



NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

DEPARTMENT OF CHEMICAL ENGINEERING

4TH Semester (2nd Year), Chemical Engineering

Subject: Chemical Eng. Thermodynamics (ChBC-41)

Instructor: Dr. Shashikant Kumar

After the completion of this course, students will be able to,

Course Outcomes (COs)

CO1: Basic understanding of the thermodynamic properties of fluid, mixture and solutions.

CO2: Apply thermodynamic principles to understand fugacity, partial molar properties, chemical potential, and activity coefficients for non-ideal fluid systems.

CO3: Investigate binary phase equilibria; perform vapour-liquid equilibrium (VLE) calculations.

CO4: Apply thermodynamic principles to reaction equilibrium between phases and reactions.

Books:

1. Narayanan, K.V., "Chemical Engineering Thermodynamics", Second Edition.
2. Smith, J.M., Van Ness, H.C., Abbott, M.M., "Introduction to Chemical Engineering Thermodynamics", 7th Edition.

Resources to be used:

1. Please see the videos on NPTEL : <https://nptel.ac.in/courses/103/103/103103144/>
2. Please read the following pages from two books as given below:

Unit	Topic	Sub Topic	Page No.
I	Thermodynamic Properties of Homogeneous Fluids	Fundamental property relations, Maxwell's relations, Residual properties and their estimation, two phase systems, thermodynamic diagrams and tables, generalized property correlation for gases.	B1: Page Nos. 206-272. B2: Page Nos. 199-230
II	Thermodynamic Properties of Mixtures or Solutions	Property relationships for systems of variable composition; chemical potential, partial molar properties, fugacity and fugacity coefficients – pure species and species in a mixture, fugacity in ideal solutions, activity coefficients, excess properties.	B1: Page Nos. 273-328 B2: Page Nos. 338-413
III	Applications of Solution Thermodynamics	VLE-qualitative behavior, Duhem's theorem, simple models for VLE (Raoult's law, modified Raoult's law, etc.). Liquid properties from VLE. Activity coefficients from experimental data – Margules, Van-Laar, and Wilson equations. Property changes of mixing, heat effects in mixing processes.	
IV	Phase Equilibria	Importance of phase equilibria in process industries, equilibrium and stability, vapour-liquid equilibria (VLE) for miscible, partially miscible and immiscible systems, their phase diagrams, azeotropes. VLE calculations at low and high pressures, analysis of multicomponent systems.	B1: Page Nos. 329-424 B2: Page Nos. 545-621



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V	Chemical Reaction Equilibria	Reaction coordinate, application of equilibrium criteria to chemical reactions, standard Gibbs energy change and the equilibrium constant, effect of temperature on equilibrium constant, evaluation of equilibrium constant and composition. Calculation of equilibrium compositions for single reactions; Phase rule and Duhem's theorem for reacting systems.	B1: Page Nos. 425-481 B2: Page Nos. 483-514
VI	Thermodynamic Analysis of Processes	Work and free energy, availability, analysis of mixing, separation processes, heat exchange, lost work calculations.	

*B1: Narayanan, K.V., "Chemical Engineering Thermodynamics", Second Edition.

*B2: Smith, J.M., Van Ness, H.C., Abbott, M.M., "Introduction to Chemical Engineering Thermodynamics", 7th Edition.