

MASC 310 – Materials Behavior and Processing

Dr. Lessa Grunenfelder
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Course Description

Materials Behavior and Processing is intended for undergraduate engineering students from all engineering disciplines. The subject of materials is broad, and encompasses metals, ceramics, polymers, composites, and other advanced materials. The 310 course covers fundamental concepts underlying the behavior of engineering materials, as well as materials selection and processing methods. The course employs an integrated approach that stresses concepts that are applicable to all materials. The structure of the course primarily follows the text by Callister, which provides a bottom up introduction to materials science incorporating fundamentals, microstructure development, properties, and manufacturing. Supplemental readings and electronic resources are utilized to highlight specific concepts. The course integrates a focus on the selection of materials and processes for engineering design.

Contact information

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Office hours: Tuesdays 11:00-12:30

Office hours with TA's every week (check Blackboard)

Course Objectives

Following completion of this course, students should be able to

- Explain the importance of materials science in everyday life, and in the context of engineering
- Work effectively in a multi-disciplinary team of peers
- Describe relationships between the atomic structure and microstructure of a material and its properties
- Explain if and how microstructure can be altered (via deformation, heat treatment, etc.) to modify specific material properties
- Given a materials design problem, evaluate the available options, apply constraints to narrow possible choices, utilize objectives to select a material and/or process, and justify the final selection.

In addition to these general themes, students will be able to perform specific tasks including

- Utilize CES EduPack to produce material property charts, access detailed records, and perform material and process selection
- Perform honest self-evaluations of performance, and fairly and accurately evaluate peers on group work

- Describe the organizational scheme of the periodic table, the electron structure of atoms, and the mechanisms of atomic bonding
- Define and differentiate between the various material families on the basis of atomic structure and bonding, properties, and processing routes
- Identify crystallographic planes and directions in cubic systems, and perform calculations based on crystal structure
- Classify defects in crystalline materials on the basis of their geometry, and describe the influence of various defects on material properties and performance
- Interpret and construct phase diagrams for binary systems, and utilize time-temperature-transformation and continuous-cooling-transformation diagrams to predict microstructure
- Discuss the environmental impact of material selection and processing choices, describe the materials life cycle, and identify possible ways to reduce the environmental impact of a product

Content

A Blackboard website for the course (<http://blackboard.usc.edu>) provides assignments, solutions, supplemental readings, and a schedule of lectures.

Text:

Fundamentals of Materials Science and Engineering: An Integrated Approach, 4th edition, William D. Callister, 2011 ISBN: 9781118061602

The Toaster Project, Thomas Thwaites, 2011 ISBN: 9781568989976 (available via Amazon and other book sellers)

Cooperative Learning Assignment Policy:

Unless otherwise specified, homework must be completed in teams (which will be assigned at the beginning of the semester). Weekly homework assignments are assigned on Thursdays and are due the following Thursday at or before the beginning of class. Homework is considered late if received later than the start of class, and will be penalized 25%. Homework will not be accepted after 24 hours past the due date and time.

Team roles. For each team assignment, the team must designate a **coordinator**, **recorder**, **monitor** and **checker**. Team roles must be rotated on every assignment and be listed clearly on the cover page of the homework solution. Once a team member has carried out a role, they may not perform that role again until everyone else on the team has done it. If a student's name is listed on the assignment, it certifies that the student has actively participated in solving the problems.

Coordinator: organizes work sessions, makes sure all team members know where and when to meet, keeps the group on task and makes sure everyone is involved.

Recorder: Prepares the final solution to be turned in. Each assignment should be written *only* in the recorder's handwriting and appear professional and legible.

Monitor: Checks to make sure all team members understand both the solution and the strategy used to obtain that solution.

