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

Mat Sci 103 Phase Transformations & Kinetics Spring, 2020

LOGISTICS

Instructors	Mark Asta mdasta@berkeley.edu Matthew Sherburne mpsherb@berkeley.edu
Teaching Assistant	Anas Abu-Odeh anas_abuodeh@berkeley.edu
Course Website	bCourses (MAT SCI 103 – LEC1)
Lectures	MWF 11am-12pm 348 HMMB
Discussions (Optional)	Th 5:30pm-6:30pm 348 HMMB
Office Hours	Prof. Asta: MW 5 - 6pm 319 HMMB Prof. Sherburne: T 5 - 6pm TH 4-5pm 481 HMMB GSI Anas: Fri 10 - 11am 350 HMMB
Textbook	David A. Porter, Kenneth E. Easterling and Mohamed Y. Sherif, *Phase Transformations in Metals and Alloys*, 3rd Edition, CRC Press (2009).
Lectures	Lectures will make use of boardwork and powerpoint. Although the powerpoint slides (as PDFs) will be posted on the course website, the material presented on the board may 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, and 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 Teaching Assistant within one week after the graded 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 should not be an altered version of work from others. 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 five homework assignments, and the second midterm will cover material from the next five homework assignments.

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 graded 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 12 from 7-10 pm. It will be a closed-book and you will be provided formula sheets with relevant equations. The final exam will be cumulative and cover all of the course content.

COURSE CONTENT AND SCHEDULE

Proposed Calendar – Subject to adjustment and change as the class develops

Day	Date	Activity	Assignments Due
Tues.	Jan. 21		
Wed.	Jan. 22	Course Syllabus and Thermodynamics Introduction	
Thur.	Jan. 23		
Fri.	Jan. 24	Single Component Free Energy Curves Pressure-Temperature Phase Diagrams	
Mon.	Jan. 25	Clausius-Clapeyron Equation and Gibbs Phase Rule	
Tues.	Jan. 28		
Wed.	Jan. 29	Phase Transformation Driving Forces Binary Mixtures	
Thur.	Jan. 30	Discussion	
Fri.	Jan. 31	Gibbs Free Energies for Binary Mixtures Chemical Potentials Method of Intercepts	**HW #1**
Mon.	Feb. 1	Two-Phase Equilibrium Common Tangent Construction Binary phase diagrams (I) Ideal-Solution "Lens" Diagram	
Tues.	Feb. 4		
Wed.	Feb. 5	Lever Rule Chord Construction	
Thur.	Feb. 6	Discussion	
Fri.	Feb. 7	Common Tangent Regular Solution Model	**HW #2**
Mon.	Feb. 8	Miscibility Gaps	
Tues.	Feb. 11		
Wed.	Feb. 12	Activities and Activity Coefficients	
Thur.	Feb. 13	Discussion	
Fri.	Feb. 14	Binary phase diagrams (II) Congruent Melting as Example of Invariant Equilibria	**HW #3**
Mon.	Feb. 15	Binary phase diagrams (III) Eutectic and Peritectic Equilibria	
Tues.	Feb. 18	Academic and Administrative Holiday – No Class	
Wed.	Feb. 19	Binary Phase Diagrams (IV) Ternary Phase Diagrams (I)	
Thur.	Feb. 20	Discussion	
Fri.	Feb. 21	Ternary Phase Diagrams (II)	**HW #4**
Mon.	Feb. 22	Ternary Phase Diagrams (III)	
Tues.	Feb. 25		
Wed.	Feb. 26	Ternary Phase Diagrams (IV)	
Thur.	Feb. 27	Discussion	
Fri.	Feb. 28	Diffusion: Fick's First Law	**HW #5**
Mon.	Mar. 2	Steady-State Diffusion Non-Steady-State Diffusion: Fick's Second Law	
Tues.	Mar. 3		
Wed.	Mar. 4	*Midterm Review*	
Thur.	Mar. 5	Discussion	
Fri.	Mar. 6	**Midterm 1**	
Mon.	Mar. 9	Useful Solutions to Diffusion Equation	
Tues.	Mar. 10		
Wed.	Mar. 11	Diffusion Mechanisms: Interstitial	

Thur.	Mar. 12	Discussion	Assignments Due
Fri.	Mar. 13	Diffusion Mechanisms: Vacancy Mediated	**HW #6**
Mon.	Mar. 16	Interdiffusion in Substitutional Alloys	
Tues.	Mar. 17		
Wed.	Mar. 18	Kirkendall Effect Mobilities and Thermodynamic Factors	
Thur.	Mar. 19	Discussion	
Fri.	Mar. 20	Interfacial Energy and Crystalline Anisotropy	**HW #7**
	Mar. 23-27	Spring Break – No Class	
Mon.	Mar. 30	Equilibrium Crystal Shape and Wulff Construction	
Tues.	Mar. 31		
Wed.	Apr. 1	Grain Boundaries & Grain Boundary Energy	
Thur.	Apr. 2	Discussion	
Fri.	Apr. 3	Solid-Solid Heterophase Interfaces	**HW #8**
Mon.	Apr. 6	Homogenous Nucleation (I) Elemental Solid/Liquid Transitions	
Tues.	Apr. 7		
Wed.	Apr. 8	Homogeneous Nucleation (II) Binary Systems	
Thur.	Apr. 9	Discussion	
Fri.	Apr. 10	Heterogeneous Nucleation (III) Solid-Solid Transformations and Strain Energy	**HW #9**
Mon.	Apr. 13	Heterogeneous Nucleation (I)	
Tues.	Apr. 14		
Wed.	Apr. 15	Heterogeneous Nucleation (II)	
Thur.	Apr. 16	Discussion	
Fri.	Apr. 17	Avrami Equation	**HW #10**
Mon.	Apr. 20	TTT Diagrams and Interface Growth	
Tues.	Apr. 21		
Wed.	Apr. 22	Diffusion Limited Growth	
Thur.	Apr. 23	Discussion	
Fri.	Apr. 24	**Midterm 2**	
Mon.	Apr. 27	Ostwald Ripening (Coarsening)	
Tues.	Apr. 28		
Wed.	Apr. 29	Spinodal Decomposition (I)	
Thur.	Apr. 30	Discussion	
Fri.	May 1	Spinodal Decomposition (II)	**HW #11**
	May 4-8	Reading Week	
Tues.	May 12	Final Exam: 7pm - 10pm	