

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-IV EXAMINATION – SUMMER 2025

Subject Code:3142004

Date:17-05-2025

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.

		Marks
Q.1	(a) What is meant by intensive and extensive property? State the differences between Microscopic approach and macroscopic approach.	03
	(b) Prove that all reversible engines working between the two constant temperature reservoirs have the same efficiency.	04
	(c) State the SFEE for a single stream inlet and single stream leaving a control volume and explain the various terms in it. Also write SFEE for following Applications: (1) Nozzle, (2) Boiler, and (3) Steam Turbine.	07
Q.2	(a) What is irreversibility? State various types of irreversibilities.	03
	(b) State the principle of increase of entropy. List the four application of entropy principle.	04
	(c) Calculate the change of entropy of 1 kg of air expanding polytropically in a cylinder behind a piston from 7 bar and 600°C to 1.05 bar. The index of expansion is 1.25.	07
	OR	
	(c) State and prove Carnot's theorem for Heat Engine and write statement of Carnot's theorem in the view of refrigerator and Heat Pump.	07
Q.3	(a) Sketch the Ideal Rankine cycle on P-V, T-s, and h-s diagram.	03
	(b) Compare the Otto, Diesel and Dual cycle for (1) Same compression ratio and (2) Same heat supplied to all cycles.	04
	(c) A reversible engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by 70°C, its efficiency is doubled. Find the temperature of the source and the sink.	07
	OR	
Q.3	(a) Draw a schematic diagram of Brayton cycle and plot the air-standard Brayton cycle on P-v and T-s diagrams.	03
	(b) Draw P-V, T-s plot of Carnot vapor cycle indicating all the processes. Also state its limitations.	04
	(c) The minimum pressure and temperature in an Otto cycle are 100 kPa and 27°C. The amount of heat added to the air per cycle is 1500 kJ/kg. Determine: (1) The pressures and temperatures at all points of the air standard Otto cycle. (2) The specific work and thermal efficiency of the cycle for a compression ratio of 8:1. Take for air : $c_v = 0.72$ kJ/kg K, and $\gamma = 1.4$.	07

- Q.4 (a)** Derive an equation of the state for a perfect gas. **03**
- (b)** With suitable T-s diagram explain methods of improving efficiency of Rankine cycle. **04**
- (c)** Explain briefly the Otto cycle with help of P-V and T-s diagram and derive an expression for air standard Otto Cycle. **07**
- OR**
- Q.4 (a)** Define the following terms: **03**
 (1) Partial pressure (2) Mole fraction
 (3) Volume fraction of a gas constituent in a mixture.
- (b)** What is an ideal gas equation? What assumptions are made in deriving the ideal gas equation of state from kinetic theory of gas? **04**
- (c)** Derive equation for air standard efficiency for Diesel Cycle. **07**
- Q.5 (a)** Explain Dalton's law of partial pressure and Avogadro's law. **03**
- (b)** Draw and explain the generalized compressibility chart. **04**
- (c)** Explain adiabatic mixing of perfect gases. **07**
- OR**
- Q.5 (a)** Write down Vanderwall's equation of state. How does it differ from ideal gas equation? **03**
- (b)** State and explain Gibbs-Dalton's law for perfect gas mixture. **04**
- (c)** Explain law of corresponding states, reduced properties and critical compressibility factor. **07**
