MASC 310 – Materials Behavior and Processing

Fall, 2018

Lecture

M/W 3:30-4:50 pm, LVL 13 (Leavey Library)

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, and encompasses metals, ceramics, polymers, composites, and other advanced materials. The 310 course covers fundamental concepts underlying the behavior of engineering materials, as well as materials processing methods. The course employs an integrated approach that stresses concepts that are applicable to all materials. The structure of the course primarily follows the text by Callister and Rethwisch, which provides a bottom up introduction to materials science incorporating fundamentals, microstructure development, properties, and manufacturing. Supplemental readings and electronic resources are utilized to highlight specific concepts.

Instructor

Prof. Paulo Branicio
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Phone: (213) 740-0364
Office hours: Immediately after lectures (M/W 5pm-6pm)
Office hours with TA's every week (check Blackboard)

Course Objectives

Following completion of this course, students should be able to

- Explain the importance of materials science in everyday life, and in the context of engineering
- Describe the organizational scheme of the periodic table, the electron structure of atoms, and the mechanisms of atomic bonding
- Define and differentiate between the various material families on the basis of atomic structure and bonding, properties, and processing routes
- Identify crystallographic planes and directions in cubic systems, and perform calculations based on crystal structure
- Describe relationships between the atomic structure and microstructure of a material and its properties
- Explain if and how microstructure can be altered (via deformation, heat treatment, etc.) to modify specific material properties
- Classify defects in crystalline materials on the basis of their geometry, and describe the influence of various defects on material properties and performance
- Interpret and construct phase diagrams for binary systems, and utilize time-temperature-transformation and continuous-cooling-transformation diagrams to predict microstructure

Content

A Blackboard website for the course (http://blackboard.usc.edu) provides assignments, solutions, and supplemental readings.

Text

Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th edition, William D. Callister and David G. Rethwisch, 2015, ISBN: 9781119234395. The course will utilize WileyPLUS, which comes with an online-only electronic version of the textbook. Please visit Blackboard and click on the WileyPLUS Homepage icon in the content folder to be taken through the registration process. Options are available to purchase an eBook or hard copy of the text in addition to the required online access.

WileyPLUS Assignments

The online WileyPLUS system is integrated through Blackboard, and assignments and textbook readings will be accessible through the Blackboard interface. Homework assignments are due by the beginning of first class of week on Monday. Homework is considered late if received later than the start of the class and will be penalized 50%. Homework will not be accepted after 1 week past the due date and time.

Exams

Exam scores will consist of two midterms and a final. Exams are closed book and closed notes. An equation sheet will be provided at each exam.

Grading

Grading	
WileyPLUS assignments	10%
Midterm 1	25%
Midterm 2	25%
Final exam	40%

Course Content

Topic	Reading
Introduction to materials science and classification of materials	Ch 1
Atomic structure and bonding	Ch 2
Crystal structures and crystallographic planes and directions	Ch 3
Structure of polymers	Ch 4
Defects	Ch 5
Diffusion	Ch 6
Mechanical properties	Ch 7
Plastic deformation and strengthening mechanisms	Ch 8
Fracture and Fatigue	Ch 9
Phase diagrams	Ch 10
Phase transformations	Ch 11
Fabrication and processing of materials	Ch 14
Composites	Ch 15

Important Dates

Midterm 1: Wednesday, September 26th
Midterm 2: Wednesday, October 31th
Final exam: Monday, December 10th 2:00-4:00 p.m.