



USC University of Southern California

MASC 310: Materials Behavior and Processing

Units: 4

Term—Day—Time: Fall 2021, TTh 10:00-11:50

Location: GFS 222

Instructor: Lessa Grunenfelder

Office: HED 213

Office Hours

- In person: Wednesday 10-11
- Online: Wednesday 11-12

Contact Info: grunenfe@usc.edu

Teaching Assistant: Patricio Martinez

Office: VHE 412

Office Hours

- In person: Tuesday 5-6
- Online: Thursday 5-6

Contact Info: mart136@usc.edu

IT Help: For issues with the virtual desktop Infrastructure (VDI) see the general tips at <https://viterbiit.usc.edu/instructional-support/> or contact Viterbi IT

Contact Info: submit a Viterbi Service Desk ticket at myViterbi email engrhelp@usc.edu, or call 213-740-0517 M-F 8:30 am-5:00 pm

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. The 310 course covers fundamental concepts underlying the behavior of engineering materials. The course employs a design-based approach with a focus on the selection of materials and processes for engineering design. Students will analyze experimental data, carry out group problem solving activities, and utilize material and process databases.

Learning Objectives

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

1. Utilize digital information storage and manipulation to look up material property data and background information.
2. Describe relationships between the atomic structure and microstructure of a material and its properties.

3. Explain if and how microstructure can be altered (via deformation, heat treatment, etc.) to modify specific material properties.
4. Describe structure-property-processing relationships.
5. Given a materials design problem: evaluate the available options, apply constraints to narrow possible choices, utilize objectives to select a material and/or process, and justify the final selection.

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

- List the material families and differentiate between them based on atomic structure and bonding, properties, and processing routes.
- Create and interpret material property charts
- Interpret a stress-strain curve. Describe a tensile test and calculate mechanical properties from tensile test data.
- Interpret and construct phase diagrams for binary systems, and utilize time-temperature-transformation and continuous-cooling-transformation diagrams to predict microstructure.
- Discuss the environmental impact of material selection and processing choices, describe the materials life cycle, and identify possible ways to reduce the environmental impact of a product.

Prerequisite(s): None

Co-Requisite(s): None

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

Course Notes

MASC 310 will utilize both asynchronous and synchronous learning modes. Class will meet twice per week. In addition, short video lectures will be posted on specific topics. It is expected that students come to synchronous sessions having watched any assigned videos. Class time will be used for questions and clarification, additional content delivery, and working exercises (both independently and in small groups). The course is structured around a semester-long material and process selection project.

Communication

Students can attend scheduled in-person and/or Zoom office hours or contact me any time via email (grunenfe@usc.edu). Email will be responded to within 24 hours (48 on weekends). Zoom links are available on Blackboard.

Technological Proficiency and Hardware/Software Required

It is helpful, though not required, to bring a laptop to class. A classroom response system (Slido) will be used during class, requiring a phone or laptop to submit a response. In-class group work will often require one computer per group of 3-4 students.

All course content will be delivered via Blackboard. For technical issues with Blackboard email blackboard@usc.edu

MASC 310 will utilize a software package, GRANTA EduPack, for background reading, homework assignments, in-class activities, and the semester project. The software is available to students free of charge through the Viterbi Virtual Desktop Infrastructure (VDI). Installation and access information can be found on Blackboard. For issues with the VDI contact Viterbi IT at enrhelp@usc.edu

USC Technology Rental Program

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 [USC Technology Rental Program Application](#).

USC Technology Support Links

[Zoom information for students](#)

[Blackboard help for students](#)

[Software available to USC Campus](#)

Required Materials

Course notes will be posted weekly to Blackboard. The GRANTA EduPack software will serve as an interactive textbook. For additional background reading, the following text is available online (you will need to log in via the USC library):

Ashby, Michael F., et al. *Materials: Engineering, Science, Processing and Design*, Elsevier Science & Technology, 2007.

<https://ebookcentral.proquest.com/lib/socal/detail.action?docID=287960>

Description and Assessment of Assignments

Short instructional videos will be posted to Blackboard periodically. 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. All questions must be answered, and videos must be viewed in their entirety for credit. Videos can be viewed after the quiz due date for review.

Synchronous sessions will incorporate class discussions, problem solving, and group work. Active participation is expected and will take the form of poll responses, small group problem solving, and full class discussions. If a student is unable to attend a synchronous session, they can receive credit for in-class activities 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.

Homework will be assigned weekly and is due before the start of class the following week (Tuesday at 10 am). The "test" tool in Blackboard will be used for homework. Homework assignments will consist of a combination of multiple choice, matching, numerical entry (calculations), file upload, and short answer questions. Two attempts will be permitted for each homework assignment with feedback provided following the first attempt.

Case study assignments will be used to introduce experimental and analytical techniques and provide additional real-world connection to course content. Each case study will be accompanied by a series of questions, including written responses requiring research and citation of sources.

Semester project: A material and process selection project will incorporate many of the key topics discussed throughout the semester. The project is divided into multiple deliverables. Detailed instructions for each project deliverable will be posted on Blackboard. Deliverables include:

- Topic selection
- Annotated bibliography of resources
- Draft introduction
- Plot formatting
- Translation
- Interviews
- Final written report
- One-slide summary (for presentation and discussion)

Examples will be provided for specific project deliverables. The course final exam period will be used for presentations and peer discussion of project outcomes.

Grading Breakdown

Assignment	% of Grade
Video quizzes	5
In-class activities (or worksheet submission)	10
Homework	25
Case studies	20
Selection project	40
Total	100

Grading Scale

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

All course assignments will be distributed and submitted via Blackboard. Assignment feedback will also be accessible via Blackboard. Final project one-slide summaries will be submitted as google slide links.

