Course	**MSEN 6380/MECH 6357 Phase Transformations and Kinetic Processes in Materials *(1/14/22 Draft)***
Professors	Lev D. Gelb
Term	Spring 2022
Meetings	Monday and Wednesday, 10:00 – 11:15 AM, ECSN 2.120

Professor's Contact Information

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Office Hours	TBA

General Course Information

Start-of-semester COVID protocols	The University directed that classes must be available in synchronous online mode through 2/4/22, at the previously scheduled time. In this class we will continue to have in-person meetings (at low density and socially-distanced) which will also be remote-accessible through Teams. Students may join the Teams meeting and participate in the lectures that way at no disadvantage. Assignments will be collected by electronic means during this period.
Prerequisites	MSEN 5300 *Introduction to Materials Science* and MSEN 5310 *Thermodynamics of Materials,* or equivalent by permission of instructor.
Course Description	This course covers diffusion, interfacial motion, nucleation, precipitation, order-disorder transitions, phase transformations, and dynamical processes at grain boundaries and on surfaces. Both macroscopic and atomic-scale approaches are used to understand these phenomena. Particular applications considered include phase transformations in bulk materials, surface evolution and thin-film growth, semiconductor processing, and nanomaterials synthesis.
Learning outcomes	This course will provide advanced students with fundamental principles and practical tools for the analysis of phase transformations and kinetic processes in materials science and engineering. Both macroscopic (thermodynamic) and atomic-scale approaches will be used. Upon completion of the course, students will be able to: • Describe diffusion in solids, liquids and gases, and upon surfaces • Describe crystal interfaces and microstructures and their evolution • Apply theories of nucleation and growth • Describe solidification, precipitation, diffusional and diffusionless transformations Successful completion of these objectives will be demonstrated through the completion of homework assignments and exam problems.
Texts & Materials	Principal materials: • R. O'Hayre, Materials Kinetics Fundamentals, 1rst ed., Wiley 2015. • Handouts Supplementary sources: • D. A. Porter and K. E. Easterling, *Phase Transformations in Metals and Alloys*, 3rd ed., CRC Press 2009. • K. A. Jackson, *Kinetic Processes*, 2nd Ed., Wiley 2010. • Balluffi, Allen, and Carter, *Kinetics of Materials*, Wiley and Sons 2005. • D. R. Gaskell, *Introduction to the Thermodynamics of Materials*.

Schedule and Academic Calendar

Week		Topic/Activity
1		Thermodynamics and phase diagrams; Chemical equilibria; surfaces
2		Chemical reaction kinetics and dynamics
3		Transport kinetics (diffusion)
4		Transport kinetics (diffusion)
5		Gas-solid kinetics and processes
6		Gas-solid kinetics and processes
7		Gas-solid kinetics and processes
8		Phase transformations, *midterm exam*
9		Nucleation theory
10		*Spring break, no class.*
11		Solidification
12		Precipitation
13		Coarsening and ripening; sintering
14		Ordering transitions, magnetic transitions, glass transitions
15		*Student presentations*
		Final exam

(The actual time spent on each topic may vary somewhat from this schedule.)

Course Policies

Grading Critera

The course grade will be based on homework, two midterms and a final exam, weighted as:

Homework	**25%**
Project	**25%**
Exams:	**50% (2x25%)**

Homework

Weekly homework assignments will consist of "warm-up" problems (with solutions provided) and problems to be turned in. **Assignments are (still) due at the start of class on Mondays** and should be submitted on eLearning. Work must be shown in order to receive credit. Your work must be your own.

The lowest **two** homework scores will be dropped. If you have an acceptable, documented reason for missing a homework (for instance, serious illness), your grade will be based on a correspondingly reduced total number of assignments; otherwise-missed assignments will receive a "zero" grade.

Exams

Two exams will be given. If you have an acceptable, documented reason for missing an exam your grade will be based on a correspondingly reduced total number of exams; otherwise-missed exams will receive a "zero" grade. **There are no make-ups for missed exams.**

You will download the second exam and submit your solutions via eLearning. You will have a limited time in which to complete your exam. Partial credit will be given only for significant progress towards solutions and at the discretion of the instructor. Work must be shown in order to receive credit.

Projects

Projects will report on an interesting or important topic in materials kinetics. Each student will prepare and give a ~20 minute classroom presentation on their topic. All students will provide anonymous feedback on each presentation.

Attendance

Regular attendance is critical to your success in this class.

Regrade Policy	Requests to have [part of] a homework/exam regraded must be made within one week of receiving the graded item back. You must provide the original homework/exam, **unaltered**, along with a clear explanation of how it was graded incorrectly. Unsubstantiated requests for additional partial credit will not be accepted. If you alter **in any way** the assignment prior to returning it, it will be considered a violation of academic integrity and treated accordingly.
Classroom Decorum	Students should conduct themselves in a manner appropriate to a University classroom setting, even when online. Any behavior that is disruptive, inconsiderate, or offensive is subject to disciplinary action.

UT Dallas Syllabus Policies and Procedures

The *University policies and procedures* segment of the course syllabus is available at:

http://go.utdallas.edu/syllabus-policies

The terms described in this syllabus are subject to change at the discretion of the Professor.