Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 4 – EXAMINATION – SUMMER 2026

Subject Code: 3142004 **Date: 16/06/2026**

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.**

Q.1	**(a)**	Define system, boundary, and surroundings with examples.	**03**
	(b)	Differentiate between quasi-static and irreversible process.	**04**
	(c)	Derive Steady Flow Energy Equation (SFEE) and apply to compressor and heat exchanger.	**07**
Q.2	**(a)**	Explain exergy and dead state.	**03**
	(b)	Prove the equivalence of Kelvin-Planck and Clausius statements of second law of thermodynamics.	**04**
	(c)	Derive Carnot theorem and explain significance for refrigerator and heat pump.	**07**
		OR	
Q.2	**(c)**	A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60°C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C. The reversible heat engine also drives a machine that absorbs 30 kW. If the heat pump extracts 17 kJ/s from the 5°C reservoir, determine, (a) The rate of heat supply from the 840°C source (b) The rate of heat rejection to the 60°C sink	**07**
Q.3	**(a)**	Sketch ideal Diesel cycle on P–V and T–s diagrams.	**03**
	(b)	Explain two methods of improving Rankine cycle efficiency.	**04**
	(c)	In an air standard Diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15°C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate (a) the cut-off ratio, (b) the heat supplied per kg of air, (c) the thermal efficiency.	**07**
		OR	
Q.3	**(a)**	Draw a neat labeled diagram of a simple Rankine cycle showing all components and indicate the processes on T-s and h-s diagrams.	**03**
	(b)	Explain limitations of Carnot vapor cycle.	**04**
	(c)	Steam at 20 bar, 360 °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 the water back into the boiler. (a) Assuming ideal processes, find per kg of steam the net work the cycle efficiency, (b) If the turbine and the pump each have 80 % efficiency, find the percentage reduction in the cycle efficiency.	**07**
Q.4	**(a)**	What is meant by a real gas? How does it differ from an ideal gas?	**03**

	(b)	Explain concept of compressibility chart and law of corresponding states.	**04**
	(c)	Derive Otto cycle efficiency and show efficiency increases with compression ratio.	**07**

OR

Q.4	**(a)**	Define mole fraction, volume fraction, and partial pressure.	**03**
	(b)	Derive Van der Waals equation of state and explain its significance.	**04**
	(c)	Derive Diesel cycle efficiency and prove Otto cycle is more efficient for same compression ratio.	**07**
Q.5	**(a)**	State Avogadro's law and Dalton's law of partial pressures.	**03**
	(b)	Draw and explain throttling and free expansion processes.	**04**
	(c)	Explain adiabatic mixing of perfect gases with derivation.	**07**

OR

Q.5	**(a)**	Write short notes on (i) Triple point of water (ii) Critical point.	**03**
	(b)	Explain concept of entropy generation in irreversible processes.	**04**
	(c)	Explain regenerative Rankine cycle with schematic and T–s diagram	**07**

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