

## **MEMS 1059: Phase Equilibria in Multicomponent Materials Fall 2020**

**Credits and contact**

**hours (lecture/lab):** 3 Credits, 3 Contact Hours (2 lecture, 1 recitation)

**Designated as 'Required'**

**or 'Elective' Course:** Required

**Course description:**

Thermodynamics of solutions with applications to materials systems; heterogeneous phase equilibria; relations between free energy and phase diagrams; electrochemistry; rate processes; thermodynamics of surfaces.

**Prerequisite and Co-requisite:** (ENGR 0022 or MET 1162) and (ME 0051 or MEMS 0051 or MET 1110 or BIOENG 1210)

**Textbook:**

D. R. Gaskell and D. Laughlin, Introduction to the Thermodynamics of Materials, 6<sup>th</sup> ed., Taylor & Francis, 2017.

**Reference Textbooks:**

G.H. Meier, "Thermodynamics of Surfaces and Interfaces: Concepts in Inorganic Materials," Cambridge University Press, 2014.

N. Birks and G.H. Meier, "Introduction to the High Temperature Oxidation of Metals," Cambridge University Press, 2009.

**Other required materials:** None

**Course Instructor:**

Grace Chen [grace.chen@scu.edu.cn](mailto:grace.chen@scu.edu.cn) Office Location 3-319B

**Teaching Assistant:**

Leah Li [994346166@qq.com](mailto:994346166@qq.com)

**Course Objectives:**

The course is designed to give juniors in MSE and Engineering Sciences an understanding of classical thermodynamics and its application to materials problems.

**Course learning outcomes/expected performance criteria:**

1. Thermodynamics of Solutions (70%)
2. Binary Phase Diagrams (70%)
3. Free Energy Diagrams (70%)
4. Chemical Reaction Equilibria (70%)
5. Thermodynamics of Electrochemical cells (70%)
6. Thermodynamics of Surfaces and Interfaces (70%)

**Course topics and time devoted to each topic:**

Review of Basic Thermodynamics (2 weeks)  
Phase Equilibria and Free Energy Diagrams (3 weeks)  
Thermodynamics of Solutions (3 weeks)  
Thermodynamics of surfaces (2 week)  
Thermodynamics of Chemical Reactions (1 week)  
Reactions Involving Solutions (1 week)  
Electrochemistry (2 week)

**Class/laboratory schedule:**

Monday 8:15-11:00am  
Location: 3-310

<b>Contribution of course to meeting the requirements of criterion 5:</b>	Engineering Science:	3 Credits
	Engineering Design:	0 Credits
	College Level Mathematics:	0 Credits
	Basic Science:	0 Credits
	Realistic Constraints:	0 Credits

**Materials Science & Engineering Program outcomes addressed:**

This course is not used to evaluate program outcomes.

Prepared by: Grace Chen, Adapted from Prof. Charles Hua

Date: 28 August 2020

## Web Site

This course uses the Blackboard system; the web site is

<https://learn.scupi.cn/>

(Note: the **https** is important, otherwise it may not load.) There you will find the course syllabus, studio and homework assignments, and other materials. Current announcements and assignments will be posted on the home page. All assignments will be uploaded through the Blackboard system. Please check the class page frequently.

## Class Format

**Phase Equilibria in Multicomponent Materials** is taught using a combined lecture/quiz format. The class begins with a session lecture to review material from the text and introduce new concepts. In the second session, the lecturer may ask questions to as many students as possible and then continue with textbook.

Each week you will turn in one assignment when applicable.

**It is imperative that you come to class prepared.** This will generally involve reading one or more chapters of the textbook, viewing tutorial videos, thinking, engaging with fellow students, practice and performing preliminary calculations. This is a three credit hour class, which means you should expect to devote at least 9 to 12 hours of effort outside the scheduled class time every week.

## Homework Assignments

Homework problems will be assigned every week or so in the class and/or posted on Blackboard. These are to be solved and turned in by **Sunday**. You may work with other people on homework, but all write-ups must be individual efforts. Homework will be graded on a 0-100 point scale.

All work will be submitted electronically through the Blackboard system. Late homework will not be accepted.

Unless specifically requested, emailed homework will not be accepted.

Please adhere to these homework guidelines:

- Your assignment must be typeset using Word and submitted electronically through Blackboard. Handwritten assignments will not be accepted.
- Put your name, ID number (last four digits), and class section at the top of the first page.
- List the names of other people you've worked with on the assignment.
- All work must be shown for each solution to receive full credit. Present your solution in a logical fashion, showing and explaining all steps in detail.
- A significant amount of the homework points is associated with obtaining the correct answer. This includes getting the correct quantity, number of significant digits, sign, and unit.

All of the homework scores will be used in your grade computation. Unless otherwise indicated, you can work with your fellow classmates in the class, but you must submit a distinct and independent write-up to receive credit.

If you're sick, or have a compelling emergency that prevents you from turning in the homework on time, email Prof. Charles Hua, [charleshua@scu.edu.cn](mailto:charleshua@scu.edu.cn). When emailing the instructor or TA, include "2019F-MSE\_1059" in the

subject field of your message. Use your university email account (ID\_number@stu.scu.edu.cn); mail from other accounts might be stopped by the SCU spam filter.

If you believe an error has been made in the grading of an assignment, bring it to the attention of your TA within ONE WEEK of its return.

## **Exams and Grading**

There will be a mid-term exam and one final exam.

The test and exam are CLOSED BOOK, CLOSED NOTES, CLOSED COMPUTER. You may bring one A4 page of notes (single side) by YOUR OWN handwriting. You will also find a calculator and a straightedge helpful.

Your grade will be based on the homework (30%), class participation (10%), mid-term exam (30%), and final examination (30%). If your homework is submitted late, you lose 10% of the credits per day past due, and have zero credit one week past due. You should participate actively in the class in order to grasp the important concepts. If you are found using cellphone or playing video games in the classroom during the lecture hours, you will lose the participation credits. For your information, the average grade at University of Pittsburgh is 55 points in the academic year 2016-17.

## **Office Hours**

If you don't understand something, and talking to your classmates doesn't help, then you should be seeking help from the instructor or teaching assistant.

Office hours are times we have specifically set aside to be available to students. During office hours, you can come to our office; you don't need an appointment. We are also available at other times; please email to schedule a time.

Current office hours will be Monday and Tuesday afternoon, 1-6pm, zone 4 -226.