Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NCHC502	Advanced Chemical Engineering Thermodynamics	3	1	0	4

Course Objective
• The course aims to impart advanced knowledge on chemical engineering thermodynamics, particularly phase equilibria, thermodynamics of solution and chemical equilibria including molecular thermodynamics.
Learning Outcomes
• Students will be able to formulate solutions to phase and chemical equilibria problems for complex systems based on classical and molecular thermodynamics and to relate thermodynamic concepts to applications in separation and chemical reactions encountered in chemical process industries.

Unit No.	Description of Lectures	Lecture Hours	Learning Outcomes
1.	**Review of basic concept:** Comparison between classical and statistical thermodynamics, equations of state.	**7 L + 2T**	Students will learn the basic of thermodynamics
2.	**Introduction to molecular thermodynamics:** Intermolecular forces, potential function and its application in chemical engineering.	**6 L + 2T**	Students will learn the molecular interactions
3.	**Thermodynamic properties:** Intermolecular forces and the theory of corresponding states, entropy calculations, maxwell relations, equilibrium and stability, thermodynamics properties of single phase, single and multicomponent systems.	**5 L + 2T**	Students will learn various thermodynamic properties
4.	**Theory of solution:** Chemical potential, fugacities, activities, activity coefficients, solubility of solids/ liquids/ gases in liquids/ gases, vapour – liquid equilibria at low and high pressures, liquid – liquid equilibria, solid – vapour – liquid equilibria.	**4 L + 2T**	Students will learn the solution thermodynamics
5.	**Phase equilibria:** Colligative properties, phase equilibria in solutions, electrolytes, Gibbs-Duhem equation.	**8 L + 2T**	Students will learn the phase equilibria
6.	**Reaction equilibria:** Chemical equilibria, equilibrium constants for homogeneous and heterogeneous reactions, simultaneous reaction and phase equilibria .	**5 L + 2T**	Students will learn the thermodynamics of chemical reactions
7.	**Exergy:** Exergy analysis.	**4 L + 2T**	Students will learn the exergy analysis
	Total	**56**	

Textbooks:

1. Sandler, S.I. (2017). *Chemical, Biochemical and Engineering Thermodynamics*. 5th Ed., Wiley.

2. Smith, J. M., van Ness, H. C., and Abbott, M. M. (2004). *Introduction to Chemical Engineering Thermodynamics*. 7th Ed., McGraw–Hill.

Reference Books:

1. Prausnitz, J. M., Lichtenthaler, R. N., and de Azevedo, E. G. (1999). *Molecular Thermodynamics of Fluid–Phase Equilibria*. Prentice Hall.
2. Haile, J. M. (1992), *Molecular Dynamics Simulation: Elementary Methods*. Wiley.