

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 3 – EXAMINATION – SUMMER 2026

Subject Code: 3131905

Date: 19/06/2026

Subject Name: Engineering Thermodynamics

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.

- Q.1** (a) Define the following terms: Thermodynamic System, Boundary, and Surroundings. 03
- (b) Explain the difference between a Path function and a Point function in thermodynamics and give one example of each. 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
- Q.2** (a) Define extensive and intensive properties and give examples of each. 03
- (b) Describe with neat diagram the bomb calorimeter. 04
- (c) Derive equation for efficiency for otto Cycle. 07
- OR
- Q.2** (c) Explain with neat schematic diagram the Simple Vapour Compression Refrigeration (VCR) cycle. Also draw P-h and T-s diagrams for it. 07
- Q.3** (a) State the assumptions made in the analysis of air standard cycles. 03
- (b) Define cut-off ratio. How cut-off ratio affects the efficiency of diesel cycle? 04
- (c) An engine working on the Otto cycle is supplied with air at 0.1 MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 KJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and mean effective pressure (for air, $C_p = 1.005$, $C_v = 0.718$ and $R = 0.287$ KJ/kg K). 07
- OR
- Q.3** (a) List the desirable properties of a good refrigerant. 03
- (b) How actual vapour cycle differs from ideal vapour cycle? Explain in detail. 04
- (c) Draw Rankine cycle on P-v, T-s and h-s diagrams and derive an expression for its thermal efficiency with and without pump work. 07
- Q.4** (a) State first law of thermodynamics. Write the limitation of first law of thermodynamics. 03
- (b) Write down Kelvin-Planck and Clausius statements of second Law of thermodynamics. 04
- (c) A machine operating as a heat pump extracts heat from the surrounding atmosphere and draws 7.5 KW power from the electric motor. It supplies heat to a house at the rate of 2,00,000 kJ per hour for the heating of the room in winter season. Calculate the COP of heat pump. If the same machine is used to cool the house in the summer which requires the heat rejection rate of 2,00,000 kJ per hour to the surrounding, then calculate the COP in this case. Also comment on the result. 07
- OR
- Q.4** (a) State the mathematical expression of the First Law of Thermodynamics for a closed system undergoing a thermodynamic cycle. 03

- (b) What is a Perpetual Motion Machine of the First Kind (PMM1)? Why does it violate the First Law of Thermodynamics? **04**
- (c) Derive the steady flow energy equation for (1) Steam Nozzle (2) Turbine. **07**
- Q.5** (a) Define the following terms: (i) Available energy (ii) Unavailable energy (iii) Dead state. **03**
- (b) What do you understand from the term "Exergy"? Explain in brief. **04**
- (c) Explain principle of increase of entropy. Apply it for the heat transfer through a finite temperature difference. **07**
- OR
- Q.5** (a) State the Clausius theorem in its mathematical form and briefly explain the type of process it is applied to. **03**
- (b) Explain the Third Law of Thermodynamics. **04**
- (c) 5 kg of water at 0°C is exposed to reservoir at 98°C . Calculate the change of entropy of water, reservoir and universe. Assume that specific heat of water is 4.187 KJ/Kg-K . **07**
