D1ACH2504 **(2 Pages)** **Name.....**
Reg. No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2025
(Regular/Improvement/Supplementary)

CHEMISTRY
FCHE1C04 – THERMODYNAMICS, KINETICS AND CATALYSIS

Time: 3 Hours **Maximum Weightage: 30**

Section A: Short answer. Answer any *eight* questions. Each carries *one* weightage.

1. Define residual entropy and discuss its relevance in thermodynamics.
2. What is the Duhem-Margules equation? Briefly explain its applications.
3. Derive the Gibbs-Duhem equation and highlight its practical applications.
4. What are partial molar properties, and how are they useful in thermodynamics of solutions?
5. Describe the phenomenological coefficients in irreversible thermodynamics.
6. What is the significance of thermal diffusion in non-equilibrium thermodynamics?
7. Explain the primary and secondary salt effects on reaction rates in solution kinetics.
8. What are Onsager reciprocal relations, and how do they apply to irreversible thermodynamics?
9. Discuss the concept of the material balance equation in diffusion-controlled reactions.
10. Write a short note on Lindemann's theory of unimolecular reactions.
11. Give the Langmuir's adsorption isotherm and its main assumptions.
12. What is meant by autocatalysis?

(8 × 1 = 8 weightage)

Section B: Short essay questions. Answer any *four* questions. Each carries *three* weightage.

13. Explain the thermodynamics of non-ideal solutions and discuss the concept of excess functions.
14. Outline the Glansdorf-Prigogine equation and its significance in thermodynamics.
15. Describe the kinetics of the acetaldehyde decomposition reaction, mentioning the Rice-Herzfeld mechanism.
16. Compare collision theory with activated complex theory in reaction dynamics.

17. Describe the BET equation and its application in determining the surface area of adsorbents.
18. Explain the Michaelis-Menten mechanism in enzyme catalysis.
19. Discuss the concept of thermo-osmosis and its applications in non-equilibrium thermodynamics. Explain how it relates to entropy production.

(4 × 3 = 12 weightage)

Section C: Essay questions. Answer any *two* questions. Each carries *five* weightage.

20. Describe in detail the kinetics of fast reactions and outline the experimental techniques used in studying these reactions, such as flash photolysis and relaxation methods.
21. Explain the Eyring equation in activated complex theory and discuss the thermodynamic aspects associated with it.
22. Discuss various methods for determining the surface area and pore structure of adsorbents, including physical adsorption techniques, X-ray methods, and mercury intrusion.
23. Explain the concept of oscillating reactions in catalysis, including the mechanisms of the of the Lotka-Volterra, brusselator and oregonator models. Describe how these models help in understanding autocatalysis and give examples of reactions that demonstrate oscillatory behavior.

(2 × 5 = 10 weightage)