



AME 231L: Mechanical Behavior of Materials

Units: 3

Term—Day—Time: Spring 2021, MW 10:00-10:50

Location: Online

Instructor: Dr. Lessa Grunenfelder

Office: Online

Office Hours: Wednesday 9:00-10:00 am

Contact Info: grunenfe@usc.edu

Teaching Assistants: Karina Hemmendinger and Daniel Goodelman

Office: Online

Office Hours: Scheduled lab periods

Contact Info: khemmend@usc.edu, goodelma@usc.edu

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 covers concepts that are applicable to all materials.

Lab reports are completed in pairs and homework and exams are individual, providing students with the chance to showcase the ability to work both collaboratively and independently.

Learning Objectives

Following completion of this course, students should be able to

- Describe mechanical testing procedures, select a procedure to ascertain a specific material property, analyze and present data
- Communicate scientific findings via clear and concise lab 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. All assignments will be submitted via Blackboard. Be sure to check Blackboard and your USC email regularly.

Prerequisite(s): None

Co-Requisite(s): None

Recommended Preparation:

MASC 110L/CHEM 105 or equivalent

Course Notes

AME 231L will utilize both asynchronous and synchronous online learning modes. Class will meet via Zoom twice per week. In addition, short video lectures will be assigned periodically on specific topics. It is expected that students come to synchronous sessions having done any assigned preparation (reading and/or videos). Synchronous class time will be used for additional content delivery, questions and clarification, and working exercises (both independently and in small groups).

The laboratory component of the course will be asynchronous. Students will do pre-lab preparation (videos and/or readings) and be provided with data for analysis. Lab reports will cover multiple weeks' worth of experiments and be completed in pairs.

Communication

Students can attend scheduled Zoom office hours or contact me any time via email (grunenfe@usc.edu). Email will be responded to within 48 hours (usually sooner).

Technological Proficiency and Hardware/Software Required

All course content will be delivered via Blackboard and Zoom. For technical issues with Blackboard email blackboard@usc.edu and for Zoom issues contact the ITS Customer Support Center at consult@usc.edu

USC technology rental program

Attending classes online and completing coursework remotely requires access to technology that not all students possess. If you need resources to successfully participate in your classes, such as a laptop or internet hotspot, you may be eligible for the university's equipment rental program. To apply, please [submit an application](#).

USC Technology Support Links

[Zoom information for students](#)

[Blackboard help for students](#)

[Software available to USC Campus](#)

Required Materials

All required materials (course notes, readings, etc.) will be linked via Blackboard at no cost to students. A variety of resources will be used, including the following basic overview of materials and processes:

https://www.nde-ed.org/EducationResources/CommunityCollege/Materials/cc_mat_index.htm

Optional Materials

If you have an interest in materials science and would like to own an excellent introductory reference text, I recommend purchasing a used copy of *Materials Science and Engineering*, by Callister and Rethwisch (any edition).

Description and Assessment of Assignments

Class preparation and participation

Occasional instructional videos will be posted to Blackboard. Students are expected to watch these videos prior to class. Each video contains embedded quiz questions. Quizzes can be taken an unlimited number of times but must

be submitted prior to the class period in which video content will be discussed. Videos can be viewed again after the quiz due date.

Synchronous Zoom sessions will involve lecture as well as individual and group work. Students are expected to participate in breakout room and full class discussions. Participation will take several forms including responses to Zoom polls, comments in the chat box, and speaking over microphone. If a student is unable to attend a synchronous Zoom session, they can receive credit for class participation by watching the posted recording and completing any polls/activities and submitting to me via email.

Lab participation

Labs will take place asynchronously. Pre-lab preparation and data will be made available at the start of each week. All pre-lab materials must be reviewed before accessing data. It is expected that all students contribute to lab reports and attend mandatory lab meetings.

- All students are required to attend the first lab meeting of the semester (week 2). This meeting will consist of TA and student introductions, an overview of lab report expectations, and an introduction to the first set of experiments. Attend the lab section you are registered for.
- The week preceding the submission of each lab report student groups are required to meet with the lab TAs (for 20 min during the scheduled lab meeting time) to discuss expectations, go over a report outline/draft and clarify any questions. Meetings will be scheduled during the lab section you are registered for.
- The week following lab report submissions all students must attend the first 30 min of their scheduled lab section for feedback on the prior report and an introduction to the next set of experiments.
- All other lab meetings are optional and will be used for TA office hours. Students are welcome to attend any lab section(s) on these weeks.

Lab reports

Lab reports will be completed in pairs. Partners will be rotated for each report. A total of 3 reports will be completed throughout the semester, with each report containing data from multiple experiments. Lab reports are due by the end of the day on Sunday (11:59 pm).

Lab homework

While lab reports are completed in pairs and cover multiple experiments, some experiments will be accompanied by individual lab homework assignments. These assignments include analysis of lab data, formatting of figures and/or tables, or written assignments on key concepts. Lab homework is due by the end of the day on Sunday (11:59 pm).

Case Studies

In addition to group lab reports there will be 4 individual lab case studies throughout the semester. Case studies are designed to introduce students to experimental and data analysis techniques relevant to aerospace engineering. Each case study will be accompanied by a series of questions (not a full lab report).

Section quizzes

Blackboard quizzes will be assigned every few weeks, covering recent sections of the course. Quizzes will be assigned on Wednesday and due by the end of day Sunday (11:59 pm). Handwritten work must be scanned and uploaded with quiz submission. Quizzes are open resource (notes/internet) but must be completed individually (no consultation with other students or anyone else).

Take home final

A cumulative take home final will be assigned following the last class meeting of the semester. The final will consist of a combination of researched and referenced essay responses, calculations, and justified multiple choice and true/false responses. Again, the final is open resource (notes/internet) but must be completed individually (no consultation with other students or anyone else).

