M.Sc. Applied Mechanics

Winter semester

Course title: FRACTURE MECHANICS

Instructor: Prof. G. Exadaktylos

exadaktylos@mail.ntua.gr

Class: Mondays 11:45-14:15

Textbook: Personal notes

Recommended Reading:

1) The Mechanics of Fatigue and Fracture - A. P. Parker, F.&N. Spon. Methuen, NY, 1981.
2) Elementary Engineering Fracture Mechanics – D. Broek, Martinus-Nijhoff, 3rd Revision, Ed., 1982.
3) Stress Analysis of Cracks Handbook, H. Tada, P. C. Paris and G. R. Irwin, Del Research Corp., Hellertown, PA, 1973.
4) Standard Test Method for Plane-Strain Fracture Toughness of Metallic Materials, ASTM Designation: E 399 – 90 (Reapproved 1997)

Contents:

Ch. 1 Introduction and Energy Considerations (History, Philosophy and Purpose, Loading modes, Energy Release Rate, Crack Growth Resistance, Surface Energy, J integral, Summary, Exercises), **Ch. 2 Stresses and Displacements around crack tips** (Review of Complex Potentials, Stresses and Displacements Around Cracks, Complex Stress Intensity Factor, Stress Intensity Factor Dimensions, Correlation with Stress Concentration Factors, Equivalence of G and K, Exercises), **Ch. 3 Methods for Determination of Stress Intensity Factors** (Westergaard and Complex Stress Functions, Greens Functions, Boundary and Mappin Collocation, Weight Function, Displacement Discontinuity Method, Compounding Methods, Experimental Determination of SIF's, Three Dimensional Problems, Mixed Mode Fracture Mechanics, Exercises), **Ch. 4 Effects of Crack Tip Plasticity** (Irwin's correction, Strip Yield Model, Plastic Zone Shapes, Correlation of SYM with Experiments, Fracture Criteria with Moderate Plasticity), **Ch. 5 Use of Fracture Mechanics in Engineering** (Determination of Fracture Toughness and Fatigue Crack Growth, Plane Stress and Plane Strain Fracture Toughness (K_{IC} and R curves, Determination of Plane Strain Fracture Toughness, *Fatigue Crack Growth*), **Ch. 6 Crack Dynamics – Unstable Propagation and Arrest** (Intro, Calculation of Kinetic Energy and Crack Arrest, Dynamic Values of K and G, Crack Branching and Arrest).