



MASC 310L: Materials Behavior and Processing

Units: 4

Term—Day—Time: Spring 2024, MW 12:00-1:20

Lecture: VHE 217

Lab: PCE 201

Instructor: Lessa Grunenfelder

Office: HED 213

Office Hours:

Online (see Blackboard for Zoom link): Monday 10:00-11:00

In person: Tuesday 12:00-1:00

Contact Info: grunenfe@usc.edu

Course Description

Materials Behavior and Processing is intended for undergraduate engineering students from all engineering disciplines, as well as Lovine and Young Academy students with a technology emphasis. The subject of materials is broad, encompassing metals, ceramics, polymers, composites, and other advanced materials. MASC 310L introduces fundamental concepts underlying the mechanical behavior of engineering materials. Lectures focus on mechanisms of deformation and failure from the atomic to macro scale. Microstructure development and structure-process-property relationships are emphasized. The laboratory component of the course exposes students to mechanical testing of materials and techniques of material characterization.

Learning Objectives

By the end of the course students will be able to:

1. Describe relationships between the atomic structure and/or microstructure of a material and its properties.
2. Explain if and how microstructure can be altered (via deformation, heat treatment, etc.) to modify specific material properties.
3. Describe material testing procedures and select a procedure to ascertain a specific material property or attribute.
4. Perform experiments, analyze results, and communicate findings via clear and concise reports.

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

1. List the material families and differentiate between them based on atomic structure and bonding, properties, typical applications, and processing routes.
2. Interpret a stress-strain curve. Describe a tensile test and calculate mechanical properties from tensile test data.
3. Interpret and construct phase diagrams for binary systems and utilize time-temperature-transformation and continuous-cooling-transformation diagrams to predict microstructure.
4. Describe degradation and failure modes and discuss ways to prevent premature failure of materials in a range of service conditions.

Recommended Preparation: MASC 110L/CHEM 105a or equivalent

Course Notes

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. Be sure to check Blackboard and your USC email regularly.

Technological Proficiency and Hardware/Software Required

A computer with internet access is required to access course materials and complete/submit assignments. Please bring a web enabled device (phone, tablet, laptop) to the lecture section of the class to respond to poll questions. Data analysis for lab reports will require use of a spreadsheet or other data analysis tool (Excel, Google Sheets, MATLAB, etc.) as well as an opensource image analysis software ([ImageJ](#)).

If you need resources to successfully participate in class, such as a laptop or internet access, there are options for you on campus including the [USC Computing Center Laptop Loaner Program](#).

For any technological difficulties or software needs please utilize the following USC Technology Support Links: [Zoom information for students](#), [Blackboard help for students](#), [Software available to USC Campus](#).

Required Readings

All course materials will be linked via Blackboard, there is no need to purchase a textbook. The primary texts used for the course, which are available online via the USC library, are linked below:

[Engineering Materials 1: An Introduction to Properties, Applications and Design](#) (5th Edition) by David RH Jones and Michael F Ashby

[Engineering Materials 2: An Introduction to Microstructures and Processing](#) (4th Edition) by Michael F Ashby and David RH Jones

Optional Readings and Supplementary Materials

For those interested, a good introductory materials text to add to your academic library is *Materials Science and Engineering: An Introduction* OR *Materials Science and Engineering: An Integrated Approach* by Callister and Rethwisch (any edition). A physical copy of the Callister text will be available in the lab for reference material and used copies are available for purchase online (I like [thriftbooks.com](#)).

Description and Assessment of Assignments

Lab Reports

Lab reports will be completed in groups. A total of 3 reports will be submitted throughout the semester, with each report containing data from multiple experiments. Group reports are intended to be collaborative, not divide and conquer, and as such, all members of a group will receive the same score. If you are having trouble with group members not appropriately contributing to a report, contact me and the TAs as soon as possible.

Homework

While lab reports are completed in groups and cover multiple experiments, some experiments will be accompanied by individual homework assignments. These assignments include analysis of lab data, formatting of figures and/or tables, calculations, and written assignments on key concepts.

Lab Memos

4 lab experiments throughout the semester will be accompanied by a lab memo (not a full lab report). These memos will be completed in pairs or groups of 3. Memos will involve a variety of tasks including data analysis and written responses to questions.

