

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

Subject Code: 3132105

Date: 19/06/2026

Subject Name: Materials 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) Explain term thermodynamics and state its objectives. **03**
(b) Explain equation of state and equilibrium. **04**
(c) Define system and surrounding. Classify system applying different criteria and quote suitable example for each. **07**
- Q.2** (a) List applications of thermodynamics in metallurgy. **03**
(b) Briefly discuss advantages and limitations of thermodynamics. **04**
(c) Write detailed note on thermodynamic processes. **07**
- OR
- Q.2** (c) Using equation of state at constant pressure, derive equation for any temperature (T) in terms of volume considering water as system. **07**
- Q.3** (a) State and interpret 0th law of thermodynamics. **03**
(b) Prove that $C_p > C_v$. **04**
(c) State Hess' law and its features used thermodynamics. Explain using example. **07**
- OR
- Q.3** (a) State law of thermodynamics that relates heat and work. **03**
(b) Discuss significance of above law of thermodynamics. **04**
(c) Derive equation $C_p - C_v = R$. **07**
- Q.4** (a) Define Heat Capacity (C). State equations for C_p and C_v . **03**
(b) State Kirchhoff's law for enthalpy calculation in thermodynamics. Apply the same for reaction involving melting and boiling phenomena. **04**
(c) Derive combined expression of 1st and 2nd law of thermodynamics in terms of internal energy, enthalpy, Helmholtz's free energy and Gibbs free energy. **07**
- OR
- Q.4** (a) What is meant by heat content or enthalpy (H)? With suitable example explain heat of reaction. **03**
(b) State 2nd law of thermodynamics and also define entropy. **04**
(c) Write note on concept of Free Energy and its application in thermodynamics. **07**
- Q.5** (a) Explain terminologies: solution, fugacity and activity. **03**
(b) State and explain Gibbs phase rule with application. **04**
(c) Briefly discuss Raoult's law, Henry's law and Sieverts law. **07**
- OR
- Q.5** (a) State and 3rd law of thermodynamics. **03**

- (b)** (i) If heat of combustion of carbon to form carbon dioxide and carbon monoxide is - 96 and -60 kCal/mol respectively. Calculate heat of formation carbon dioxide from carbon monoxide. **04**
- (ii) If free energy change and enthalpy change for following reaction at 500 K is - 110.5 kJ/mol and - 87 kJ/mol respectively. Calculate entropy change for the reaction at 500 K. Reaction: $\text{CuO(s)} + \text{H}_2\text{(g)} = \text{Cu(s)} + \text{H}_2\text{O(g)}$
- (c)** Discuss importance of Ellingham diagram in metallurgy with suitable example. **07**
