Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III(NEW) EXAMINATION – SUMMER 2023

Subject Code:3131905 Date:28-07-2023

Subject Name:Engineering Thermodynamics

Time:02:30 PM TO 05:00 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.**

			MARKS
Q.1	**(a)**	Discuss the type of thermodynamic system by giving suitable example of it.	**03**
	(b)	Explain thermodynamic equilibrium and state the Zeroth law of thermodynamics.	**04**
	(c)	Derive the general energy equation and deduce it for steady flow energy equation.	**07**
Q.2	**(a)**	Discuss the Limitation of first law of thermodynamics.	**03**
	(b)	Explain the terms PMM – I and PMM – II with suitable diagram.	**04**
	(c)	Give comparison between Otto, diesel, and dual cycles based on same compression ratio and heat rejection.	**07**
		OR	
	(c)	Derive equation for efficiency for Diesel Cycle.	**07**
Q.3	**(a)**	Explain state and property also describe intensive and extensive property.	**03**
	(b)	Show that the COP of a heat pump is greater than the COP of refrigerator by unity.	**04**
	(c)	How actual Brayton cycle differs from the theoretical cycle? Explain with the help of T-S diagram.	**07**
		OR	
Q.3	**(a)**	Define: i) Enthalpy of formation, ii) Enthalpy of reaction, iii) Adiabatic flame temperature.	**03**
	(b)	Write down Kelvin-Planck and Clausius statements of 2 Law of thermodynamics.	**04**
	(c)	In a steam power station, steam flows steadily through a 0.2 m diameter pipeline from the boiler to the turbine. At the boiler end, the steam conditions are found to be p= 4 MPa, t = 400^{o}C, h = 3213.6 kJ/kg, and v = 0.073 m^{3}/kg. At the turbine end, the conditions are found to be p = 3.5 MPa, t = 392^{o}C, h= 3202.6 kJ/kg and v=0.084 m^{3}/kg. There is a heat loss of 8.5 kJ/kg from the pipeline. Calculate the steam flow rate.	**07**
Q.4	**(a)**	Discuss causes of irreversibility for a thermodynamic system.	**03**
	(b)	Explain the Clausius inequality.	**04**
	(c)	An engine working on the otto cycle is supplied with air at 0.1MPa, 35^{o}C. The compression ratio is 8. Heat supplied is 2100kJ/kg, Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and mean effective pressure (for air, Cp = 1.005, Cv = 0.718 and R = 0.287 kJ/kg K).	**07**

OR

Q.4	**(a)**	State first law of thermodynamics. Write the limitation of first law of thermodynamics.	**03**
	(b)	What is the mean temperature of heat addition? Explain its significance.	**04**
	(c)	Show that efficiency of a reversible heat engine operating between two constant temperatures is maximum.	**07**
Q.5	**(a)**	Draw the sketch of Rankine cycle p-V, T-s and h-s diagram (consider Inlet and exit to turbine is superheated and saturated steam respectively).	**03**
	(b)	Draw block diagram of Vapour Compression Refrigeration system. Write down all four processes only. Also show these processes on p-h diagram.	**04**
	(c)	Steam at 20 bar, 360^{o}C is expanded in a steam turbine to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assuming ideal processes, find per kg steam the network and the cycle efficiency.	**07**

OR

Q.5	**(a)**	Define following terms: 1) dead state 2) high grade energy 3) irreversibility.	**03**
	(b)	Define cut-off ratio. How cut-off ratio affects the efficiency of diesel cycle?	**04**
	(c)	Explain the availability of steady flow process.	**07**

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