Grading Timeline

Assignments will be graded within a week of submission. Students can access feedback on homework and project submissions via Blackboard.

Late work

Final project report and one-slide summary deadlines are firm. Throughout the semester, however, *students will be granted up to 3 one-week extensions on any homework, video quiz, case study, or intermediate project deliverable, no questions asked.*

Technology in the classroom

Students are permitted to take notes using whatever means best suits their learning style. Editable pdf files of course notes will be provided, so taking notes on a laptop or tablet is welcome. Computers will occasionally be necessary for group work. A computer or phone will be necessary to respond to poll questions.

Academic integrity

Students are welcome to discuss assignments with peers. All submitted work, however, must be the student's own. Any information taken from sources must be cited – proper citation format for project deliverables and case study submissions will be discussed. Project submissions will be checked for originality using Turnitin via Blackboard

Attendance

Attendance in class is encouraged, but not required. When it is necessary for a student to miss a class session, credit for in-class activities can be earned by reviewing the notes/class recording and completing and submitting the activity pages of the weekly course worksheet. Attendance at final project presentations is required.

Classroom norms

Engineering is a professional degree. To model the expectations of a professional work environment in our field, and promote a respectful classroom environment,

- Come to class prepared, having completed any pre-class reading or viewing and with the supplies necessary to work problems in class (pen/pencil, paper, calculator, etc.)
- Actively listen and participate in discussions, providing space for others to speak, and being respectful in comments and responses
- Work collaboratively, with an understanding that students come to MASC 310 from various majors and with a wide range of prior knowledge
- Students can leave for bathroom breaks during class but should do so without causing disruption
- Laptops can be used for class activities and note taking, but use of laptops for other purposes during class is not acceptable

Sharing of course materials outside of the learning environment

USC has a policy that prohibits sharing of any synchronous and asynchronous course content outside of the learning environment.

Course evaluation

Student feedback is essential to the success of any course. Students will be provided with weekly opportunities for feedback and course reflection as part of each homework assignment. Additionally, time will be allocated to complete the standard USC course evaluation survey at the end of the semester.

Course Schedule: A Weekly Breakdown

Assignments are due via Blackboard prior to the start of class each week (Tuesday at 10 am). See weekly schedule on Blackboard for due date reminders and video quiz deadlines.

Week	Topics	Assigned	Due	Reading
Week 1	Intro to materials and properties	HW 1 Project deliverable 1: Topic Selection		Ch 1
Week 2	Material and process selection for design	HW 2	HW 1 Project deliverable 1	Ch 2, Ch 3
Week 3	Stress and strain Sociotechnical aspects of design	HW 3 Project deliverable 2: Annotated bibliography	HW 2	Ch 4: 4.1-4.3
Week 4	Atomic bonding and packing	HW 4 Case study 1: XRD	HW 3 Project deliverable 2	Ch 4: 4.4
Week 5	Atomic level properties: density and modulus	HW 5 Project deliverable 3: Draft introduction	HW 4	Ch 4: 4.5-4.6
Week 6	Properties for selection: performance indices	HW 6 Case study 2: Material indices	HW 5 Case study 1	Ch 5
Week 7	Plastic deformation	HW 7	HW 6 Project deliverable 3	Ch 6: 6.1-6.3 Ch 7
Week 8	Manufacturing and process selection	Case study 3: Manufacturing Project deliverable 4: plot formatting	HW 7 Case study 2	Ch 18
Week 9	Fracture and fatigue	HW 8 Project deliverable 5: Translation	Project deliverable 4	Ch 8 Ch 9
Week 10	Manipulating strength	HW 9 Project: Final report and one-slide	HW 8 Case study 3	Ch 6: 6.4-6.6

Week	Topics	Assigned	Due	Reading
Week 11	Phase diagrams	HW 10 Case study 4: Phase diagrams	HW 9 Project deliverable 5	Supp.
Week 12	Phase transformations	HW 11 Case study 5: Heat treatment of steel	HW 10	Supp.
Week 13	Processing for properties	HW 12 Project deliverable 6: Interviews	HW 11 Case study 4	Ch 19
Week 14	Durability		HW 12 Case study 5	Ch 17
Week 15	Materials and the environment		Project deliverable 6 Project: Final report and one-slide	Ch 20
FINAL	Final report one-slide presentations and class discussion			

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

Statement on Academic Conduct and Support Systems

[The current Statement on Academic Conduct and Support Systems is a required component of all USC syllabi and is updated regularly. Faculty should use the latest version of the Statement on Academic Conduct and Support Systems found in the [Curriculum Coordination Office's Syllabus Template](#). The Statement below is current as of Spring 2021.]

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." Other forms of academic dishonesty are equally unacceptable. See additional information in [SCampus and university policies](#) on scientific misconduct.

Support Systems:

[Counseling and Mental Health](#)

phone number (213) 740-9355

On call 24/7

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

[National Suicide Prevention Lifeline](#)

Phone number 1 (800) 273-8255

On call 24/7

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 \(RSVP\)](#)

Phone Number (213) 740-9355(WELL), press "0" after hours

On call 24/7

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

[USC Office of Equity, Equal Opportunity, and Title IX](#)

Phone number (213) 740-5086

Title IX Office (213) 821-8298

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](#)

Phone number (213) 740-5086 or (213) 821-8298

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

[The Office of Disability Services and Programs](#)

Phone number (213) 740-0776

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.

[USC Campus Support and Intervention](#)

Phone number (213) 821-4710

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

[Diversity at USC](#)

Phone number (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 phone number (213) 740-4321

HSC phone number (323) 442-1000

On call 24/7

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 phone number (213) 740-6000

HSC phone number (323) 442-1200

On call 24/7

Non-emergency assistance or information.