ACE Engineering College
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Question Paper Code: ME305PC   ACE-R20

Semester End Examination

II B. Tech- I Semester- MARCH-2022

THERMODYNAMICS

(MECHANICAL ENGINEERING)

Time: 3 Hours   **Max. Marks: 70**

H. T. No										

*Answer any 5 **Questions out of 8 Questions** from the following*

Q.No	Question	Marks
1. a)	Define "Control Volume" and list any five engineering applications that could be called as "control volumes".	6
b)	Explain Macroscopic and Microscopic apparoach. Brief about Zeroth law of thermodynamics with neat diagram.	8
2. a)	Name any five temperature measuring instruments used in engineering practice. Further, mention the thermometric property that forms the basis for temperature measurement in each of them.	6
b)	Employing the first law of thermodynamics to an isometric process and an isobaric process, respectively, deduce the relations for Constant Volume Specific Heat (c_v) and Constant Pressure Specific Heat.	8
3. a)	Define "Nozzle" and "Diffuser". Apply the Steady Flow Energy Equation (SFEE) to a "Steam Nozzle" and thus deduce the expression for the exit steam velocity.	6
b)	At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3000 kJ/kg and the velocity is 60 m/s. At the discharge end, the enthalpy is 2762 kJ/kg. The nozzle is horizontal and adiabatic. Calculate the velocity of the fluid at the exit of the nozzle. If the inlet area of the nozzle is 0.1 m^2 and the specific volume at inlet is 0.187 m^3/kg, calculate the mass flow rate of the fluid.	8
4. a)	Draw the P-T phase diagram of a pure substance by considering water as the example. Explain the Solid-Liquid-Vapor phase transformation with reference to this diagram.	6
b)	1 kg of steam at a pressure 1 bar (abs) and 0.80 dry is compressed in a cylinder to a pressure 2 bar (abs) as per the governing law $Pv^{1.2}$ = constant. Calculate (i) the final condition of steam, (ii) the change in internal energy and (iii) the net heat transfer.	8
5. a)	Write the Kelvin-Planck statement and the Clausius statement of the second law of thermodynamics. Derive their equivalence by providing pertinent sketches.	6
b)	Two reversible heat engines 1 and 2 are connected in series such that 1 is rejecting heat directly to 2. Engine 1 receives 200 kJ at a temperature 421°C from a hot source, while Engine 2 rejects heat to a cold sink that is at a temperature 4.4°C. The work output of the Engine 1 is two times that of Engine	8

	2. Calculate (i) the intermediate temperature between the Engines 1 and 2, (ii) the efficiency of each Engine, and (iii) the heat rejected to the cold sink.	
6. a)	What is the significance of the law of corresponding states? Deduce the same for a Van der Waals real gas.	6
b)	A gaseous mixture comprises l kg of Oxygen and 2 kg of Nitrogen at a pressure of 150 kPa and a temperature of 20°C. Determine the changes in internal energy, enthalpy, and entropy of the mixture, when the mixture is heated to a temperature of 100°C (i) at constant volume and (ii) at constant pressure.	8
7. a)	Explain the Dual-Combustion Air-Standard Cycle together with relevant P-v and T-s diagrams.	6
b)	An ideal Otto cycle works on a compression ratio of 8. At the beginning of the compression process, air is at 100 k Pa and 17°C. An amount of heat of 800 kJ/kg is transferred to air during the constant volume heat addition process. Determine (i) the maximum temperature and pressure that occur during the cycle, (ii) the net work output and (iii) the air-standard efficiency.	8
8. a)	Explain, along with relevant schematic diagram and T-s diagram, the Vapor Power Rankine Cycle.	6
b)	Derive an expression for the air-standard efficiency of the Brayton (Joule) Cycle together with neat P-v and T-s diagrams.	8