MSE 0048: Thermodynamics of Materials
Syllabus for 2022 Spring

Instructor: Dr. Yingjie Wu (Office: Room 4-226; Email: yingjie.wu@scupi.cn)

Lecture: Tuesday, 8:15 am – 11:00 am, Room 3-103
Office Hours: Tuesday, 1:50 pm – 4:25 pm, Room 4-226
TA: Yuanbo Chen (Email: mrchenyb@163.com)
QQ Group: 559483750
Prerequisites: PHYS 0174, CHEM 0960

Course Description:

This course teaches the essential thermodynamics of materials, which concerns the application of thermodynamic principles to the analysis of multiple phenomena related to the property and behavior of materials. The course covers topics on three major sections, thermodynamic principles, phase equilibria and reactions & transformations dealing with oxidation, energy, and phase transformations. The course provides the contents including the role of work terms other than PV work (e.g., magnetic work) along with their attendant aspects of entropy, Maxwell equations, and the role of such applied fields on phase diagrams.

Course Objectives:

The goals of this course are 1) to develop advanced understanding on the basic concepts and principles of thermodynamics, 2) to apply thermodynamic principles to analyze various phenomena in materials, and 3) to familiarize students with using thermodynamic calculations for material design. Thus, this course provides fundamental knowledge and training for undergraduates to perform their senior projects in the fields of materials science and engineering.

Applicable ABET Outcomes:

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to function on multi-disciplinary teams
3. An ability to identify, formulate, and solve engineering problems
4. An ability to communicate effectively
5. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Required Resources:

Required textbook:

1. Gaskell, D.R., and D.E. Laughlin. ***Introduction to the Thermodynamics of Materials***. 6th ed., Boca Raton, FL: CRC Press, 2018. Print.

Useful supporting materials:

1. Lewis, G.N. and M. Randall, ***Thermodynamics***, revised by K.S. Pitzer and L. Brewer, 2nd ed., New York, NY: McGraw-Hill, 1961. Print.
2. Kubaschewski, O. and C.B. Alcock, ***Metallurgical Thermochemistry***, 5th ed., Oxford: Pergamon Press, 1979. Print.
3. Schafer, H., ***Chemical Transport Reactions***, translated by H. Frankfort, New York, NY: Academic Press, 1964. Print
4. Smith, J.M. and H.C. van Ness, ***Introduction to Chemical Engineering Thermodynamics***, 4th ed., New York, NY: McGraw-Hill, 1987. Print.
5. Johnson, D.A., ***Some Thermodynamic Aspects of Inorganic Chemistry***, New York, NY: McGraw- Hill, 1953. Print.
6. Darken, L.S. and R.W. Gurry, ***Physical Chemistry of Metals***, New York, NY: McGraw-Hill, 1953. Print.
7. Denbigh, K., ***The Principles of Chemical Equilibrium***, 3rd ed., Cambridge University Press, 1971. Print.
8. Wagner, C., ***Thermodynamics of Alloys***, translated by S. Mellgren and J.H. Westbrook, Cambridge, MA: Addison-Wesley Press, 1952. Print.

Course Content (tentative):

Week	Date	Topics (Lecture)	Reading assignment	Assginment
1 T	2/22/21	Introductuion & Basic Thermodynamics	Chapters 1, 2 and 3	Assignment #1
2 T	3/1/21	Basic Thermodynamics	Chapters 5, 6 and 8	
3 T	3/8/21	Thermochemistry	Chapters 11 and 12	Assignment #2
4 T	3/15/21	Phase Equilibria in Unary System	Chapter 7	Assignment #3
5 T	3/22/21	Solution Thermodynamics	Chapter 9	Assignment #4
6 T	3/29/21	Solution Thermodynamics	Chapters 9 and 13	Assignment #5
7 T	4/5/21	**Holiday (No Class)**		
8 T	4/12/21	Midterm Review		
9 T	4/19/21	**Midterm Exam (2 hrs)**		
10 T	4/26/21	Solution Thermodynamics	Chapter 13	Assignment #6
11 T	5/3/21	**Holiday (No Class)**		
12 T	5/10/21	Electrochemistry	Chapter 14	Assignment #7
13 T	5/17/21	Phase Equilibria	Chapter 10	Assignment #8
14 T	5/24/21	Phase Equilibria	Chapter 10	Assignment #9
15 T	5/31/21	Phase Transformation	Chapter 15	
16 T	6/7/21	Phase Transformation	Chapter 15	Assignment #10
17 T	6/14/21	Final Review		
18 T	6/21/21	**Final Exam (2 hrs)**		

Grading Policies:

Requirements	Corresponding Percentages
Assignments (10)	15%
Midterm Exam	35%
Final Exam	45%
Participation	5%

Grading Scale:

100% ≥ A ≥ 90%; 90% > A− ≥ 85%; 85% > B+ ≥ 80%; 80% > B ≥ 76%; 76% > B− ≥ 73%; 73% > C+ ≥ 70%; 70% > C ≥ 66%; 66% > C− ≥ 63%; 63% > D ≥ 60%; 60% > F.

Homework:
There will be about ten homework assignments that will be submitted to Blackboard either as Word document or as pdf ***before the start of the class (8:15 am) on the due day***. If you are unable to attend a class, you may attach a note to your homework and submit it in advance. ***If homework is submitted late, you would lose 10% per day. You may receive no credit if homework is not submitted within a week from the due day.***

Exams:
There will be a midterm exam and a final exam in this course. An equation sheet might be permitted (information about this will be given a week before the exam). The students need to be present during the exam. In case of an emergency (doctors notice), a make-up exam might be given. The only allowed things during the exams are electronic calculators and writing and drawing instruments. Paper and the exam sheet will be provided. Other computational tools, such as mobile phone, are not allowed.

A student found ***cheating***, ***attempting to cheat***, having an ***unauthorized device/tool*** during the exam ***independent of the reason*** will receive a zero on the exam.

Participation:
Participation through presence but also answering questions, asking questions, contributing to activities is very important to improve active learning for each student. Therefore, your participation will be graded during each lecture starting with the second week.