MTEN 205 Mechanical Behavior of Materials

Credits and contact hours
3-0-3 (3 lecture hr/wk-0 lab hr/wk-3 course credit)

Monday, Wednesday: 10:00 am – 11:20 am

MTEN teaching laboratory
https://njit.webex.com/meet/molodetsnjit.edu

Instructor: Irina Molodetsky https://njit.webex.com/meet/molodetsnjit.edu
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Textbook

Hosford, William F.. Mechanical Behavior of Materials, Cambridge University Press, 2009. ProQuest Ebook Central, http://ebookcentral.proquest.com/lib/njit/detail.action?docID=472008

Additional instructional materials will be provided

Specific course information

a. Description:

The course will introduce the fundamentals of the mechanical behavior of materials. Mechanical properties of metals, plastics and ceramics will be compared using examples of the strain-stress curves obtained in the tensile testing. Elastic and plastic deformations in metals will be explained using electronic and microscopic basis. Effects of the microstructure and macrostructure on the mechanical behavior of materials at room and elevated temperatures will be demonstrated in practical examples.

Prerequisites: MTEN 201, MTEN 202

Co-requisites: MTEN 206

b. Required, Elective, or Selective Elective – Required

Specific goals for the course

a. The student will be able to:

1. Compare main mechanical properties of typical engineering materials
2. Define mechanical properties obtained in the tensile testing
3. Relate deformations on macroscopic and microscopic levels
4. Predict mechanical behavior of polymers based on structure (chain, secondary bonds)
5. Identify the material to meet specific mechanical behavior requirements

Topics

1. Introduction. Different mechanical behavior of materials – examples from nature. Definition of terms. Rigid body concept. Stress and Strain. Transformation of axes. Principle stresses. Mohr's circle diagrams (1,2)

2. Stress elements. Visualizing Stress States. Hooke's Law: normal and shear moduli. Microscopic basis of elasticity. Isotropic and anisotropic thermal expansion. Tensile test: elastic and plastic behavior of materials. Engineering and true stress-strain. (3-4)

3. Hardness- as a mechanical property. Hardness as a link between mechanical, chemical and optical properties (5).

4. Introduction of the final project (material characterization of the interfaces between joined materials with different mechanical properties)(5).

5. Macroscopic and microscopic plastic deformation. Dislocations. Effect of the macrostructure on the mechanical properties of metals. Dislocation mobility in alloys, solid solutions and intermetallics (6,7)

6. Mechanical behavior of polymers. Glassy, rubbery and viscous regimes. Three-points test of plastic materials. Negative thermal expansion of rubbers. Viscoelasticity. Hydrogels. (8-10)

7. Mechanical behavior of ceramics and glasses. Fractures. Bioinspired materials with superior mechanical performance. Ceramics with exception mechanical performance – micro-and macrostructure-properties relationship (11-12)

Course Structure

1. The lecture component contains weekly "Food for thoughts" unit followed by a 2 questions quiz (20%)
2. Bi-weekly homeworks are assigned that require 3 components: use of Matlab/Excel, life-long learning experience, hand-written calculation. (60%)
3. Final exam – presentation (20%)

Communication

1. This course will use the NJIT Canvas site accessed by http://canvas.njit.edu for all communications regarding changes in the schedule, status of the experiments, score rubrics, files and documents.
2. All online communications are done on webex https://njit.webex.com/meet/molodetsnjit.edu unless other address is specified
3. Additional online individual or team discussions will be scheduled on Canvas and require you to sign up to a specific slot.
4. If circumstances require online communication with the entire class, it will be done through **Webex** hosted by the instructor

Grading

Above 90 A
Above 85 B+
Above 80 B
Above 75 C+
Above 70 C
Above 60 D
Below 60 F

Professional Behavior

- You are expected to participate in the class discussions
- Support inclusive learning environment
- Provide feedback to instructor using "muddy" point after class submission on Canvas site (extra points)

- Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:

http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.
Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. ***Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university.*** If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at *dos@njit.edu*"

www.njit.edu/academics/pdf/academic-integrity-code.pdf

Accommodations due to a disability

If you need accommodations due to a disability please contact Marsha Williams-Nicholasto, Associate Director of Disability Support Services, Kupfrian 201 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.