Grading Breakdown

Assignment	% of Grade
Class preparation/participation	5
Lab participation	5
Lab reports (3)	35
Case studies (4)	20
Lab homework	5
Section quizzes (3)	15
Take home final	15
Total	100

Grading Scale

Course final grades will be determined using the following scale.

Numerical Score	Letter Grade	Numerical Score	Letter Grade
90-100	A	74-78	C
87-90	A-	70-74	C-
84-87	B+	65-70	D+
82-84	B	60-65	D
80-82	B-	55-60	D-
78-80	C+	0-55	F

Assignment Submission

All course assignments will be distributed and submitted via Blackboard. Assignment feedback will also be accessible via Blackboard.

Grading Timeline

Assignments will be graded within a week of submission. Students can access feedback on lab homework, quizzes, and lab reports via Blackboard.

Late work

Deadlines for lab reports and the final exam are firm. A late penalty of 10% will be applied immediately following the due date, with an additional 15% deduction every 12 hours thereafter. Throughout the semester students will be granted 2 no-questions-asked extensions on any lab homework, case study submission, or section quiz. Extensions will move the due date to Friday, end of day (11:59 pm).

Academic integrity

Students are welcome to discuss lab reports and lab homework with peers. All submitted work, however, must be the student's own. Any information taken from sources must be cited – proper citation format for lab reports and the final exam will be discussed. Quizzes and the final are open resource (notes/internet) but must be completed individually (without consultation with peers, TAs, or anyone else).

Attendance

Attendance at MW synchronous Zoom lecture sessions is encouraged, but not required. When it is necessary for a student to miss a synchronous session, credit for in-class activities can be earned by watching the posted recording and completing and submitting any poll answers or activity write-ups. While many lab meetings are optional, students must attend mandatory meetings (see weekly schedule). Missed mandatory meetings must be discussed ahead of time with the TAs and a suitable alternative meeting time arranged.

Netiquette

"Netiquette" or "internet etiquette," describes recommended behaviors for online communication.

- Students can log in to synchronous sessions using a computer, tablet, or phone
- Students should update their display name in Zoom to reflect how they would like to be addressed by the instructor and peers
- Students should mute themselves when not speaking
- Students are encouraged, though not required, to turn on their webcams while in breakout rooms and while participating in discussions. If a camera is not available, or cannot be turned on, students should upload a profile photo to their Zoom account.
- Students are encouraged to unmute to ask questions at any time during synchronous sessions, and/or use the raise hand and chat features in Zoom.
- Students can eat, drink, and leave for bathroom breaks at any time during synchronous sessions
- Chat acronyms, emoticons, etc. are permitted in chat and on discussion boards

Please contact me with any questions about class policies or any issues with conduct in Zoom sessions or other online interactions.

Synchronous session recording notice

Synchronous sessions will be recorded and made available to students via Blackboard. Transcripts of the chat will also be archived and made available to students. Breakout room discussions will not be recorded.

Sharing of course materials outside of the learning environment

Per university policy, recordings of synchronous sessions as well as all asynchronous course materials (notes, assignments, etc.) cannot be shared outside of the MASC 310 learning environment.

SCampus Section 11.12(B)

Distribution or use of notes or recordings based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study is a violation of the USC Student Conduct Code. This includes, but is not limited to, providing materials for distribution by services publishing class notes. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the Internet or via any other media. (See Section C.1 Class Notes Policy).

Course evaluation

Course evaluation occurs at the end of the semester university-wide. The learning experience evaluation is a critical tool for instructors and the university to improve teaching. Students are asked to provide honest and constructive feedback and focus on specific aspects of instruction as opposed to personal characteristics of the instructor. In addition to the end of course evaluations, students will be provided with weekly opportunities for feedback and course reflection as part of each homework assignment.

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 our online classroom space, and the university as a whole, is a safe and inclusive environment that facilitates learning.

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Lab Topic	Lab Meeting	Assigned	Due
Week 1 (No class 1/18)	Intro to materials and classification	NO LAB	No meeting		
Week 2	Stress and strain	Plotting stress-strain curves	Mandatory (all students)	HW1	HW 1
Week 3	Tensile properties and hardness	Tensile testing: Elastic modulus/yield to fracture	Optional	HW 2 QUIZ 1	HW 2 QUIZ 1
Week 4	Bonding	Optical microscopy, analysis of fractured samples	Optional		
Week 5 (No class 2/15)	Metallic crystal structures	Case Study #1: Microscopy	Mandatory (20 min)		Lab report #1 Case study #1
Week 6	Directionality in crystals	Vickers Indentation	Mandatory (all students)	HW 3 QUIZ 2	HW 3 QUIZ 2
Week 7	Defects	Yield strength estimation	Optional		
Week 8	Atomic level mechanisms of deformation	NO LAB	No meeting		
Week 9	Strengthening I	Case Study #2: XRD/crystal structures	Mandatory (20 min)		Lab report #2 Case study #2
Week 10	Strengthening II	NO LAB	No meeting	QUIZ 3	QUIZ 3
Week 11	Phase I	Deformation + Vickers, annealing rolled specimens + Vickers	Mandatory (all students)	HW 4	HW 4
Week 12 (No class 4/7)	Phase II	Tensile testing on annealed and CW steel	Optional		
Week 13	Processing for properties	Case Study #3: Heat treatment of iron alloys	Mandatory (20 min)		Lab report #3 Case study #3
Week 14	Foams + composites	Case Study #4: Aerospace materials	Optional		Case study #4
Week 15	Failure	NO LAB	No meeting		
FINAL	Take home exam			4/28	5/10 by 10:00 am

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298

equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.