**UNIVERSITY OF CALIFORNIA**
**College of Engineering**
**Department of Materials Science & Engineering**

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**MAT SCI 103**
Phase Transformations & Kinetics

**Spring, 2017**

## LOGISTICS

**Course Website** bCourses (MAT SCI 103 –LEC 001)

**Lecture** MWF 11:00-12:00 HMMB 348

**Discussion** W 5:00-6:00 HMMB 348

**GSI** Max Poschmann, maxp@berkeley.edu

**Office Hours** Professor Asta: Mon, 3:00-5:00 pm and Wed, 1:30-3:30 pm, HMMB 216

Max Poschmann (GSI): Th & Fri, 10-11 am, HMMB 350

**Textbook** David A. Porter, Kenneth E. Easterling and Mohamed Y. Sherif, *Phase Transformations in Metals and Alloys*, 3rd Edition, CRC Press (2009).

The information in the textbook will be supplemented by material taken from several other textbooks and related resources. All such material will be uploaded to the course website.

**Lectures** Lectures will make use of boardwork, with some powerpoint figures used to augment the content. Although the powerpoint figures will be posted on the course website, the material presented on the board will not be. You are encouraged to attend the lectures, as they will augment what is presented in the textbook.

## GRADING

"As a member of the UC Berkeley community, I act with honesty, integrity and respect for others" (http://www.asuc.org/honorcode/index.php)

**Ethics**

Please remember that this is your honor code. It is a simple pledge that will serve you well during your academic career, and provide a solid foundation for success in your career as a practicing professional, when you will be held to even higher standards.

**Course Grade**

There are no individual thresholds assigned to the different components of your grade. All components are scored, weighted, pooled, then mapped onto a curve for a course grade determination at the end of the semester, based on the following guidelines.

**Homework 25%**

Due dates: Homework assignments are to be submitted electronically on the course website by 11:59 pm on Fridays. Deadlines are firm, to allow for timely uploading of solutions as additional study guides. When computing the final homework grade, the lowest two scores on the assignments will be dropped. No late assignments will be accepted.

Regrade policy: Homeworks will be graded by the course reader. If you have a question about the grading of an assignment, you must submit a hardcopy of the homework, with a cover sheet explaining your rationale for requesting more points. This must be submitted to the GSI within one week after the homework has been returned. **After one week regrades will not be considered.**

Your homework submissions must be your own work. The objective of these assignments is to guide your self-learning. Homework is not meant to be a "group learning" exercise, and not an artistic alteration of answers from others to avoid a plagiarism charge. Homework sets containing similar solutions may be considered academic dishonesty, in which case zero points will be awarded for the assignment and a report to the Center for Student Conduct will be considered.

**Midterms 40%**

Two midterms will be given on the dates listed in the table below. The midterms will be held in class. The exams will be closed-book and you will be provided formula sheets with relevant equations. Midterms are not cumulative. The first exam will test material from the first six weeks, and the second midterm will cover material from the next six weeks.

Regrade policy: If you have a question about the grading of an exam, you must submit it, with a cover sheet explaining your rationale for requesting more points, to the GSI within one week after the exam has been returned. **After one week regrades will not be considered.**

**Final Exam 35%**

A cumulative three hour final exam will be held on Tuesday, May 9 from 7-10 pm.

## COURSE CONTENT AND SCHEDULE

| Date | Section | Topics | HW/Exams |
|---|---|---|---|
| Wed, 1/18 | 11am-12pm | *Lecture 1*: Introduction, Review of Thermodynamics | |
| Wed, 1/18 | 5-6pm | *Lecture 2*: Phase Equilibria and Gibbs Free Energy | |
| Fri, 1/20 | 11am-12pm | *Lecture 3*: Gibbs Phase Rule | |
| Mon, 1/23 | 11am-12pm | *Lecture 4*: Free Energies of Binary Mixtures | |
| Wed, 1/25 | 5-6pm | *Lecture 5:* Ideal Solutions and Regular Solutions | |
| Wed, 1/25 | 11am-12pm | Discussion | |
| Fri, 1/27 | 11am-12pm | *Lecture 6*: Bragg Williams model | **HW01** |
| Mon, 1/30 | 11am-12pm | *Lecture 7*: Order-disorder transitions | |
| Wed, 2/1 | 11am-12pm | *Lecture 8*: Binary phase diagrams(I) | |
| Wed, 2/1 | 5-6pm | Discussion | |
| Fri, 2/3 | 11am-12pm | *Lecture 9*: Binary phase diagrams (II) | **HW02** |
| Mon, 2/6 | 11am-12pm | *Lecture 10*: Binary phase diagrams (III) | |
| Wed, 2/8 | 11am-12pm | *Lecture 11*: Binary phase diagrams (IV) | |
| Wed, 2/8 | 5-6pm | Discussion | |
| Fri, 2/10 | 11am-12pm | *Lecture 12*: Ternary phase diagrams (I) | **HW03** |
| Mon, 2/13 | | *Lecture 13:* Ternary phase diagrams (II) | |
| Wed, 2/15 | 11am-12pm | *Lecture 14*: Ternary phase diagrams (III) | |
| Wed, 2/15 | 5-6pm | Discussion | |
| Fri, 2/17 | 11am-12pm | *Lecture 15*: Fick's first law | **HW04** |
| Mon, 2/20 | 11am-12pm | Campus Holiday | |
| Wed, 2/22 | 11am-12pm | *Lecture 16*: Steady-state diffusion | |
| Wed, 2/22 | 5-6pm | Discussion | |
| Fri, 2/24 | 11am-12pm | *Lecture 17*: Fick's second law | **HW05** |