Checker: Double-checks and submits the final solution. It is the responsibility of the checker to make sure the recorder has not made any errors in transcribing the solution, and to bring the homework solution to class and submit it on time. If the checker anticipates a problem getting to class on time on the due date of the assignment, it is their responsibility to make sure the assignment is submitted on time (find someone else to submit or bring the assignment to the instructor's office prior to class)

Individual accountability. Every team member is expected to individually outline a proposed approach to each problem before the team meets. On some assignments, this will be explicitly required and individual outlines will need to be signed and submitted with the homework solution. Additionally, all students will periodically be asked to evaluate how well they and their teammates are performing as team members. These evaluations will be incorporated into the assignment of final homework grades.

Team conflict. Teams will be assigned using an algorithm in an attempt to maximize team success. That said, should a team encounter conflict they must do their best to resolve any issues as a group. Should repeated attempts to improve team functioning (including instructor intervention) prove unsuccessful, a nonparticipant may be fired and a team member who feels they are doing all of the work may quit. Students who are fired or who quit a team must find another team willing to accept them, or receive zeros for the remainder of the homework.

Firing: If a team member does not participate on an assignment, their name should not be included on the solution (and they will receive a zero on the assignment). If the non-participation continues, the team should arrange to meet with the instructor. If no resolution is achieved, the participating team members may notify the uncooperative member via email that they are in danger of being fired, cc'ing the instructor on the email. If there is no subsequent improvement, the participating members should notify the individual via email that they are no longer a member of the team, and copy the instructor.

Quitting: Students who are consistently doing all of the work for their team may issue a warning via email that they will quit unless they start getting greater participation from their team members (copy the instructor). A second email must be sent to the team and the instructor to officially quit the team if conditions do not improve.

Any student who is fired from or quits a team must meet with the instructor immediately to avoid receiving zeros for the remaining assignments.

Why team homework? There are several motivations behind the use of team homework in the MASC 310 course. The first is that one of the main learning objectives in the course, and a key skill for every practicing engineer, is the ability to work effectively as a member of a multi-disciplinary team. Students in MASC 310 come from many different majors and therefore have valuable insight and experiences to share with one another. By working in diverse teams, the playing field in the course is leveled, and students with prior knowledge of certain aspects

of the course content (for example, mechanical engineers familiar with stress-strain curves) can share that expertise with students who have not seen the content in previous classes. Working as a team reduces stress and facilitates deeper learning, while providing each student with a built-in study group.

Another benefit to team homework is student access to feedback. MASC 310 is a very large course (~100 students spread over 2 sections). In a course this large, homework assignments often become watered down to make grading feasible. With group homework, the number of assignments being turned in is reduced, allowing for more meaningful questions to be asked and more meaningful feedback to be provided.

Finally, there is no better way to ensure understanding of a concept than explaining that concept to others. Students, like professors, learn best when they teach. Team homework enables students to take ownership over their education, helping their teammates while at the same time cementing their own understanding.

Project Deliverables

MASC 310 culminates with a design project. Details of the project will be discussed in class and posted on Blackboard. Project deliverables will be assigned with specific due dates and times. Late project deliverables are penalized 25% if received after the specified time, and an additional 25% every 12 hours thereafter.

Software: The course will use software called CES EduPack for homework assignments and the final project. The software will be available through the Viterbi virtual desktop infrastructure (VDI). See Blackboard for details.

A free online software package, CATME, will be used for assigning homework teams and completing tasks such as team evaluations. More information on how to use the CATME interface will be discussed in class.

Exams: While homework is completed in teams, students will be tested as individuals. Exam scores will consist of 2 midterms and a final. Exams are closed book and closed notes. An equation sheet will be provided for each exam, and made available prior to the exam to facilitate studying. On all exams, any homework team for which the average exam grade exceeds 85% will receive 2 points extra credit.

Grading

Grading	
Team Homework	15%
Midterm 1	20%
Midterm 2	20%
Project	15%
Final exam	30%

Diversity Statement

I am committed to creating an inclusive environment in which all students are respected and valued. I will not tolerate disrespectful language or behavior on the basis of age, ability, color/ethnicity/race, gender identity/expression, marital/parental status, military/veteran's status, national origin, political affiliation, religious/spiritual beliefs, sex, sexual orientation, socioeconomic status or other visible or non-visible differences. I expect the same from you.

