

ME/MSE/AE/CEE/CHBE 7774 – Fatigue of Materials and Structures

Spring 2024

Credit Hours:	3-0-3
Prerequisites:	graduate standing
Catalog Description:	Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading and fatigue crack propagation
Instructor:	Professor Richard W. Neu Woodruff School of Mechanical Engineering Materials Science and Engineering room: MRDC 4105 phone: 404-894-3074 e-mail: rick.neu@gatech.edu
Office Hours:	MW 11:00 AM – 1:00 PM (immediately after class), and by appointment; Virtual Office Link: https://gatech.zoom.us/j/2014424609?pwd=THIEWUVlelZoODMyC9VRThvdjdBQT09
Textbook:	Suresh, S., <i>Fatigue of Materials</i> , 2 nd Ed., Cambridge University Press, 1999 *
Reference Books:	Bannantine, J.A., Comer, J.J., and Handrock, J.L., <i>Fundamentals of Metal Fatigue Analysis</i> , Pearson, 1990 Dowling, N.E., <i>Mechanical Behavior of Materials</i> , 4 th Ed., Pearson, 2013 <i>ASM Handbook, Vol. 19: Fatigue and Fracture</i> , ASM, 1996 * Lee, Y.-L., Barkey, M.E., and Kang, H.-T., <i>Metal Fatigue Analysis Handbook</i> , Elsevier, 2012 * Murakami, Y., <i>Metal Fatigue: Effects of Small Defects and Nonmetallic Inclusions</i> , Elsevier, 2002 * Schijve, J., <i>Fatigue of Structures and Materials</i> , 2 nd Ed., Springer, 2009 * *online access through GT library
Goals:	To provide a working knowledge of state-of-the-art methods and contemporary issues of fatigue life prediction and associated physical processes, with emphasis on metal fatigue.
Evaluation:	Homework: 33.4% Midterm Exam: 33.3% Final Exam: 33.3%
Important Dates:	Monday, March 4: Midterm Exam Wednesday, May 1, 8:00 AM – 10:50 AM: Final Exam

Topics

Reading in BCH

Reading in Suresh

INTRODUCTION

History of fatigue

Foreword

1.1

Different approaches to fatigue analysis

1.2-1.3

ENGINEERING METHODS TO QUANTIFY FATIGUE DAMAGE

Stress-life approach

1.1-1.6

7.1-7.2, 7.4, 7.6

Strain-life approach

2.1-2.8

3.3, 8.1

Damage-tolerant approach (i.e., fatigue crack growth using fracture mechanics)

3.1-3.5

9.1-9.6, 9.12, 10.1, 10.3, 10.6

Comparison of methods

6.1-6.6

GEOMETRY AND LOADING EFFECTS

Notches

4.1-4.7

7.9, 8.2

Variable amplitude loading (incl. cycle counting; load sequence)

5.1-5.8

7.3, 8.3

Multiaxial fatigue

7.1-7.5

7.10, 8.4-8.5

FATIGUE MECHANISMS IN METALS

Cyclic deformation in single and polycrystals

2.1-2.5, 2.8-2.11, 3.1-3.2, 3.4-3.7, 3.9

Fatigue crack initiation (incl. VHCF regime)

4.1-4.4, 4.6-4.11

Fatigue crack growth (FCG) & FCG thresholds

10.2, 10.4, 10.7, 10.8

VARIOUS OTHER TOPICS

Statistical analysis and probabilistic methods

7.5

Crack closure (incl. variable amp. loading in FCG)

14.1-14.8, 14.11-14.15

Small fatigue cracks

15.1-15.9

Contact fatigue: rolling and fretting

13.4-13.7

Corrosion-fatigue

16.1-16.4

High temperature fatigue (incl. creep-fatigue; thermomechanical fatigue)

16.6-16.8

Supplemental readings will be posted on Canvas