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| Mon, 2/27 | 11am-12pm | *Lecture 18*:<br>Solutions to diffusion equation | |
| Wed, 3/1 | 11am-12pm | *Midterm 1* | **EXAM** |
| Wed, 3/1 | 5-6pm | No Class | |
| Fri, 3/3 | 11am-12pm | *Lecture 19*:<br>Atomistic mechanisms of diffusion | |
| Mon, 3/6 | 11am-12pm | *Lecture 20*:<br>Diffusion couples | |
| Wed, 3/8 | 11am-12pm | *Lecture 21*:<br>Kirkendall effect | |
| Wed, 3/8 | 5-6pm | Discussion | |
| Fri, 3/10 | 11am-12pm | *Lecture 22*:<br>Interfaces: structure and energy | **HW06** |
| Mon, 3/13 | 11am-12pm | *Lecture 23*:<br>Surfaces and equilibrium crystal shape | |
| Wed, 3/15 | 11am-12pm | *Lecture 24*:<br>Solid-solid interfaces | |
| Wed, 3/15 | 5-6pm | Discussion | |
| Fri, 3/17 | 11am-12pm | *Lecture 25*:<br>Coherent vs. incoherent interfaces | **HW07** |
| Mon, 3/20 | | *Lecture 26*:<br>Homogeneous nucleation (I) | |
| Wed, 3/22 | | *Lecture 27*:<br>Homogeneous nucleation (II) | |
| Wed, 3/22 | | Discussion | |
| Fri, 3/24 | | *Lecture 28*:<br>Homogeneous nucleation (III) | **HW08** |
| Mon, 3/27 | | **Spring Break** | |
| Wed, 3/29 | | **Spring Break** | |
| Fri, 3/31 | | **Spring Break** | |
| Mon, 4/3 | 11am-12pm | *Lecture 29*:<br>Heterogeneous nucleation (I) | |
| Wed, 4/5 | 11am-12pm | *Lecture 30*:<br>Heterogeneous nucleation (II) | |
| Wed, 4/5 | 5-6pm | Discussion | |
| Fri, 4/7 | 11am-12pm | *Lecture 31*:<br>Growth and Avrami equation | **HW09** |
| 4/10 | 11am-12pm | *Lecture 32*:<br>TTT diagrams | |
| 4/12 | 11am-12pm | *Lecture 33*:<br>Growth of pure solid in liquid | |
| 4/12 | 5-6pm | Discussion | |

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| 4/14 | 11am-12pm | *Lecture 34*:<br>Dendritic growth | **HW10** |
| 4/17 | 11am-12pm | *Lecture 35:*<br>Growth of binary solid in liquid | |
| 4/19 | 11am-12pm | *Midterm 2* | **EXAM** |
| 4/19 | 5-6pm | *Lecture 36*:<br>Zone refining and coring | |
| 4/21 | 11am-12pm | *Lecture 37*:<br>Constitutional supercooling<br>Cellular and dendritic solidification | |
| 4/24 | 11am-12pm | *Lecture 38*:<br>Spinodal decomposition (I) | |
| 4/26 | 11am-12pm | *Lecture 39*:<br>Spinodal decomposition (II) | |
| 4/26 | 5-6pm | Discussion | |
| 4/28 | 11am-12pm | *Lecture 40*:<br>Martensitic transformations | **HW11** |
| 5/1 | | RRR: Reviews TBA | |
| 5/3 | | RRR: Reviews TBA | |
| 5/5 | | RRR: Reviews TBA | |
| 5/9 | 7-10pm | Final Exam Tuesday May 9, 7-10pm | **EXAM** |