Course ID and Title: MASC310L Materials Behavior and Processing
Units: 4
Term—Day—Time: Fall 2024, MW, 2:00-3:20 PM
Location: SSL 202

Instructor: Prof. Lessa Grunenfelder
Office: HED 213
Office Hours:
Online (see Brightspace for Zoom link): Monday 12:00-1:00 PM
In person: Thursday 11:00 AM- 12:00 PM
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Course Description
Materials Behavior and Processing is intended for undergraduate engineering students from all engineering disciplines, as well as Iovine 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 Brightspace website for the course (https://brightspace.usc.edu/d2l/home) will be used for general announcements, assignments, course emails, and important course documents and information. Be sure to check Brightspace and your USC email regularly. Assignments will be submitted through Gradescope, which will be accessed via Brightspace. A Piazza page, also linked through Brightspace, is available for questions and discussion.

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, Brightspace help for students, Software available to USC Campus.

Required Readings

All course materials will be linked via Brightspace, 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 and available through the course website:

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 and used copies are available for purchase online (I like thriftbooks.com).

Description and Assessment of Assignments

Lab Reports

Lab reports are completed in groups of 3-4. A total of 3 reports will be submitted throughout the semester, with each report containing data from multiple experiments. Groups will be rotated for each report.

Homework

While lab reports are completed in groups and cover multiple experiments, many 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 (occasionally groups of 3). Memos will involve a variety of tasks including data analysis and written responses to questions.

Exams

There is one midterm exam and one final exam in MASC310L. Exams are individual and take place in person.

Participation

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, completing the activity pages posted to Brightspace, saving as a pdf, and submitting to me via email (grunenfe@usc.edu). To receive credit activity pages must be submitted within 2 weeks of the missed class period. If you attend class, there is no need to submit activity pages.

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 all lab TAs and Prof. Grunenfelder 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. It is your responsibility to communicate with lab group members about any absences and ensure that you are completing all necessary tasks to enable your group to be successful. Unexcused absences may result in an inability to complete and submit 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 follows, with a maximum score of 20:

Criteria	Unsatisfactory 0 points	Developing 2 points	Fair 5 points	Exemplary 10 points
Lab attendance	3 or more unexcused absences	2 unexcused absences	1 unexcused absence	Attended all lab sessions or received approval for all necessary absences
Lab contributions	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 experiment and assignments, comments from group members and TAs favorable

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

Assignment Submission Policy

All course assignments will be distributed and submitted via Brightspace using the built in Gradescope tool. Feedback will be available through Gradescope as well. All assignments are due prior to the start of your scheduled lab section unless otherwise noted (HW 3 and the material comparisons lab memo will be completed and submitted during lab rather than before).

Grading Timeline

Homework assignments, lab memos, and exams grades will be posted within a week of submission. Lab reports will be graded within two weeks.

Grading Scale

Course final grades will be determined using the following 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

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 lab memo, no questions asked. Beyond 2 extensions 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 discussed.

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.

Academic dishonesty has a far-reaching impact and is considered a serious offense against the university. Violations will result in a grade penalty, such as a failing grade on the assignment or in the course, and disciplinary action from the university itself, such as suspension or even expulsion.

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.

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 relation to the class, whether obtained in class, via email, on the internet, or via any other media. Distributing course material without the instructor's permission will be presumed to be an intentional act to facilitate or enable academic dishonestly and is strictly prohibited. (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 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 classroom space, and the university, is a safe and inclusive environment that facilitates learning.

Course Schedule

	Lecture Topic	Lab	Deliverables
Week 1 8/26-8/30	Classification of materials Stress and strain	Intro and safety	**Safety agreement**
Week 2 9/2-9/6 *No class 9/2, 9/3*	Tensile properties	NO LAB	
Week 3 9/9-9/13	Stress strain curves and hardness Atomic bonding	Tensile and shear testing of metals	
Week 4 9/16-9/20	Atomic structure of materials	Vickers hardness	**HW 1**
Week 5 9/23-9/27	Plastic deformation and dislocations	Polymers	**HW 2**
Week 6 9/30-10/4	Strengthening mechanisms	Rolling and Vickers on rolled samples	**Lab report 1** **HW 3 (complete during lab)**
Week 7 10/7-10/11 *No class 10/9-10/11*	Annealing	NO LAB	
Week 8 10/14-10/18	Midterm Intro to phase diagrams	Annealing and Vickers Tensile testing of annealed steel	**Polymers memo**
Week 9 10/21-10/25	Phase diagrams cont.	Phase diagrams	**Lab report 2**
Week 10 10/28-11/1	Phase transformations	Heat treatment of steel	**Phase diagrams memo**
Week 11 11/4-11/8	Hybrid materials	Fabrication of composite samples	**Heat treatment memo**
Week 12 11/11-11/15 *No class 11/11, 11/12*	Manufacturing	NO LAB	
Week 13 11/18-11/22	Failure	Testing of composite samples	**HW 4**
Week 14 11/25-11/29 *No class 11/27-11/29*	Durability and corrosion	NO LAB	
Week 15 12/2-12/6	Materials and the environment	Material comparisons	**Lab report 3** **Comparisons memo (complete during lab)**
FINAL	Friday, Dec 13th 2-4 PM		Refer to the final exam schedule in the USC *Schedule of Classes* here.

Statement on University Academic and Support Systems

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.

Student Financial Aid and Satisfactory Academic Progress:
To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the Financial Aid Office webpage for undergraduate- and graduate-level SAP eligibility requirements and the appeals process.

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 consists 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) 740-2500
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.