Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III EXAMINATION – SUMMER 2025

Subject Code:3131905 Date:31-05-2025

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.**
5. **Steam table, Gas table and Mollier chart is permitted.**

			Marks
Q.1	**(a)**	Define the terms: (1) Thermodynamics System (2) Property (3) Cycle	**03**
	(b)	Explain thermodynamic equilibriumbriefly.	**04**
	(c)	Derive S.F.E.E. clearly stating assumptions. Reduce it for turbine.	**07**
Q.2	**(a)**	Show that the COP of a heat pump is always greater than the COP of refrigerator.	**03**
	(b)	Explain PMM of kind I and II.	**04**
	(c)	Steam enters a nozzle at 7 bar pressure and 20º C (initial enthalpy = 2850 kJ/kg) and leaves at a pressure of 1.5 bar. The initial and final velocities of steam is 40 m/s nad 700 m/s respectively throught the nozzle. The mass flow rate is 1400 kg/hr and heat loss from the nozzle is 11705 kJ/hr. Specific volume at exit is 1.24 m^3/kg.Determine final enthalpy and exit area.	**07**
		OR	
	(c)	An inventor claims that his engine developes 75 kW of power while operating between 1023K and 298K temperature. The amount of fuel(C.V. of fuel = 74500 kJ/kg) burnt per hour is 3.9 kg. Comment about the validity of his claim and justify your comment.	**07**
Q.3	**(a)**	State and prove Clausius theorem.	**03**
	(b)	Show that efficiency of a reversible heat engine operating between two constant temperatures is maximum.	**04**
	(c)	A block of 100 kg of iron at temperature 100ºC is immersed in 50 kg of water at a temperature of 20ºC. Determine the entropy change for combined system of iron and water. Take Cp of iron and water as 0.42 kJ/kgK and 4.18 kJ/kgK respectively.	**07**
		OR	
Q.3	**(a)**	Define: (i) Availability (ii) Irreversibility and (iii) Dead state.	**03**
	(b)	Explain Guoy-Stodola theorem.	**04**
	(c)	Explain principle of increase of entropy. Apply it for the heat transfer through a finite temperature difference.	**07**
Q.4	**(a)**	Enlist desirable properties of good refrigerant.	**03**
	(b)	For the same compression ratio and heat rejection, compare Otto, Diesel and Dual cycle. Explain with p-v and T-s diagram.	**04**

	(c)	Draw Rankine cycle on P-v, T-s and h-s diagrams and derive an expression for its thermal efficiency with and without pump work.	**07**

OR

Q.4	**(a)**	State the assumptions made for the analysis of air standard cycle.	**03**
	(b)	Explain simple regenerative Rankine cycle.	**04**
	(c)	A diesel engine has compression ratio of 20. The compression begins at 0.1 MPa and 35ºC. The heat added is 1700 kJ/kg. Calculate maximum pressure and temperature of cycle, work done per kg of air and cycle efficiency.	**07**
Q.5	**(a)**	Define the following terms related to combustion process: (i) HCV (ii) LCV (iii)Enthalpy of formation	**03**
	(b)	Explain Bomb calorimeter with neat sketch.	**04**
	(c)	Discuss factors affecting performance of VCR cycle.	**07**

OR

Q.5	**(a)**	Explain Stoichiometric air fuel ratio in detail.	**03**
	(b)	Calculate the amount of theoretical air required for the combustion of 1 kg of acetylene (C_2H_2) to CO_2 and H_2O.	**04**
	(c)	In a steam power cycle, the dry saturated steam supplied at 15 bar. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work.	**07**

****