Participation

Completion of lab activities requires attending and actively participating in your scheduled lab section. If you need to miss lab because of travel, illness, religious holidays, etc. email your lab TA and instructor ahead of time (with as much advanced notice as possible). For excused absences you will be provided with data to analyze and other information necessary to complete any assignments. Lab reports are completed in groups. Following each report submission, a group work survey will be distributed. Lab participation grades will be assigned as detailed on the following page:

Criteria	Unsatisfactory	Developing	Accomplished	Exemplary	Total
Lab Attendance	0 points	5 points	8 points	10 points	/10
	3 or more unexcused absences	2 unexcused absences	1 unexcused absence	Attended all lab sessions or received approval for all necessary absences	
Lab Contributions	0 points	5 points	8 points	10 points	/10
	Group members and/or TAs report lack of participation on all 3 lab reports	Group members and/or TAs report lack of participation on 2 lab reports	Group members and/or TAs report lack of participation on 1 lab report	Participated in all experiments and assignments, comments from group members and TAs favorable.	
				TOTAL	/20

Lecture sections will involve participation in the form of small group and whole-class discussions and response to poll questions. Attendance at lecture is not required but highly encouraged. Participation points for missed lectures can be made up by reviewing the posted course notes and completing the activity pages of the weekly course worksheet (available on Blackboard), saving as a pdf, and submitting to me via email (grunenfe@usc.edu). To receive credit worksheets must be submitted within 2 weeks of the missed class period.

Grading Breakdown

Assessment Tool (assignments)	% of Grade
Lab reports (3)	25
Lab participation	5
Lecture participation	5
Homework	15
Lab memos (4)	15
Midterm	15
Final exam	20
TOTAL	100

Grading Scale

Letter grade	Corresponding numerical point range
A	92-100
A-	90-91
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	65-69
D	60-64
D-	55-59
F	54 and below

Assignment Submission Policy

All course assignments will be distributed and submitted via Blackboard, typically using the built in Gradescope tool. Feedback will be available through Blackboard/Gradescope as well.

Grading Timeline

Homework assignments, mini write-ups, and exams grades will be posted within a week of submission. Lab reports will be graded within two weeks.

Late Work and Extension Policy

Lab report due dates and exam dates are firm. For lab reports, 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 one-week extensions on any homework or memo, no questions asked. Beyond 2 extension the late policy for lab reports will apply to other assignments.

Classroom Norms

Students are welcome to take notes on a device or by hand. Phones can be used to respond to poll questions. Students are asked not to use devices for non-course related activities during class time.

Academic Integrity

Students are welcome to discuss lab work and homework problems with peers and TAs. All submitted work, however, must be the student's own. Any information taken from sources must be cited – proper citation format will be provided.

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the [student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

A Note on Use of AI

Use of artificial intelligence (AI) powered programs on assignments must be disclosed. AI tools are permitted to help you brainstorm ideas or revise work you have already written. Be aware that AI text generation tools may present incorrect information, biased responses, and incomplete analyses; thus they are not yet prepared to produce text that meets the standards of this course. To adhere to our university values, you must cite any AI-generated material (e.g., text, images, etc.) included or referenced in your work and provide the prompts used to generate the content. Using an AI tool to generate content without proper attribution is considered plagiarism.

Please note: I will not be using any AI tools in grading your work or providing feedback – all comments will be my own.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. 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. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Course Evaluations

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. Opportunities to provide general course feedback mid-semester will be offered following the submission of each lab report.

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, is a safe and inclusive environment that facilitates learning.

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Lab
Week 1 1/8-1/12	Materials and classification Stress and strain	Intro and safety
Week 2 1/15-1/19 <i>No class 1/15</i>	Tensile properties	NO LAB
Week 3 1/22-1/26	Hardness Atomic bonding	Tensile and shear testing of metals
Week 4 1/29-2/2 HW 1 due	Atomic structure of materials	Vickers hardness
Week 5: 2/5-2/9 HW 2 due	Plastic deformation and dislocations	3D printing of polymers
Week 6 2/12-2/16 Lab report 1 due	Strengthening mechanisms	Tensile testing of polymers
Week 7 2/19-2/23 <i>No class 2/19</i>	Annealing	NO LAB
Week 8 2/26-3/1 Polymers memo due	Intro to phase diagrams Midterm (2/28)	Rolling and Vickers on rolled samples
Week 9: 3/4-3/8 HW 3 due	Phase diagrams cont.	Annealing and Vickers Tensile testing of cold worked and annealed steel
3/11-3/15	Spring Break	
Week 10 3/18-3/22 Lab report 2 due	Phase transformations	Phase diagrams
Week 11 3/25-3/29 Phase diagram memo due	Hybrid materials (3/27 lecture meets in VHE 122)	Heat treatment of steel
Week 12 4/1-4/5 Heat treatment memo due	Manufacturing	Fabrication of composite samples
Week 13 4/8-4/12 HW 4 due	Failure	Testing of composite samples
Week 14 4/15-4/19 Comparisons memo due	Durability and corrosion	Material comparisons
Week 15 4/22-4/26 Lab report 3 due	Materials and the environment	NO LAB
Final Exam	Friday, May 3 11:00-1:00 PM (You can find exam dates/times for all of your courses here)	

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, compromises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. [The Office of Student Accessibility Services](#) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

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

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

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services

(though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

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

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

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.