Georgia Institute of Technology

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

Spring 2016

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: Monday & Friday 2 PM – 3 PM, Wednesday 2 PM – 4 PM, and by appointment

Textbooks:
Suresh, S., *Fatigue of Materials*, Cambridge University Press, 2nd Ed., 1999
Bannantine, J.A., Comer, J.J., and Handrock, J.L., *Fundamentals of Metal Fatigue Analysis*, Prentice-Hall, 1990

Reference Books:
Dowling, N.E., *Mechanical Behavior of Materials*, Prentice-Hall, 3rd Ed., 2007
ASM Handbook, Vol. 19: Fatigue and Fracture, ASM, 1996

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:	25%
Exams (20% each):	40%
Final exam:	35%

Important Dates:

Wednesday, February 10:	Exam #1
Friday, March 18:	Exam #2
Monday, May 2, 2:50 PM – 5:40 PM:	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
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
Fatigue crack growth (incl. review of fracture mechanics)	3.1-3.5	9.1-9.6, 10.1, 10.3, 10.6-10.8
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		10.2, 10.4
VARIOUS OTHER TOPICS		
Statistical considerations		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