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:
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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=THlEWUVlelZoODMycC9VRThvdjdBQT09

Textbook: Suresh, S., *Fatigue of Materials*, 2nd Ed., Cambridge University Press, 1999 *

Reference Books:
Bannantine, J.A., Comer, J.J., and Handrock, J.L., *Fundamentals of Metal Fatigue Analysis*, Pearson, 1990
Dowling, N.E., *Mechanical Behavior of Materials*, 4th Ed., Pearson, 2013
ASM Handbook, Vol. 19: Fatigue and Fracture, ASM, 1996 *
Lee, Y.-L., Barkey, M.E., and Kang, H.-T., *Metal Fatigue Analysis Handbook*, Elsevier, 2012 *
Murakami, Y., *Metal Fatigue: Effects of Small Defects and Nonmetallic Inclusions*, Elsevier, 2002 *
Schijve, J., *Fatigue of Structures and Materials*, 2nd 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***	***ASTM Standards***
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	E466, E468, E739, E1823, E2948
Strain-life approach	2.1-2.8	3.3, 8.1	E606
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	E647
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	E1049
Multiaxial fatigue	7.1-7.5	7.10, 8.4-8.5	E2207, E3459
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	E647
VARIOUS OTHER TOPICS			
Statistical analysis and probabilistic methods		7.5	E2283
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	E2789
Corrosion-fatigue		16.1-16.4	
High temperature fatigue (incl. creep-fatigue; thermomechanical fatigue)		16.6-16.8	E2368, E2714

Supplemental readings will be posted on Canvas