RUTGERS-THE STATE UNIVERSITY OF NEW JERSEY

School of Engineering

Department of Materials Science and Engineering

14:635:206

Thermodynamics of Materials (4 credits)

Spring 2017

Mon 12:00 PM - 1:20 SEC-208, Thu 12:00 PM - 1:20 SEC-210,

Tue 10:20 AM - 11:40 SEC-207

Busch Campus

Dr. E. Koray Akdoğan

Malcolm McLaren Center for Ceramics Research, Room 114

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Course Syllabus

Thermodynamics of Materials, which is a four credit sophomore-year course, provides a rigorous introduction to the laws of Thermodynamics, develops the essential elements of chemical thermodynamics as used in Materials Science and Engineering (MSE), and demonstrates its utility in various applications. The subject of this course constitutes the foundation for a wide-range of materials processing methodologies, and is also an indispensable tool with which the behavior and properties of materials are analyzed. Thermodynamics of Materials is of fundamental importance in all aspects of MSE (structure-processing-properties), making it the most fundamental core course in the undergraduate curriculum.

- **Course Administration:** All correspondence will be made through the Sakai site of the course using memoranda in the form of announcements, a copy of which will be delivered to each student's e-mail account on file with the registrar's office. It is the responsibility of the student to carefully read all correspondence and follow instructions. Lecture notes and homeworks (and their solutions), teaching aids, and test results will be disseminated

to the students via Sakai. The students are strongly encouraged to check the course web site on Sakai frequently.

- **Course Evaluation:** 3 tests each of 33.3% weight, approximately 4-5 weeks apart. There is no final examination. The final letter grade will be assigned based on the arithmetical average of all three test scores, and compliance with attendance and homework requirements (see below)

- **Attendance:** Attendance is mandatory; 2 unexcused attendances will result in lowering of the student's final cumulative average score by 5 points prior to letter grade assignment.

- **Homeworks:** Homeworks are mandatory; 8-10 homeworks will be assigned. Students are required to be upload their solutions on time into their dropbox on Sakai. More than 1 unexcused late homeworks or more than 1 missing homework will result in lowering of the student's final cumulative average score by 5 points prior to letter grade assignment. Solutions to homeworks will be provided for self-study in preparation for tests.

- **Office Hours:** 2 x week (TBA), or by appointment. Walk-ins are welcomed. Also a forum will be available on Sakai to initiate Q&A and discussion sessions. Students may also contact me via e-mail. I will make every effort to speak to you and help you wherever and whenever you need to talk to me.

- **Textbook:** D.R. Gaskell, "Introduction to the Thermodynamics of Materials," 5th Ed., CRC Press (2008).

- **Teaching Aids:** Dr. Akdoğan's extensive lecture notes and public domain Mathematica Simulations will be made available to the students on Sakai.

- **Required Software:** Mathematica Player freeware will be made available to the students on Sakai.

- **Prerequisites:** 01:160:160, 01:640:244.

Lectures by Topic

1. Introduction Mathematical Background & Fundamental Definitions
2. The First Law of Thermodynamics
3. The Second Law of Thermodynamics
4. Thermochemistry, Heat Capacity and Enthalpy
5. Thermodynamic Variables, Relations & Auxiliary Functions
6. The Third Law of Thermodynamics
7. Phase Equilibrium in a One Component System
8. The Behavior of Gases
9. The Chemical Potential & Formalism of Multicomponent Open Systems
10. Thermodynamics of Solutions
11. Gibbs Free Energy Composition and Phase Diagrams of Binary System
12. Reactions Involving Gases Reactions Involving Gases
13. Reactions Involving Pure Condensed Phases and a Gaseous Phase
14. Reaction Equilibria in Systems Containing Components in Condensed Solution
15. Statistical Interpretation of Entropy
16. Thermodynamics of Crystalline Defects
17. Elements of Surface Thermodynamics
18. Thermodynamics of Electrochemistry (time permitting)