Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3130109 Date:28-07-2023

Subject Name:Thermodynamics for Aeronautical Engineering

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)**	Define: system, surrounding, boundary and universe.	**03**
	(b)	Explain Carnot cycle with P-V and T-s diagram.	**04**
	(c)	With the help of a neat diagram explain the working of a simple gas turbine plant (The Brayton Cycle).	**07**
Q.2	**(a)**	State the statements of second law of thermodynamics.	**03**
	(b)	Explain the effect of superheating on Rankine cycle efficiency.	**04**
	(c)	Explain with neat sketches the working of four stroke petrol engine (Otto cycle) and represent its thermodynamic cycle on p-V and T-S diagram.	**07**
		OR	
	(c)	Compare the efficiency of Otto cycle and Diesel cycle for same compression ratio and same heat addition.	**07**
Q.3	**(a)**	Define a thermodynamic system. Differentiate between open system, closed system and an isolated system.	**03**
	(b)	State first law of thermodynamics. Also define internal energy of the system and show that internal energy is a property of the system.	**04**
	(c)	A fluid at a pressure of 3 bar, and with specific volume of 0.18 m 3/kg, contained in a cylinder behind a piston expands reversibly to a pressure of 0.6 bar according to a law, $P = C/V^2$, where C is a constant and V is a specific volume. Calculate the work done by the fluid on the piston.	**07**
		OR	
Q.3	**(a)**	Write the applications of first law to steady flow process.	**03**
	(b)	In an internal combustion engine, during the compression stroke the heat rejected to the cooling water is 50kJ/kg and the work input is 100kJ/kg. Calculate the change in internal energy of the working fluid stating whether it is a gain or loss.	**04**
	(c)	Explain the steady flow energy equation for nozzle and boiler.	**07**
Q.4	**(a)**	What do you mean by the term ‘Entropy’? Prove that entropy is a property of a system.	**03**
	(b)	Derive an expression for the efficiency of the reversible heat engine.	**04**
	(c)	Two Carnot engines work in series between the source and sink temperatures of 550 K and 350 K. If both engines develop equal power determine the intermediate temperature.	**07**
		OR	
Q.4	**(a)**	Derive the relation, Cp-Cv = R.	**03**
	(b)	For the following given differential equations, du = Tds – pdv	**04**

and dh = Tds + vdp, prove that for perfect gas equation, $\left(\frac{\partial u}{\partial p}\right)_T = 0$ and $\left(\frac{\partial h}{\partial p}\right)_T = 0$.

(c) Prove the following relations. **07**

$$\left(\frac{\partial T}{\partial p}\right)_s = \frac{Tv\beta}{c_p} \quad \text{and} \quad \left(\frac{\partial T}{\partial v}\right)_s = -\frac{T\beta}{c_v K}.$$

Q.5 **(a)** Write the limitations of Carnot vapour power cycle. **03**

(b) Explain the concept of available and unavailable energy. When does the system become dead? **04**

(c) Write a short note on Rankine vapour power cycle. (Schematic diagram, p-V and T-s diagrams) **07**

OR

Q.5 **(a)** Enlist the components of jet engine and write their functions. **03**

(b) Draw h-s diagram of diffuser and derive its efficiency equation. **04**

(c) Derive the expression of nozzle exit velocity and efficiency of nozzle used in a jet engine. On which law of thermodynamics it works? **07**

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