

# “Phase Equilibria in Materials”

Fall 2015\_445.702

Professor Eun Soo Park

## Syllabus

*Location:* 33-327

*Meeting time:* Monday, Wednesday 09:30-10:45

*Class web page:* <http://etl.snu.ac.kr/portal/index.jsp>

### **Teaching staff**

Instructor: Eun Soo Park

Office: 33-313

Telephone: 02-880-7221

Email: [espark@snu.ac.kr](mailto:espark@snu.ac.kr)

Office hours: by appointment

**Text:** A. PRINCE, "Alloy Phase Equilibria",

Elsevier publishing company (1966)

**Prerequisite coursework:** (Introduction to Metallurgical) Thermodynamics, Phase transformation in materials

**References:** 1) Frederick N. Rhines, "Phase Diagrams in Metallurgy",

McGraw-Hill Book Company, INC (1956)

2) Paul Gordon, "Principles of Phase Diagrams in Materials Systems",

McGraw-Hill Book Company, INC (1968)

3) D.A. Porter and K.E. Eastering, "Phase Transformations in Metals and Alloys",

Nelson thornes Ltd (2001)

**Additional reading materials will be provided.**

### **Course Description:**

This course provides the fundamental concepts and advanced understandings of phase equilibria in materials, including relationship of free energy to phase diagram. The course will address some kinetic and non-equilibrium concepts and some phenomenological discussions. In particular, phase and composition determinations in ternary and quaternary systems, relationship between phase diagrams and thermodynamic data, and cooling paths during cooling of the ternary melts will be covered. This course can provide a working knowledge of how to construct and read phase diagrams and use them to solve problems involving materials and process design.

Prof. Eun Soo Park

Department of Materials Science and Engineering/Seoul National University

## **Schedule**

- week 1** *Introductory Thermodynamics*
- week 2** *Thermodynamics of Solutions*
- week 3** *Binary Phase Diagrams: Two-phase Equilibrium*
- week 4** *Binary Phase Diagrams: Three-phase Equilibrium*
- week 5** *Binary Phase Diagrams: Limited Solubility in Both the Liquid and Solid State*
- week 6** *Binary Phase Diagrams: Reactions in the Solid State*
- week 7** *Binary Phase Diagrams: Allotropy of the Components*
- week 8** *Ternary Phase Diagrams: Two-phase Equilibrium*
- week 9** *Ternary Phase Diagrams: Three-phase Equilibrium*
- week 10** *Ternary Phase Diagrams: Four-phase Equilibrium*
- week 11** *Ternary Phase Diagrams: Intermediate Phases*
- week 12** *Ternary Phase Diagrams: Liquid Immiscibility*
- week 13** *Ternary Phase Diagrams: Four-phase Equilibrium Involving Allotropy of One Component*
- week 14** *The Association of Phase Regions*
- week 15** *Quaternary Phase Diagrams I*
- week 16** *Quaternary Phase Diagrams II*

## **Components of Your Grade:**

### **1) Exams (mid: 30% + final: 35%)**

There will be two exams, each of which will take 2-3 hours. The exams will be conceptual and difficult. In general, I will not use class time for the exams and instead will reserve separate time slots.

### **2) Reports and Presentation (15%)**

Assignments handed in after the start of class lose credit depending on the timing. If you wish, you may work together on homework assignments. But, you must hand in your own work, in your own words.

### **3) Quiz (10%) and attendance (10%)**

There will be a few short quizzes among the major exams. These will take place in class and early for 20 minutes.

**Remarks:** The ratio for grade is possible to change up to 5% depending on the student's achievement.

## **Course Policies, Questions and Answers**

### **Q: Will there be a recitation section?**

**A:** None is planned, but if you really want one, speak up. We can negotiate.

Although most class periods will be lecture, I am hoping that the weekly class meetings will proceed in a discussion style format, so please do ask questions.

### **Q: What is the policy for attendance?**

**A:** Please be on time. Being late disrupts the instructor and other students. If you cannot attend a class, please let me know in advance by email.

### **Q: What is the policy for late homework?**

**A:** Late assignments go to my office. If I'm not around, slide it under my door and leave me an email so that I know when you turned it in.