

USC Viterbi

School of Engineering

MASC 551: Mechanical Behavior of Engineering Materials

Units: 4

Lectures: TTh 9:30 – 11:20
OHE 132

Instructor: Dr. Lessa Grunenfelder
Office: HED 213
Office hours: Tu 11:30-12:30
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Teaching Assistant: Roya Ermagan

Course Description: This course focuses on the mechanical properties of materials. This will include metals, ceramics, and polymers, and composites. The lectures will emphasize stress and strain relationships and how the macroscopic mechanical behavior is related to the microstructure of the material. This course will discuss elementary dislocation theory and relate this to basic strengthening mechanisms in crystalline materials. Physical and chemical mechanisms that alter the mechanical properties will be discussed. Fatigue and fracture will also be discussed in terms of fundamental mechanisms.

Learning Objectives: The course is aimed at teaching the basics of the mechanical behavior of materials which includes metals, ceramics, polymers, thin films, covalent solids and amorphous materials. The course will cover the necessary basics from elasticity, dislocation theory, strengthening mechanisms and fracture mechanics. The course will emphasize the mechanical behavior at the atomic-defect level, At the end of this class, the student is expected to have a broad understanding of the mechanical behavior of engineering materials.

Recommended Preparation: The recommended preparation includes undergraduate introduction to chemistry and the equivalent of MASC 310 (undergraduate introduction to materials).

Books: Lecture notes provided during class will contain all information necessary to learn the material. Readings for each topic will be provided in the following textbooks, both available free of charge through the USC Library (log in to USC account to access the links provided):

“Mechanical Behaviour of Engineering Materials,” J. Roesler, H. Harders and M. Baeker
<https://link-springer-com.libproxy2.usc.edu/content/pdf/10.1007%2F978-3-540-73448-2.pdf>

“Mechanical Behavior of Materials,” W.F. Hosford
<https://ebookcentral.proquest.com/lib/socal/detail.action?docID=472008>

The following supplemental texts, with additional information for interested students, are on reserve at the library:

“Mechanical Metallurgy”, G.E. Dieter
“Mechanical Behavior of Materials”, T.H. Courtney
“Deformation and Fracture of Engineering Materials”, R.W. Herzberg
“Mechanical Behavior of Materials”, McClintock and Argon
“Fracture of Structural Materials”, Tetelman and McEvily
“Mechanical Behavior of Materials” Meyers and Chawla, Prentice Hall, 1998
“Introduction to Dislocations” D. Hull and D.J. Bacon 5th ed. Butterworth

For students who have not taken an undergraduate course in materials (MASC 310 or equivalent) the following introductory texts are recommended for relevant background information:

"Materials Science and Engineering" 5th ed. William D. Callister
"Principles of Engineering Materials", Barrett, Nix and Tetelman

Grading:

Midterm Exams (2):	50%
Final Exam:	35%
Homework (3):	15%

Exam policy: There will be two midterm exams, which count for 25 percent each. Midterm exams cover material from the previous exam up to the last class before the exam. The Final Exam, worth 35 percent of the course grade is cumulative. Exams are closed book, closed notes, with no calculators permitted. Exams focus on conceptual understanding.

Homework: There will be 3 homework assignments throughout the semester, one prior to each exam. Homework will be due the class before the exam, and solutions will be reviewed. Each homework assignment is worth 5 percent of the course grade. Homework must be submitted prior to the start of class on the designated due date (see below). *Late homework will not be accepted as solutions will be discussed in class.*

Important dates:

HW 1 due	Tuesday, Oct 1
Midterm 1	Thursday, Oct 3 (in class)
HW 2 due	Tuesday, Nov 5
Midterm 2	Thursday, Nov 7 (in class)
HW 3 due	Thursday, Dec 5
Final exam	Thursday, Dec 12 (11:00-1:00 pm)

Topics covered

The course will cover the following topics. For each section of the course, lecture notes will be distributed and reading will be recommended in the Roesler and/or Hosford texts.

- Structure of materials (review)
- Elasticity
- Plasticity
- Mechanical behavior of metals
- Mechanical behavior of ceramics
- Mechanical behavior of polymers
- Mechanical behavior of composites
- Fracture
- Fatigue
- Creep
- Special topics (time permitting): Mechanical properties of , nano-structured materials, thin films, inorganic amorphous materials, intermetallics and hard materials

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct.

<http://www.usc.edu/dept/publications/SCAMPUS/gov/>

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at:

<http://www.usc.edu/student-affairs/SJACS/>

Sanctions include but are not limited to: grade sanctions (e.g., "F" in course) and dismissal from the academic department (see following excerpt from SJACS site).

http://www.usc.edu/student-affairs/SJACS/forms/sjacs_appa.pdf

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with the Office of Disability Services and Programs (DSP, STU 301, [213-740-0776](tel:213-740-0776)) each semester. You must deliver an approved DSP letter to one of the instructors as early in the semester as possible. Please see SCampus

(<http://www.usc.edu/dept/publications/SCAMPUS/>) for additional policies that are not covered here (i.e. academic integrity, proper conduct, etc.) but that do still apply!