

Materials 442: Thermodynamics of Materials II

Course Description: 3 Cr. U/G., Application of thermodynamics to materials processes and systems. Behavior of solutions; binary free energy-composition and phase diagrams; reaction equilibria; electrochemical thermodynamics; application. Prereq: Jr St; Matleng 441(P).

Textbook:

D. R. Gaskell, Introduction to the Thermodynamics of Materials, 3rd edition, Taylor & Francis (1995).

Prerequisites by Topics:

- Ideal gas law
- First law of thermodynamics; heat, energy
- Second law of thermodynamics, entropy, Gibbs energy
- Third law

Course Objectives:

- Students will be able to analyze phase equilibria in 1- and 2-component systems
- Students will be able to differentiate between the behavior of ideal and real gases
- Students will be able to analyze the behavior of ideal and non-ideal condensed solutions.
- Students will be able to determine the influence of the Gibbs energy on the reactions in gases, liquids and solids.
- Students will understand the role played by thermodynamics in the development of phase diagrams.

Topics Covered:

- Phase equilibria in 1- and 2-component systems
- Thermodynamic behavior of real gases
- Thermodynamic behavior of ideal and non-ideal condensed solutions
- Gibbs energy, activity and activity coefficient in binary phase diagrams.
- Equilibrium constant $K_p(K_x)$
- Effect of temperature and pressure on $K_p(k)$
- Ellingham diagrams

Project:

Thermodynamic calculations concerning the production of H_2SO_4 .

Written Communications

Write a project report

Oral Communications

None

Laboratory Exercises

None

Class/Laboratory Schedule: List the number of lectures, lab sessions, etc., and the amount of time devoted to each.

3 hours of lectures and discussion per week

Methods of Assessment:

- Homework
- Class examinations
- Project report

Resources Commonly Available:

- Instructor
- Textbook
- Library material
- Hand-outs

Desirable Student Competencies:

- Students will be able to determine the reactions involving ideal and non-ideal solutions.
- Students will be able to apply their knowledge of thermodynamics to the solution of materials problems in other materials courses

Contribution of Course to Meeting the Professional Component:

The course provides the foundation for the use of thermodynamics in solving materials problems in the professional career of the materials engineer.

Relationship to Program Objectives:

This course meets the following outcomes:

1-i, ii, iii and 2-v, vi, vii

The outcomes are being evaluated through homework, examinations, class discussions, design projects.

All outcomes are continuously addressed throughout the course.

The outcomes will be satisfactorily met by 80% of the class obtaining a grade of "C" or better in this course.

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