MAE 160
Mechanical Behavior of Materials (4 units)

Class Schedule: four hours of lectures (including one hour of mandatory problem solving session), eight hours of outside preparation. 12 hours/week total

Course Coordinator(s): Ekaterina Evdokimenko

Textbooks/Materials:

1. J.F. Shackelford, Introduction to Materials Science for Engineers (8th Edition), Prentice Hall, New York, 2014
2. R.W. Hertzberg, R.P. Vinci, and J.L. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials (5th Edition), John Wiley & Sons, Inc., New York, 2012
3. T.H. Courtney, Mechanical Behavior of Materials (2nd Edition), Waveland Press, Inc., New York, 2005
4. W.D. Callister and D.G. Rethwisch, Materials Science and Engineering An Introduction (8th Edition), John Wiley and Sons, New York, 2009

Catalog Description: Elasticity and inelasticity, dislocations and plasticity, strengthening mechanisms. creep, fatigue, fracture. Mechanical behavior of metals, ceramics, polymers, and composites. Laboratory demonstrations of selected topics.

Prerequisites: MAE 20, MAE 130A (or SE 101A) and MAE 131A, or consent of instructor

Course Type: Required

Performance Criteria:

Objective 1
1.1 Students will demonstrate an understanding of the structure-deformation behavior correlation in engineering materials.

Objective 2
2.1 Students will demonstrate the ability to identify the deformation mechanisms operative in various engineering materials.
2.2 Students will demonstrate the ability to qualitatively predict the mechanical properties of materials using a variety of strengthening theories.

Objective 3

3.1 Students will demonstrate an understanding of the dependency of materials' mechanical performance on both test temperature and strain rate.
3.2 Students will demonstrate an understanding of several material models, their limitations, and applications.

Objective 4
4.1 Students will demonstrate the ability to determine stress intensity factors for a variety of specimens/flaws configurations.
4.2 Students will demonstrate the ability to design using a fracture mechanics approach.

Objective 5
5.1 Students will demonstrate knowledge of temperature transition effects in engineering materials and how various microstructures influence the fracture behavior.

Objective 6
6.1 Students will demonstrate knowledge of fatigue crack growth using fracture mechanics theory.
6.2 Students will demonstrate an understanding of designing for fatigue applications, and for predicting fatigue lifetimes of engineering components using fracture mechanics approach.

Course Objectives:
(Numbers in parentheses refer to the specific MAE Program Outcomes)

1. To teach students the deformation behavior of engineering materials as a function of various external factors, such as temperature, strain rate, stress state, and internal microstructural features. (1, 2, ME10, ME11)

2. To teach students the mechanisms of deformation and the various methods of strengthening materials. (1, 2, ME10, ME11)

3. To teach students the concept of linear elastic fracture mechanics, its limitation and application in real engineering situations. (1, 2, ME10, ME11)

4. To teach students the role of microstructure and test conditions on the fracture behavior of materials. (1, 2, ME10, ME11)

5. To teach students the concept of fatigue fractures, and methods of predicting fatigue lifetimes of components. (1, 2, ME10, ME11)

Course Topics:

1. Crystal Structure
2. Elasticity
3. Plasticity
4. Imperfections in solids
5. Fracture
6. Strengthening mechanisms
7. Creep
8. Fatigue
9. Structure/property relationships

Last updated: 12 June 2019