강 의 계 획 서 (Syllabus)

교과목명: **재료상변태**   교과목번호: **445.302**   강좌번호: **001**   학점: **3 credits**
(including 1 credit for design)

담당교수: **Eun Soo Park**   연 구 실: **33-313**

연 락 처: **880 – 7221**   전자우편: **espark@snu.ac.kr**

수강대상: **Students in 3rd or 4th Grade**   선수과목: **재료공학원리, 재료열역학**

강의시간: **Mon. & Wed. 09:30 - 10:45**   강 의 실: **실시간 Zoom 화상강의**

면담시간(office hour): **by appointment**   **(실시간 질문 미응답/화상 미접속시 결석처리 불이익)**

Textbook: D.A. Porter and K.E. Eastering

   "Phase Transformations in Metals and Alloys"
   Chapman & Hall (2009) ISBN: 978-1-4200-6210-6

References: Paul G. Shewman, "Diffusion in Solid," TMS (1989)

   Reed-Hill, "Physical Metallurgy Principles," PWS–Kent (1992)

   Additional reading materials will be provided.

Course Description:

This course presents a unified treatment of the thermodynamics and kinetics of phase transformations from phenomenological and atomistic viewpoints. Phase transformations in condensed metal and nonmetal systems will be discussed. This course begins with reviewing the principles of thermodynamics, phase equilibriums, diffusion, and crystal interfaces. The topics include absolute reaction rate theory, thermodynamics of irreversible processes, thermodynamics of surfaces and interfaces, chemical kinetics, nucleation and growth, spinodal decomposition, order-disorder transformations, diffusional transformations, martensitic transformations, coarsening, and glass transition. By the end of the semester, you will be able to understand key concepts, experimental techniques, and open questions in the transformation phenomena of various materials.

   Chapter 1   Thermodynamics and Phase Diagrams

   Chapter 2   Diffusion
   Diffusion Mechanism
   Diffusion Equation and Its Solutions
   High Diffusivity Path
   Diffusion in Multiphase Binary Systems

   Chapter 3   Crystal Interfaces and Microstructure
   Interfacial Free Energy
   Boundaries in Single Phase Solids
   Interphase Interfaces in Solids
   Interface Migration

Chapter 4   <u>Solidification</u>
Nucleation in Pure Metals
Growth of Pure Solids
Solidification of Single Phase Alloys
Eutectic Solidification

Chapter 5   <u>Diffusional Transformations in Solids</u>
Homogeneous Nucleation
Heterogeneous Nucleation
Precipitate Growth
TTT Diagrams
Precipitation in Age-Hardening Alloys
Spinodal Decomposition
The Precipitation of Ferrite from Austenite
Ordering Transformation

(Chapter 6)   <u>Diffusionless Transformation</u>
Characteristics of Diffusionless Transformation
Martensite Transformation

Remarks: Due to the large amount of contents to cover, I might skip some of the items in the above list with notice.

Components of Your Grade:

1) **Exams (1st: 25%; 2ⁿᵈ 25%; final: 25%)**
There will be three exams, each of which will take 2-3 hours. I will not use class time for the exams and instead will reserve separate time slots. The exams will be conceptual and difficult.

2) **Team project (15%, tentative)**
Course participants will organize into small groups. Topics for phase transformation will be discussed, and each group will submit a proposal and reports as well as give a final presentation.

3) **Homework (5%) (+Incentive Homework 5%) and Attendance (5%)**
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.

Remarks: 1) The weight of each component above could be adjusted up to 5% based on students' performance. 2) Student who retakes this course will have their final scores adjusted downward by 5% in order to ensure fairness with other students.
● 청강학생은 숙제는 제출하지 않아도 되지만 시험은 반드시 참여해야 함.

Course Policies, Questions and Answers

Q: Will there be recitation sections?

A: None is planned, but if you really want them, speak up. I can arrange them if necessary.
Although most classes will be lectures, I strongly encourage you to engage in discussions and ask questions in order to facilitate interactive learning experiences.

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.