

ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY (AAiT)

SCHOOL OF CHEMICAL AND BIO-ENGINEERING

Course Name: Chemical Engineering Thermodynamics

Course Code: CBEg 2104

Academic Year: 2015/2016 (2008 E.C) For 2nd Year, Semester II

Instructors: Habtamu A., Zinabu T.

Course Objectives:

Enable students to understand basic of chemical engineering thermodynamics in chemical engineering processes.

Learning Outcomes:

- Apply different equations of state to estimate the thermodynamic properties of pure substances
- Understand application of the fundamental property relations in thermodynamic analysis of chemical processes
- Understand and apply principles of thermodynamics for phase equilibrium
- Understand and apply solution thermodynamics to develop and analyze phase equilibria
- Understand and apply the principles of chemical equilibrium to maximum achievable conversion and estimate extent of reaction

Course Contents:

1. Properties of Pure Substances and Constant Composition Fluids

- 1.1 PVT Properties of Pure Substances
- 1.2 Review of Phase Diagram
- 1.3 Representation by Equations of State
- 1.4 Ideal Gas Law
- 1.5 Virial Equation of State
- 1.6 Cubic Equations of State
- 1.7 Principle of Corresponding States

2. Development of Equations for Changes in H, U and S

- 2.1 Fundamental Property Relation
- 2.2 Property Relations, Total Differentials, and Maxwell Relations
- 2.3 Definition of the Heat Capacities
- 2.4 Final General Equations for ΔS , ΔH and ΔU
- 2.5 Changes in H, U and S for Ideal Gases
- 2.6 Changes in H, U and S for Non-ideal Gases
- 2.7 Evaluation of Residual Properties

3. PHASE EQUILIBRIA OF A PURE SUBSTANCE

- 3.1 Criteria of Equilibrium
- 3.2 Practical Aspects
- 3.3 Clapeyron Equation
- 3.4 Clausius-Clapeyron Equation
- 3.5 Vapor Pressure Equations
- 3.6 Fugacity of a Pure Substance

4. Thermodynamics of Solutions

- 4.1 Partial Molar Properties 1. Definition
- 4.2 Property Relations for Mixtures
- 4.3 Fugacity of a Component in a Mixture
- 4.4 Criteria of Phase Equilibrium for Mixtures
- 4.5 Ideal Solutions
- 4.6 Vapor-Liquid Equilibria for Ideal Solutions
- 4.7 Property Relations for Mixtures
- 4.8 Flash Calculations
- 4.9 Property Changes on Mixing

5. Chemical Reaction Equilibria

- 5.1 Criteria of Equilibrium and Reaction Stoichiometry
- 5.2 Definition of the Equilibrium Constant
- 5.3 Typical Standard States
- 5.4 Solving for Equilibrium Compositions of Single
- 5.5 Reactions in One Phase
- 5.6 Temperature Dependence of the Equilibrium Constant
- 5.7 Heterogeneous Reactions
- 5.8 Multiple Chemical

Evaluation: - Project work/Assignments20%

Quiz (4-6).....40%

Final Exam40%

Attendance Requirements: - At least 75% of lectures

TEXT BOOKS:

1. Smith J.M., Van Ness H.C. and Abbott M.M. (2001). Introduction to Chemical Engineering Thermodynamics (6th Edition), McGraw-Hill.
2. Berhanu Assefa. (2008). Chemical Engineering Thermodynamics, Teaching Materials.

REFERENCE BOOKS:

1. Yenus A. Cengel, Michael A. Boles (2006). Thermodynamics an Engineering Approach (5th Ed.). McGraw-Hill Higher Education.
2. Robert H. Perry Don W. Green. Perry's Chemical Engineers' Handbook