CEPC2007 CHEMICAL ENGINEERING THERMODYNAMICS (3-0-0)

Overall course Objective: The objective of the course is to introduce the students to thermodynamic laws and thermodynamic properties of solutions and pure fluids. Explaining the importance equations/rule/ like Gibbs-Duhem equation, Redlich-Kwong equation, Lewis-Randall rule. Relating chemical reaction equilibria studies with thermodynamic properties of systems.

Course Outcomes:

CO1: Apply the first and second laws of thermodynamics to chemical processes.
CO2: Compute the properties of ideal and real gas mixtures
CO3: Estimate heat and work requirements for industrial processes.
CO4: Determine thermodynamic properties of gaseous mixtures and solutions.
CO5: Determine equilibrium constant and composition of product mixture for single and multiple reactions.

Course Articulation Matrix

COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	2	3	2	2	1	-	-	-	-	-	-	-
CO3	2	2	3	3	2	-	-	-	-	-	-	-
CO4	2	2	2	3	2	-	-	-	-	-	-	-
CO5	2	2	3	2	1	-	-	-	-	-	-	-

Module I: (12 hr)

The first law of thermodynamics, the thermodynamic state and state function, constantvolume and constant pressure processes.

Properties of pure fluids: PVT behavior of pure substances, virial equations of state, theideal gas, applications of virial equations, cubic equation of state, theorem of correspondingstates.

Second Law: Entropy, work function, phase rule, introduction to third law.

Module II: (10 hr)

Criteria of phase equilibrium, ideal solutions (use of Raoult's) law, generation of Pxy andTxy diagram for ideal solution.

Non-ideal behavior, partial properties, Gibbs-Duhem equation, calculation of fugacitycoefficient using generalized correlation, excess Gibbs energy, Lewis-Randall rule, activitycoefficient for VLE data.

Module III: (8 hr)

Solution thermodynamics: Thermodynamic properties and VLE from equation of state,properties of fluid mixtures using Redlich-Kwong equation of states.

Module IV: (8 hr)

Chemical reaction equilibrium: Criteria to chemical reactions, Gibbs energy changeequilibrium constant, effect of temperature, calculation for single reaction in homogeneousand heterogeneous systems.

Books:

1. Introduction to Chemical Engineering Thermodynamics, 7th ed. by J M Smith, H CVan Ness, and M M Abbott, McGraw-Hill.
2. Textbook of Chemical Engineering Thermodynamics, 2nd ed. by K V Narayanan,PHI, 2013.
3. Chemical, Biochemical, and Engineering Thermodynamics, 4th ed. by S I Sandler,Wiley.
4. Engineering and Chemical Thermodynamics, 2nd ed. by M D Koretsky, Wiley.
5. Introductory Chemical Engineering Thermodynamics, 2nd ed. by J R Elliott and C TLira, PHI.
6. Fundamentals of Chemical Engineering Thermodynamics, 1st ed. by T Matsoukas,PHI.
7. Chemical Engineering Thermodynamics by Y V C Rao,Orient Blackswan.

Digital learning resources:

1. Chemical engineeringthermodynamics by Prof. Sasidhar Gumma, Department of Chemical Engineering, IIT Guwahati

   (Link: https://nptel.ac.in/courses/103/103/103103144/)

2. Chemical Engineering Thermodynamics by Prof. Sandip Roy, Department of ChemicalEngineering, IIT Bombay

   (Link: https://nptel.ac.in/courses/103/101/103101004/)