



Engineering Fracture Mechanics

MECHENG 5144

Credit Hours:

3.00

Course Levels:

Undergraduate (1000-5000 level)

Graduate (5000-8000 level)

Course Components:

Lecture

Course Description:

Fracture and fatigue of solids; stress intensity factors; stability of cracks; compliance and energy methods; plane stress, plane strain effects; crack propagation and arrest criteria.

Prerequisites and Co-requisites:

Prereq: 2020 (420) or 2040, and Math 2174, 2177, or 2415 (415); or Grad standing in Engineering.

Course Goals / Objectives:

- Obtain understanding of nature of stress and strain fields surrounding sharp crack like defects in elastic solids as characterized by the stress intensity factor, including the effects of cracked structure geometry, and limited near tip plasticity
 - Obtain an understanding of basic energy relationships in fracture, including the strain energy release rate and the J-integral
 - Obtain a basic understanding of the concepts and experimental methods for characterization of material fracture resistance through fracture toughness and related material dependent parameters
 - Ability to apply a variety of crack propagation criteria for determining the critical values of the applied loading and crack length at crack propagation
 - Obtain a basic understanding of the mechanisms and modeling of fatigue crack growth (cyclic sub-critical loading and crack growth)
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Course Topics:

- Introduction, Some History and Motivation
 - The Modes of Fracture and Their Symmetries
 - Elements of Elasticity Theory
 - Linear Elastic Crack Tip Stress and Displacement Fields
 - The Stress Intensity Factor (Analytical and Numerical Solutions)
 - The Plastic Zone, Plane Stress vs. Plane Strain, K Dominance and Linear Elastic Fracture Mechanics (LEFM)
 - Griffith and the Energetics of Cracked Bodies
 - The J-Integral
 - Fracture Toughness, Fracture Criterion and LEFM, Plane Stress Fracture and R-Curves, Mixed Mode Crack Growth
 - Materials issues in Fracture of Metals (ductile vs. brittle), Ceramics, Plastics and Composites
 - Fatigue Crack Growth
 - Designing Against Fracture
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Designation:

Elective