EML 6934 – FAILURE OF MATERIALS IN MECHANICAL DESIGN
FALL 2009

Textbook: *Failure of Materials in Mechanical Design*
Jack. A. Collins, Second Edition, Wiley-Interscience Publication

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Classroom NEB 201, MWF: Period 8 (3:00-3:50)

Course Website http://www.mae.ufl.edu/courses/fall2009/eml6934

Office Hours Mon and Wed, 10:00-11:30 am

References:
Metal Fatigue in Engineering, 2nd Edition, Wiley Interscience, Stephens et al.
Fatigue Design by E. Zahavi
Fundamentals of Structural Integrity by Alten. F. Grandt Jr., John-Wiley and Sons
Mechanical Behavior of Materials by William F. Hosford, Cambridge Univ Press
Mechanical Behavior of Materials by Keith Bowman, John-Wiley and Sons

Goals: This is an applied course dealing with evaluation of fatigue life of machine elements subjected to steady and alternating multi-axial (3D) stresses, with applications in mechanical and structural design. Applications of fatigue life analysis to design machine elements such as gears, rotors, compressor and turbine discs, blades, and other structural components subjected to monotonic and fatigue stresses will be emphasized. Fatigue design using the stress-life approach, local strain-life approach, and fracture mechanics approach, will be studied in detail, for both High Cycle Fatigue (HCF) and Low Cycle Fatigue (LCF) conditions, with numerous design examples. Fatigue life evaluation of machine elements subjected to complex spectrum loading will be analyzed using cumulative fatigue damage theories and rain flow counting methods. Damage tolerant life prediction methods will be presented.

Topics:

1. Modes of Mechanical Failure
2. Strength and deformation of engineering metals, Dislocation theory
3. State of Stress at a Point, Principal Stresses, etc.
4. Relationships between Stress and Strain, Plastic Stress-Strain Relationships
5. Combined Stress Theories of Failure and their Use in Design.
6. High-Cycle Fatigue, Multiaxial Fatigue Stresses, Goodman Diagram
7. Concepts of cumulative fatigue damage, Spectrum loading, Rain flow Counting Techniques.
8. Low-Cycle Fatigue.
9. Stress Concentration, Local Strain-Life Approach, and Neubers rule
10. Introduction to Linear Elastic Fracture Mechanics
11. Use of Fracture Mechanics principles for fatigue life analysis.
12. Fatigue crack growth properties, Applications to life analysis and design
13. Damage Tolerance and Fracture Control Applications in Design
14. High Temperature Effects (Creep, Thermo Mechanical Fatigue)

Homework: Several design projects involving machine elements such as gears, pressure vessels, bearings, rotating shafts, compressor and turbine components, etc will be assigned. Use of software packages such as MATLAB, MAPLE or MATHCAD will be required.

Grading Policy:

Homework	= 20%
Midterm	= 40 %
Final	= 40%