MAE 523 Fracture Mechanics

Instructor: Dr. Yongming Liu
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Office Hours: **MW 10:00 -12:00**; and anytime when I am in the office with the door open

Lecture/Lab: **MW 1:30-2:45 PSA108**

Web access: ASU Blackboard System

Catalog Description: Linear elastic fracture mechanics. Modification with small scale yielding. Fatigue Fracture. Experimental Methods in Fracture.

Prerequisites: MAE 520 or CEE 521.

Textbook: Fracture Mechanics Fundementals and Applications, T.L. Anderson, Third Edition, Taylor & Francis. ISBN 0-8493-1656-1 (recommended)
Advanced Fracture Mechanics, M. F. Kanninen and C. H. Popelar. Oxford University Press. (reference book)

Software: Matlab, ANSYS/ABAQUS

Course Objectives:

1. To examine and comprehend the principle involved fracture analysis of engineering materials.
2. To enable students to use fundamental principles of mechanics for the development and applications of material/structural fracture analysis.
3. To train students of scientific computation, engineering statistics, data analysis, and academic writing.
4. To introduce of advanced and currently active research topics in the damage, fracture, and fatigue communities.

Topics Covered:

Topic	Hours
Introduction	2 hours
Review of mechanics of materials	2 hours
Linear Elastic Fracture Mechanics	8 hours
Elastic Plastic Fracture Mechanics	8 hours
Numerical and Experimental Fracture Analysis	2 hours
Fatigue Fracture Analysis	8 hours
Advanced topics	6 hours
Exams	2 hours

Class Schedule:

Two 75-minute lectures per week

Examination policy:

The in-class exam will be given in PSA108 on Monday October 19 at 1:30 am. There will be no make-up exam. In unusual circumstances excuses may be granted for the in-class exams. For predictable absences excuses must be requested well in advance of the exam day. Excused exam will increase the weight of the term paper. There will be **no Final Exam**. Exams will be open book and open notes. The original problem papers and your solutions will be stapled together and turned in.

One project, **one term paper**, and an **oral presentation** will be required. Detailed requirements and formatting will be given separately during the semester.

Evaluation Methods:

1. Exam I (October 19)	20	20%
2. Project	20	20%
2. Term paper	25	25%
3. Homework	20	20%
4. Oral Presentation	15	15%

100 total points
Letter grades will be assigned based on the following scale:

A+:	95 and above
A:	87.5 - 100
B:	77.5 - 87.5
C:	67.5 - 77.5
D:	55.0 - 67.5
E:	otherwise

CE 525 – Mechanical Damage of Materials

Introduction
Survey of structural failures
Historical perspective
Fracture mechanics and design

Review of Mechanics of Materials and Elasticity
Analysis of stress and strain
Stress-Strain relationships
Plane elasticity
Plastic deformation of materials and components
Notched members

Fundamentals of Linear Elastic Fracture Mechanics
Energy principle and Griffith theory
Crack tip stress/strain analysis
Stress Intensity Factor

Mixed-mode fracture

Fundamentals of elastic-plastic fracture mechanics
Crack tip opening displacement
J integral
Relationship between J and CTOD
J controlled fracture and crack growth

Numerical and Experimental Fracture Analysis
Overview
Finite element method
Stress and displacement matching
Mesh and convergence
Other simulation approaches
Fracture testing

Fatigue fracture of materials
Overview of fatigue analysis of materials
Fatigue crack growth laws and life prediction
Crack closure
Variable and random loading crack growth
Subcycle failure mechanisms
Material microstructure effect

Advanced topics
Probabilistic fracture mechanics and uncertainty quantification
Non-continuum based fracture analysis
Rate and environment dependent fracture of materials

Persons(s) who prepared this description and date of preparation:

Y. Liu Aug 15, 2015