy, ii) the heat flow, and iii) the work done. Sketch the process on a p-v and T-s diagram. Assume nitrogen to act as a perfect gas. Molecular weight of nitrogen = 28	*CO2*	*PO1*	**06**

			UNIT - IV			
	7	a)	Explain Ideal and Real gases.	*C02*	*PO1*	**06**
		b)	Discuss compressibility factor and use of compressibility charts.	*C02*	*PO1*	**08**
		c)	Determine the pressure exerted by CO_2 using (i) Vander Waal's equation (ii) Ideal gas equation. Temperature and specific volume are 120°C and 1.5 m^3/kg respectively Given: Molar volume of the gas = 66 m^3/kg mole a = 365.6 kNm^4/ $(kg\ mole)^2$; b = 0.0423 m^3/(kg mole).	*C02*	*PO1*	**06**
			OR			
	8	a)	Explain pure substance, triple point and critical points, saturated liquid and superheated vapor states of a pure substance.	*C02*	*PO1*	**08**
		b)	Explain P-T diagram of pure substance.	*C02*	*PO1*	**06**
		c)	A vessel having a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Determine the following: (i) the pressure, (ii) the mass, (iii) the specific volume, (iv) the specific enthalpy, (v) the specific entropy, and (vi) the specific internal energy	*C02*	*PO1*	**06**
			UNIT - V			
	9	a)	Develop an expression for air standard efficiency of Otto cycle.	*C03*	*PO2*	**08**
		b)	Represent Otto, Diesel and Dual cycles on P-V diagram and T-S diagram when compression ratio and heat addition are same. Prove that Otto cycle gives the highest efficiency.	*C03*	*PO1*	**06**
		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.	*C03*	*PO2*	**06**
			OR			
	10	a)	In a Diesel cycle, the compression ratio is 15. Compression begins at 0.1MPa, 40°C. The heat added is 1.675 MJ/kg. Find i) the maximum temperature in the cycle ii) the cycle efficiency iii) the temperature at the end of the isentropic expansion iv) the cut-off ratio and the MEP of the cycle.	*C03*	*PO2*	**10**
		b)	Explain the working of simple Rankine cycle with the help of schematic diagram, P-V, T-S diagram.	*CO2*	*PO1*	**10**

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