

AME 231L – Mechanical Behavior of Materials

Dr. Lessa Grunenfelder
Spring, 2019

Lecture

MW 10:00-10:50 am VHE 210
No class 1/20, 2/17, 3/16, 3/18

Course description

AME 231L introduces the fundamental concepts of materials science in the context of aerospace engineering applications and mechanical behavior. Lectures focus on fundamentals, microstructure development, and structure-property relationships. The laboratory component of the course exposes students to mechanical testing of materials and the techniques of material characterization. The behavior of crystalline materials, specifically metals, is emphasized, though the course stresses concepts that are applicable to all materials. Specific focus is given to steels and cast irons.

Lab reports are completed in groups and homework and exams are individual, providing students with the chance to showcase the ability to work both collaboratively and independently. Lab sections are capped at 10 people to allow each student to perform all experiments and obtain hands on experience.

Contact information

Dr. Lessa Grunenfelder
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Office hours: Monday 1:00 -2:00 pm, or by appointment

TAs: Joel Bahena jabahena@usc.edu
Karina Hemmendinger khemmend@usc.edu
Office hours with TAs every week (check Blackboard)

Course Objectives

Following completion of this course, students should be able to

- Perform experiments, analyze and present data, and communicate findings via clear and concise reports
- Explain the importance of materials science in everyday life, and in the context of aerospace engineering
- Describe structure-property relationships in engineering materials
- Explain if and how microstructure can be altered (via deformation, heat treatment, etc.) to modify specific material properties

A Blackboard website for the course (<http://blackboard.usc.edu>) will be used for general announcements, assignments, course emails, and important course documents and information. Homework and lab reports will be submitted via Blackboard. Be sure to check Blackboard and your USC email regularly.

Text: Materials Science and Engineering – an Introduction, 10th edition, Callister and Rethwisch, 2014 ISBN: 9781119405498

Feel free to purchase a hard copy of the textbook (new or used) from the USC bookstore, or purchase or rent an electronic version of the text:

<https://www.vitalsource.com/products/materials-science-and-engineering-an-william-d-callister-jr-v9781119405498>

Past editions contain all necessary content. Homework is not assigned out of the textbook. Students are responsible only for material covered in class/labs.

Tentative Schedule (week-by-week)

Week	Topic	Book Ch	Lab
1/3	Introduction and classification of Materials Stress-strain, elastic deformation	1 6	Lab safety and lab reports
1/20	<i>No class 1/20</i> Tensile properties and hardness	6	Tensile testing – Elastic modulus/Yield to fracture
1/27	Bonding	2	Plotting stress-strain curves
2/3	Crystal structures	3	Vickers Indentation
2/10	Plastic deformation	6, 7	Optical characterization of fractured samples
2/17	<i>No class 2/17</i> Dislocations and strain hardening	4, 7	Electron microscopy (CEMMA) LAB REPORT #1 DUE
2/24	Solid solution and grain boundary strengthening	7	Deformation by rolling/Vickers on rolled specimens
3/2	Annealing MT	7	Anneal rolled specimens/Vickers of annealed samples
3/9	Introduction to microstructure and phase diagrams More complex phase diagrams	9	Polishing for crystallographic information LAB REPORT #2 DUE
3/16	SPRING BREAK – No class/lab		
3/23	The Fe-C phase diagram Phase transformation	9 10	Characterization/testing of aerospace materials
3/30	Phase transformation cont. Structure-property relationships	10	Characterization/testing of aerospace materials (cont.)
4/6	Metal alloys Cellular materials	11 --	Heat treatment/testing of Fe alloys LAB REPORT #3 DUE
4/13	Composites	16	Synthesis of composites
4/20	Failure	8	Testing and analysis of composites
4/27	Failure cont.	8	LAB REPORT #4 DUE No lab

Laboratory

Location: KAP B28 (attend the section you are registered for – see schedule of classes for days and times)

Labs are experience-based, so lab participation is required. Lab experiments and reports are completed in groups. *Please alert me and your lab TA if you are experiencing issues with your lab group.* Lab reports are due during the designated week (see schedule above) and are submitted via Blackboard.

Wear long pants and close-toed shoes to lab.

Important Dates

Midterm: Wednesday 3/4, in class

Final exam: *Monday 5/11, 8:00-10:00*

Exams are closed book. An equation sheet will be provided, and calculators are allowed. Exams will cover material from both lecture and lab.

Grade Breakdown

Grading	
Lab Reports (4)	40%
Lab Participation and Homework	15%
Midterm	20%
Final Exam	25%

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 based on 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, is a safe and inclusive environment that facilitates learning.

Statement for Students with Disabilities

Any student 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 the instructor (or to the Coach) as early in the semester as possible. DSP is located in STU 301 and is open from 8:30 a.m. – 5:00 p.m., Monday through Friday, (213) 740-0776.

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.

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).