



# USC University of Southern California

## **MASC 310L: Materials Behavior and Processing**

Units: 4

Term—Day—Time: Spring 2023, MW 2:00-3:20

Location: WPH B28

Instructor: Lessa Grunenfelder

Office: HED 213

Office Hours:

In person: Tuesday 1-2

Online: Monday 12-1

Contact Info: [grunenfe@usc.edu](mailto:grunenfe@usc.edu)

Teaching Assistants:

Karina Hemmendinger ([khemmend@usc.edu](mailto:khemmend@usc.edu))

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Prashil Joshi ([psjoshi@usc.edu](mailto:psjoshi@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, and encompasses 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.

### Communication

Students can attend scheduled office hours or contact me any time via email ([grunenfe@usc.edu](mailto:grunenfe@usc.edu)). Email will be responded to within 48 hours.

### 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](#)).

### USC Technology Rental Program

If you need resources to successfully participate in your classes, such as a laptop or internet access, there are options for you on campus. While long term laptop rentals are no longer available, short-term rentals can be obtained via the [USC Computing Center Laptop Loaner Program](#). Computers are also accessible via computer labs throughout campus. Wi-Fi is available at all campus and student housing locations.

### USC Technology Support Links

[Zoom information for students](#)

[Blackboard help for students](#)

[Software available to USC Campus](#)

## Required Materials

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

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

For those interested, a good introductory materials text to add to your academic library is *Materials Science and Engineering: An Introduction* OR by *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 <https://www.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.

### Homework

While lab reports are completed in groups and cover multiple experiments, many experiments and/or lectures 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.

### Mini write-ups

5 lab experiments throughout the semester will be accompanied by a mini write-up (not a full lab report). These write-ups will be completed in pairs. Pairs will be rotated with every write-up. Mini lab write-ups 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, 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.

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, saving as a pdf, and submitting to me via email ([grunenfe@usc.edu](mailto:grunenfe@usc.edu)).

## Grading Breakdown

Assignment	% of Grade
Lab reports (3)	25
Lab participation	5
Class participation	5
Homework	10
Mini write-ups (5)	20
Midterm	15
Final exam	20
Total	100

## Grading Scale

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

## Course-specific Policies (Assignment Submission, Grading Timeline, Late work, and Technology)

### Assignment Submission

All course assignments will be distributed and submitted via Blackboard. Feedback will be available through Blackboard 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

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 up to 2 one-week extensions on any homework or mini write-up, no questions asked. Beyond 2 extension the late policy for lab reports will apply to other assignments.

### Academic Integrity

Students are welcome to discuss lab reports 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 for lab reports will be provided.

## Technology in the classroom

### 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.

### Synchronous session recording notice

Lecture sessions may be recorded.

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

*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 [SCampus 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.

## Important dates

Midterm Exam: Wednesday, March 1<sup>st</sup>, 2:00-3:20 PM

Final Exam: Monday, May 8<sup>th</sup>, 2:00-4:00 PM

## Course Schedule: A Weekly Breakdown

	<b>Topics/Daily Activities</b>	<b>Lab</b>
<b>Week 1</b> 1/9-1/13	Materials and classification Stress and strain	Intro and safety
<b>Week 2</b> 1/16-1/20 <i>No class 1/16, 1/17</i>	Tensile properties	NO LAB
<b>Week 3</b> 1/23-1/27	Stress strain curves and Hardness Atomic bonding	Tensile and shear testing of metals
<b>Week 4</b> 1/30-2/3	Atomic structure of materials	Vickers hardness
<b>Week 5</b> 2/6-2/10	Plastic deformation and dislocations	Optical analysis
<b>Week 6:</b> <b>REPORT 1 DUE</b> 2/13-2/17	Strengthening mechanisms	Tensile testing of polymers
<b>Week 7</b> 2/20-2/24 <i>No class 2/20, 2/21</i>	Annealing	NO LAB
<b>Week 8</b> 2/27-3/3	Intro to phase diagrams Midterm	Rolling and Vickers on rolled samples
<b>Week 9:</b> 3/6-3/10	Phase diagrams	Annealing and Vickers Tensile testing of annealed steel
<b>SPRING BREAK</b> <i>No class 3/13-3/17</i>	NO CLASS	NO LAB
<b>Week 10:</b> <b>REPORT 2 DUE</b> 3/20-3/24	Phase transformations	Phase diagrams
<b>Week 11</b> 3/27-3/31	Composites and foams	Heat treatment of steel
<b>Week 12</b> 4/3-4/7	Manufacturing	Strength to weight ratio
<b>Week 13</b> 4/10-4/14	Fatigue and Fracture	Fabrication of composite samples
<b>Week 14</b> 4/17-4/21	Creep Durability and corrosion	Testing of composite samples Corrosion setup
<b>Week 15:</b> <b>REPORT 3 DUE</b> 4/24-4/28	Materials and the environment	Corrosion observation

## 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.

## 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](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on [Research and Scholarship Misconduct](#).

### **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](http://osas.usc.edu). You may contact OSAS at (213) 740-0776 or via email at [osasfrontdesk@usc.edu](mailto:osasfrontdesk@usc.edu).

### **Support Systems:**

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*  
[studenthealth.usc.edu/counseling](http://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](http://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](http://studenthealth.usc.edu/sexual-assault)

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

*Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086*

[eeotix.usc.edu](http://eeotix.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](http://usc-advocate.symplicity.com/care_report)

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.usc.edu](http://osas.usc.edu)

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) 821-4710*

[campussupport.usc.edu](http://campussupport.usc.edu)

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*

[diversity.usc.edu](http://diversity.usc.edu)

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*

[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

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) 442-120 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.

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

[ombuds.usc.edu](http://ombuds.usc.edu)

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) 442-3340 or [otfp@med.usc.edu](mailto:otfp@med.usc.edu)*

[chan.usc.edu/otfp](http://chan.usc.edu/otfp)

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