Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3130109 Date:18-01-2024

Subject Name:Thermodynamics for Aeronautical Engineering

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.**

Q.1	**(a)**	What is thermal energy reservoir? Define in terms of heat source and sink.	**03**
	(b)	Define 1st law of Thermodynamics also discuss PMM-1.	**04**
	(c)	In a gas turbine unit, the gas flow through the turbine is 15 kg/sec and the power developed by the turbine is 12000 KW. the enthalpies of gases inlet and outlet are 1260 KJ/Kg and 400 KJ/Kg respectively, and velocity of gases at inlet and outlet are 50 m/sec and 110 m/sec respectively. Calculate (1) the rate at which heat is rejected to turbine and (2) the area of the inlet pipe given that the specific volume of gases at inlet is 0.45 m^3/kg.	**07**
Q.2	**(a)**	Explain Reversible and Irreversible process with suitable Examples.	**03**
	(b)	A heat pump is used to heat the house in the winter. A house requires 50 KJ/sec heat for heating in winter which which is delivered by heat pump pump from outside air. Work required to operate the heat pump is 8 KW. Calculate co-efficient of performance of heat pump and heat abstracted from the outside.	**04**
	(c)	What do you mean by term entropy? What are the characteristics of entropy?	**07**
		OR	
	(c)	Explain concept of exergy and its application.	**07**
Q.3	**(a)**	Write the limitation of Carnot cycle.	**03**
	(b)	Discuss effect of superheating of steam and increase in boiler pressure on the efficiency of Rankine cycle.	**04**
	(c)	Derive Maxwell equation and state their importance in thermodynamics.	**07**
		OR	
Q.3	**(a)**	Sketch Rankine cycle on P-V, T-S and h-s diagram.	**03**
	(b)	In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 34.5 bar and exhaust pressure is 0.25 bar. determine (1) the turbine work (2) the pump work (3) condenser heat flow, (4) the Rankine efficiency. Assume flow rate of 9.5 kg/sec.	**04**
	(c)	What is Joule-Thomson Coefficient? Derive it using Variable Maxwell Relations.	**07**
Q.4	**(a)**	Define heat exchanger. Give its classification.	**03**
	(b)	Define and Explain Helmholtz & Gib's function.	**04**
	(c)	Explain effect of regeneration on Brayton cycle with schematic diagram.	**07**
		OR	
Q.4	**(a)**	Explain Joules experiment with neat sketch.	**03**
	(b)	Explain Quasi-static process with p-V Diagram.	**04**
	(c)	Derive an air standard efficiency expression for Brayton cycle in terms of $r_{p \text{ and } \gamma}$.	**07**

Q.5	**(a)**	Explain available and unavailable energy.	**03**
	(b)	In an otto cycle the temperature at the beginning and end of the isentropic compression are 316 K and 595 K Respectively. Determine the air standard efficiency and compression ratio.	**04**
	(c)	Write down Jet engine components. Derive expression for component efficiency of any one component.	**07**

OR

Q.5	**(a)**	Explain working principle of jet propulsion.	**03**
	(b)	State the type of irreversibility. what is their effect?	**04**
	(c)	Two Carnot engines works in series between the source and sink temperature of 1200K and 300K.if both engines having same efficiency, determine the intermediate temperature.	**07**

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