Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131905 Date:18-01-2024

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 and Mollier Chart (h-s diagram) is permitted.**

			MARKS
Q.1	**(a)**	Define state, property, cycle.	**03**
	(b)	Explain Zeroth law of thermodynamics stating it's application.	**04**
	(c)	Explain First law of thermodynamics for the closed system i) undergoing a cycle and ii) change of state/process.	**07**
Q.2	**(a)**	Carnot cycle is practically impossible. Justify the statement	**03**
	(b)	Compare steady flow processes with unsteady flow processes.	**04**
	(c)	Write down Kelvin-Planck's and Clausius' statements for Second Law of thermodynamics. Prove equivalence between them.	**07**
		OR	
	(c)	At the inlet to an insulated nozzle, steam enters at 687 kPa and 205°C with 3000 m/min velocity and leaves at a pressure of 137 kPa and 30000 m/min velocity. Determine enthalpy of leaving steam. Mention the assumptions made.	**07**
Q.3	**(a)**	Explain the terms 'EXERGY' and 'ANERGY'.	**03**
	(b)	Prove that entropy is the property of system.	**04**
	(c)	Derive an expression for exergy of a closed system.	**07**
		OR	
Q.3	**(a)**	Explain the Third Law of Thermodynamics.	**03**
	(b)	State the types of irreversibility. Discuss their effects.	**04**
	(c)	A heat engine receives 1000 kW of heat from an infinite heat source at 559 K and rejects heat at 279 K to an infinite heat sink. Comment whether the cycle is possible or irreversible for following heat rejection amounts: i) 400 kW ii) 490 kW iii) 850 kW	**07**
Q.4	**(a)**	State the functions of the following components of V.C.R. system: (1) Condenser (2) Expansion Valve (3) Evaporator	**03**
	(b)	Compare Carnot and Rankine cycle.	**04**
	(c)	In an ideal Rankine cycle, steam at 20 bar and 350° C expands in steam turbine to 0.05 bar. The saturated water after condensation fed back to the boiler. Determine i) net work done per kg of steam ii) Rankine cycle efficiency.	**07**
		OR	
Q.4	**(a)**	Discuss with T-s diagram, the effect of superheat and condenser pressure variation on performance of Rankine cycle.	**03**
	(b)	Discuss any two factors affecting the performance of VCR cycle.	**04**
	(c)	In an engine operated on Otto cycle, the compression ratio is 6 and the compression starts at 30° C and 100 kPa. The maximum temperature of the cycle	**07**

is 1250°C. Determine; i) heat supplied pe kg of air ii) air standard efficiency of the cycle iii) Mean effective pressure of the cycle. Take Cv = 0.716 and $\gamma = 1.4$

Q.5	**(a)**	Explain effect of regeneration on the performance of Rankine cycle using appropriate diagram.	**03**
	(b)	Draw block diagram of Vapour Compression Refrigeration system. Write down all four processes and show these processes on p-h diagram.	**04**
	(c)	Explain Junker's gas calorimeter with neat sketch.	**07**

OR

Q.5	**(a)**	Explain effect of sub cooling in VCR cycle using p-h diagram.	**03**
	(b)	Derive an expression for thermal efficiency of an Otto cycle.	**04**
	(c)	Determine the mass of air required for the complete combustion of 1 kg of an Iso-Octane (C_8H_{18}) used as a fuel for an engine. Assume air contains 23% O_2 by mass.	**07**

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