EMAT 570 **Instructor: Sudhakar Vadiraja, PhD, PE**
Mechanical Behavior of Materials Office Hours: ELC 218, × 4267

Catalogue Description:
Topics cover deformation and fracture in engineering materials, including elastic and plastic deformation from simple continuum mechanics and microscopic viewpoints. In addition, fracture mechanisms, linear elastic and nonlinear elastic fracture mechanics, fatigue failure, stress/life and damage-tolerant design approaches, creep and stress rupture topics are also included.

Credits: 3.0 Credit Hours (Lectures)

Designation: Required course (Metallurgical & Materials Engineering, General Engineering – Welding Option)

Prerequisites: EMAT 251/EGEN 213/EMAT 351, or consent of the instructor.

Lab: There is no lab allotted to this course.

Textbook:
Required: Norman E. Dowling, *Mechanical Behavior of Materials*, 4th Edition, ISBN 13: 978-0-13-139506-0, Pearson Prentice Hall (2013).

Additional References:
- R.W. Hertzberg, R.P. Vinci, J.L. Hertzberg, *Deformation and Fracture Mechanics of Engineering Materials*, 5th edition, ISBN 13: 978-0-470-52780-1, John Wiley & Sons, Inc. (2013).
- George Dieter, *Mechanical Metallurgy*, McGraw-Hill. (1986).

Relationship of Course to Metallurgical and Materials Engineering Program Outcomes:
All metallurgical/materials engineering students should be conversant with the basic aspects of the mechanical behavior of materials, from both a mechanics and materials science perspective.

Objectives: The objective of this course is to provide the student with:
- An understanding of the mechanics and micro-mechanisms of elastic and plastic deformation, fatigue failure, creep as applied to engineering materials.
- A thorough introduction to the principles of fracture mechanics and its significance.
- Practical examples of the application of fracture mechanics to design and life prediction methods.

Outcomes: Graduates of the course will be able to:
- Use simple continuum mechanics and elasticity principles to determine the stresses, strains and displacements in a loaded structure.
- Understand the basic strengthening mechanisms that can improve the mechanical properties of materials.
- Understand and analyze strain hardening and plastic theory in metals.
- Use fracture mechanics to quantitatively estimate failure criteria and life prediction strategies for both elastic and plastically deforming structure.
- Understand fatigue and creep failures and how they affect structural lifetimes of components.
- Have basic design strategy of engineering materials for optimal fatigue and creep life.
- Fulfill **ABET outcomes 1 & 9** (consult the Course Catalog and Department Guidelines)

	Tentative Course Plan	Forecast lectures
1	Stress and strain relationships-elastic behavior (Ch. 2 & 5)	3
2	Strengthening mechanisms (Callister book) …….Test 1	4
3	Theory of plasticity (Ch. 7)	3
4	Fracture mechanics-fracture of cracked members (Ch. 8) ……Test 2	4
5	Fatigue of materials: stress and strain-based approaches (Ch. 9 &14)	3
6	Fatigue crack growth and life prediction (Ch. 11)	4
7	Creep and Stress rupture (Ch. 15) …….Finals	3
8	Tests	2
	Total	**26**

Assessment:

Homework:	10%
Term paper: *(Oral-8 pts, Written report-7 pts)*	15%
Tests (2): *(25% each)*	50%
Finals	25%
Total	100%

Grading:
A = (92-100), A− = (90-91.9), B+ = (88-89.9), B = (82-87.9), B− = (80-81.9), C+ = (78-79.9), C = (72-77.9), C− = (70-71.9), D+ = (68-69.9), D = (62-67.9), D− = (60-61.9), F = (0-59.9)

Academic Integrity:
Academic dishonesty/cheating will not be tolerated. Acts of academic dishonesty include (but are not limited to):

- Plagiarism
- Copying from another student's paper while taking a quiz or examination
- Using unlawful aids (books, notes, cell phones or other electronic devices, etc.) to pass an examination (*unless the instructor has clearly stated that it is an open notes or open book exam*)
- Assisting another student in an act of academic dishonesty

If it is determined that a student has deliberately cheated on a quiz, examination, or assignment, he or she will be dropped from the course with an "F" grade. In compliance with Montana Tech policy, cases of academic dishonesty will be reported to the Office of the Vice Chancellor for Academic Affairs.

Requirements:

1. Attend all tests/exams/term paper seminars
2. **Talking with other students or sleeping in class or having earphones during lecturing is prohibited and is considered disruptive behavior.**

Contribution to Professional Component:
Engineering Topics - 100%
Engineering Design - Yes
Computer Usage - Yes
Ethics - No,
Statistics - No, Safety - No

ABET outcomes covered: 1 & 9

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(9) Integrate the understanding of the scientific and engineering principles underlying the four major-elements of the field: structure, properties, processing and performance related to metallurgical and materials systems appropriate to the field

Prepared by: **Sudhakar Vadiraja, PhD, PE**