

Course outline

Course name: Chemical Engineering Thermodynamic II

Course code: ChEg2082

Degree Program: B.Sc. in Chemical Engineering

Year: II

Semester: II

ECTS credits: 5

Instructor: Tesfaye K.

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Course Objectives & Competences to be acquired

The course aims to introduce students with basic principles of thermodynamics in understanding efficiency of heat and mass transfer, and extent of chemical reaction in process units in process industry.

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

- ✓ To understand the application of thermodynamics to optimize process parameters
- ✓ To know how heat and mass flux can be modeled for a system with reactions.
- ✓ Estimate thermodynamic properties of ideal non-ideal solutions, and reactions.

Course Description/Course Contents 1. Thermodynamic property relations

- 1.1. The Maxwell Relations
- 1.2. General Relations for du , dh , ds , C_v , & C_p
- 1.3. internal Energy Changes
- 1.4. Enthalpy Changes
- 1.5. Entropy Changes
- 1.6. Specific Heats C_v and C_p
- 1.7. The Δh , Δu , and Δs of Real Gases
- 1.8. Enthalpy Changes of Real Gases
- 1.9. Internal Energy Changes of Real Gases
- 1.10. Entropy Changes of Real Gases

2. Heat of reactions & heat effects

- 2.1 The standard heat of reaction
- 2.2 Standard heat of formation
- 2.3 Standard heat of combustion
- 2.4 Effect of temperature on the standard heat of reaction
- 2.5 Relation between heats of reaction at constant pressure
- 2.6 Heat effects of industrial reactions

3. Chemical equilibrium

- 3.1 sensible heat effect
- 3.2 Change of Gibbs energy with extent of Reaction
- 3.3 Spontaneous reaction – equilibrium
- 3.4 Law of mass action for a gas mixture
- 3.5 Chemical equilibrium in the presence of pure condensed phase;
- 3.6 Independent reactions;
- 3.7 Phase rule for system with chemical reactions;
- 3.8 Effect of temperature on equilibrium constants;
- 3.9 Displacement law of equilibrium

4. Ideal solutions

- 4.1 Perfect solutions
- 4.2 Mixing properties of ideal solutions
- 4.3 Effect of temperature and pressure on vapor liquid equilibrium
- 4.4 Effect of solutes on the freezing point of solvent
- 4.5 Effect of non-volatile solute on the boiling of solvents
- 4.6 Osmotic pressure

5. Non-ideal solutions

- 5.1 Variables & excess variables of mixing
- 5.2 Effect of T & P on activity coefficient

5.3 Different composition scales and standard states

5.4 Vapor-liquid equilibrium

5.5 Liquid-liquid equilibrium

5.6 Law of mass action for liquid phase systems **Assessment/Evaluation**

Continuous Assessment.....50%

Assignments.....15%

Quizzes.....15%

Tests.....20%

Final exam.....50%

Text Book:

1. Smith J. M., Van Ness H. C., and Abbott M. M.(2001). Introduction to chemical engineering thermodynamics.6rd Ed. McGraw-Hill, New York.