ADVANCED FRACTURE MECHANICS AND STRUCTURAL INTEGRITY–MEEG 5963
Spring Semester 2020

Instructor: Ashok Saxena, 315 John A. White Engineering Hall, asaxena@uark.edu, 479-530-2425, 479-466-4301 (Cell, text messages welcome)
Pre-requisite: Fundamentals of Fracture

Text Book: Ashok Saxena, Advanced Fracture Mechanics and Structural Integrity, Publisher: CRC Press, Taylor and Francis Group, ISBN: 978-1-138-54426-0, Published 2019.

See the following website for buying the book: https://www.crcpress.com/Advanced-Fracture-Mechanics-and-Structural-Integrity/Saxena/p/book/9781138544260

Course Description and Objectives: To provide an in-depth treatment of advanced topics such as fracture, crack initiation and growth under elastic-plastic and time-dependent creep and creep-fatigue conditions. The course emphasizes fundamental underpinnings of nonlinear fracture mechanics and its use in material evaluation and life prediction methodology for structural components. Micro-mechanics of fracture and crack growth processes are also covered. Upon completion of this course, the students will be ready to undertake research in areas of nonlinear fracture mechanics and/or apply the concepts to evaluate structures.

The course assumes that students have previously taken a course on Fundamentals of Fracture Mechanics and are already familiar with stress intensity parameter and how it applies to predicting crack growth and fracture under dominantly linear elastic conditions. This course addresses topics such as Analysis of Cracks under Elastic-Plastic Loading, J- Integral as Fracture Criterion, Methods of Determining J, Crack Growth Resistance Curves, Micromechanics of Ductile Fracture and Constraint Effects,
Fatigue Crack Growth under Gross Plasticity, Analysis of Cracks in Creeping Bodies, Creep Crack Growth, Creep-fatigue Crack Growth, and Applications of nonlinear fracture mechanics in integrity assessment of components operating at high temperatures.
Grading Policy: Term grades will be based on 6 homework assignments. The five best grades on homework assignments will count for a total of 75%. A take-home final examination will count for the remaining 25% of the grade.

Reference Books:
1. T. L. Anderson, Fracture Mechanics: Fundamentals and Applications –Second edition,CRC Press, 1995, ISBN 0-8493-4260-0
2. Various other references and internet resources to be provided in the Handouts

Course Schedule

Dates	**Topic**	Module	Points
March 6-8	Introduction and Review of Linear Elastic Fracture Mechanics Analysis of Cracks Under Elastic-Plastic Conditions	Chapter 1 Chapter 2	
March 11-15	Methods of Estimating J-Integral	Chapter 3	
March 17	**ASSESSMENT DUE : Homework 1- 2.1, 2.2, 2.4, 2.6, 2.8, 2.12**		**15**
March 18-22	Crack Growth Resistance Curves and Measures of Fracture Toughness Effects of Constraint on Fracture and Stable Crack Growth	Chapter 4 Chapter 5	
March 24	**ASSESSMENT DUE: Homework 2- 3.1, 3.2, 3.9, 3.13, 4.5, 4.7**		**15**
March 25-29	Microscopic Aspects of Fracture	Chapter 6	
March 31	**ASSESSMENT DUE: Homework 3- 5.3, 5.4, 6.3, 6.6, 6.9, 6.10**		**15**
April 01-05	Fatigue Crack Growth Under Large Scale Plasticity	Chapter 7	
April 7	**ASSESSMENT DUE: Homework 4- 7.1, 7.2, 7.3,7.6, 7.8, 7.10**		**15**
April 08- 12	Analysis of Cracks in Creeping Materials	Chapter 8	
April 14	**ASSESSMENT DUE: Homework 5- 8.1, 8.2, 8.6, 8.7, 8.10**		**15**
April 15-19	Creep-fatigue Crack Growth	Chapter 9	
April 21	**ASSESSMENT DUE: Homework 6 – 9.1, 9.3, 9.4, 9.8**		**15**
April 22 - 26	Applications		
May 02	**ASSESSMENT DUE: Take Home Final Examination**		**25**

Grading Policy

Homework and take-home examination must be solely student work; in other words, no collaboration is permitted. Homework is due at midnight of the posted due date. Best five of six homework submissions will count for 15% each for a total of 75% toward the grade and the take-home final will count for 25% of the grade.