You are here to learn the course content, and I am here to teach it, but we are all here to grow as people and learn from one another. It is each of our responsibility to ensure that the classroom, and the university as a whole, is a safe and inclusive environment that facilitates learning.

Statement for Students with Disabilities

Any candidate requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. to 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776. The email address is ability@usc.edu. The website for DSP has additional information regarding accommodations and requests (www.usc.edu/disability).

Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others and to avoid using another's work as one's own. All students are expected to understand and abide by these principles.

Section 11.00 of *SCampus*, the USC Student Guidebook, which outlines behaviors that violate the USC Student Conduct Code, can be found here:

<https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/>

A list of recommended sanctions for a range of academic integrity violations are located in Appendix A of *SCampus*, which can be found here:

https://scampus.usc.edu/files/2009/08/appendix_a.pdf

Should there be any suspicion of academic dishonesty, students are referred to the Office of Student Judicial Affairs and Community Standards (SJACS) for further review. The SJACS review process can be found here:

http://www.usc.edu/student-affairs/SJACS/pages/students/academic_integrity.html

The SJACS website provides additional resources that you will find helpful in understanding what is meant by academic integrity, such as the following:

Academic Integrity: A Guide for Graduate Students

<http://www.usc.edu/student-affairs/SJACS/forms/GradIntegrity.pdf>

Academic Integrity Overview

<http://www.usc.edu/student-affairs/SJACS/forms/AcademicIntegrityOverview.pdf>

Incompletes

An incomplete (IN) is given when work is not completed because of documented illness or some other emergency occurring after 80% of the course has been completed. Arrangements for the IN and its removal should be initiated by the student and agreed to by the instructor prior to the final exam. The University policy on IN is as follows (from the USC Catalogue):

Conditions for Removing a Grade of Incomplete: If an IN is assigned as the student's grade, the instructor will fill out the IN Completion form which will specify to the student and to the department the work remaining to be done, the procedures for its completion, the grade in the course to date, and the weight to be assigned to work remaining to be done when computing the final grade. A student may remove the IN by completing only the work not finished as a result of illness or emergency. Previously graded work may not be repeated for credit. It is not possible to remove an IN by re-registering for the course, even within the designated time.

Time Limit for Removal of an Incomplete: One calendar year is allowed to remove an IN. Individual academic units may have more stringent policies regarding these time limits. If the IN is not removed within the designated time limit, the course is considered "lapsed" and the grade is changed to an IX and it will be calculated into the grade point average as 0 points. Courses offered on a Credit/No Credit basis or taken on a Pass/No Pass basis for which a mark of IN is assigned will be lapsed with a mark of NC or NP and will not be calculated into the grade point average.

Standards of Appropriate Online Behavior

This course involves both in-person and online segments. The protocols defined by the USC Student Conduct Code will be upheld in online classes. Students are not allowed to post inappropriate material, spam to the class, use offensive language, or engage in online flaming. For more information, please visit <http://www.usc.edu/student-affairs/SJACS>

Emergencies and Course Continuity

In case of emergency, and if travel to campus is difficult, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of 2SC, teleconferencing, and other technologies. Although this course uses the 2SC LMS for online support, an emergency site for the course is also available through 2SC (2SC.usc.edu). For

additional information about maintaining classes in an emergency, please access:
<http://cst.usc.edu/emergency-preparedness/>

In the Event of Technical Breakdowns: Students may submit assignments to the instructor via email by the posted due date. Remember to frequently back up your work, post assignments once completed, load files onto a power drive, and keep a hard copy of papers/projects.

Academic Accommodations

The University of Southern California is committed to full compliance with the Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA). As part of the implementation of this law, the University will continue to provide reasonable accommodation for academically qualified candidates with disabilities so that they can participate fully in the University's educational programs and activities. Although USC is not required by law to change the "fundamental nature or essential curricular components of its programs in order to accommodate the needs of disabled candidates," the University will provide reasonable academic accommodation. It is the specific responsibility of the University administration and all faculty serving in a teaching capacity to ensure the University's compliance with this policy.