Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2024

Subject Code:3131905 Date:29-11-2024

Subject Name:Engineering Thermodynamics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of steam table is permitted.**

Q.1	**(a)**	What do you mean by thermodynamic equilibrium? Explain in detail.	**03**
	(b)	'Entropy is a property of the system.' Prove the statement.	**04**
	(c)	Write two major statements of second law of thermodynamics and show that violation of one statement leads to violation of other one.	**07**
Q.2	**(a)**	Explain in brief - PMM 1 and PMM 2.	**03**
	(b)	Define and explain: (i) Homogenous and Heterogeneous system (ii) Intensive and Extensive properties	**04**
	(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.	**07**
		OR	
	(c)	300 kJ/s of heat is supplied at a constant fixed temperature of 290°C to a heat engine. The heat rejection takes place at 8.5°C. The following results were obtained : (i) 215 kJ/s are rejected. (ii) 150 kJ/s are rejected. (iii) 75 kJ/s are rejected. Classify which of the result report a reversible cycle or irreversible cycle or impossible results.	**07**
Q.3	**(a)**	Give comparison of Carnot and Rankine cycle.	**03**
	(b)	A rigid cylinder containing 0.004 m^3 of nitrogen at 1 bar and 300 K is heated reversibly until temperature becomes 400 K. Determine : (i) The heat supplied. (ii) The entropy change. Assume nitrogen to be perfect gas (molecular mass = 28) and take $\gamma = 1.4$	**04**
	(c)	Write a short note on Bomb calorimeter.	**07**
		OR	
Q.3	**(a)**	Explain the concept of available and unavailable energy. When does the system become dead?	**03**
	(b)	Explain the terms irreversibility and effectiveness. State types of irreversibilities.	**04**

	(c)	5 kg of water at 0^0C is exposed to reservoir at 98^0C. Calculate the change of entropy of water, reservoir and universe. Assume that specific heat of water is 4.187 KJ/Kg-K.	**07**
Q.4	**(a)**	State advantages and disadvantages of regenerative feed heating.	**03**
	(b)	Derive an expression for thermal efficiency of an Otto cycle.	**04**
	(c)	In a steam power cycle, the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work.	**07**

OR

Q.4	**(a)**	State the assumptions made for analysis of air standard cycles.	**03**
	(b)	Explain effect of regeneration on the performance of Rankine cycle using appropriate diagram.	**04**
	(c)	Explain principle of increase of entropy.	**07**
Q.5	**(a)**	An inventor claims that a new heat cycle will develop 0.4 kW for a heat addition of 32.5 kJ/min. The temperature of heat source is 1990 K and that of sink is 850 K. Is his claim possible?	**03**
	(b)	Compare Otto, Diesel and Dual cycles for (i) Same compression ratio and heat supplied (ii) Same maximum pressure and temperature	**04**
	(c)	Explain simple Vapour Compression Refrigeration (VCR) cycle with P-h and T-s diagrams.	**07**

OR

Q.5	**(a)**	Explain minimum air volume requirement for complete combustion of 1 m^3 Hydrogen fuel.	**03**
	(b)	Explain the following terms: (i) Adiabatic flame temperature (ii) Enthalpy of reaction (iii) Enthalpy of formation (iv) Stoichiometric air fuel ratio	**04**
	(c)	Discuss various factors affecting the performance of simple VCR cycle.	**07**

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