

USCViterbi
School of Engineering

AME 560, Fatigue and Fracture

Units: 3.0

Spring 2017, Tuesday and Thursday, 12:30-1:50 pm

Location: OHE 100B

Instructor: Hahn

Office: TBD

Office Hours: (2-3 pm, Tuesday and Thursday)

Contact Info: hahnmt@usc.edu 310-350-3035

Teaching Assistant: TBD

Office: TBD

Office Hours: TBD

Contact Info: TBD

Course Description

“Behavior of materials under cyclic and static fatigue; plastic instability; life-time predictions; brittle and ductile fracture; crack propagation and plastic blunting.”

The course looks at fracture from mechanics and materials science perspectives, illustrating theory through practical examples.

Learning Objectives

The course should provide a background on why and how things break which can be applied to the study of mechanical behavior or the practical issues of preventing fracture.

Recommended Preparation: basic knowledge of materials science and mechanics of materials.

Course Notes

Copies of the lecture slides will be posted on Desire2Learn

Technological Proficiency and Hardware/Software Required

Lectures and other course information may be accessed through Desire2Learn

Required Readings and Supplementary Materials

Text: Deformation and Fracture Mechanics of Engineering Materials, R. W. Hertzberg, R. Vinci, and J. Hertzberg, 5th Edition, Wiley.

Optional:

Fundamentals of Creep in Metals and Alloys, M. E. Kassner

Superplasticity in Metals and Ceramics, Nieh, Wadsworth, and Sherby

S. Suresh, Fatigue of Materials, Cambridge.

Description and Assessment of Assignments

Homework is optional and will be corrected but not graded.

Grading Breakdown

How will students be graded overall, including the assignments detailed above. Participation should be no more than 15%, unless justified for a higher amount. All must total 100%.

Assignment	Points	% of Grade
Midterm 1	100	20
Midterm 2	100	20
Final	100	60
TOTAL	300	100

If the optional failure analysis project is done, it counts 5% and the exams count 95%.

Assignment Submission Policy

Assignments may be handed in in person before or after class or submitted through DEN.

Additional Policies

Exams are open book, open notes. Calculators are permitted but no other electronic devices may be used.

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Week 1 1/10, 1/12	Introduction to Fracture	Hertzberg, Chapter 5	
Week 2 1/17,1/19	Fracture Mechanics 1 &2	Hertzberg, Chapter 6	
Week 3 1/24, 1/26	Dislocations and Plastic Deformation; Strengthening Mechanisms	Hertzberg, Chapter 2; Hertzberg, Chapter 3	
Week 4 1/31, 2/2	Fracture Mechanics 3; Ductile Fracture Mechanisms	Hertzberg, Chapter 6 Hertzberg, Chapter 7	
Week 5 2/7, 2/9	First Exam (2/7) Cyclic Deformation	Room TBD Hertzberg, Chapter 9	
Week 6 2/14, 2/16	Cyclic Deformation; Stress-Life and Strain-Life Tests	Hertzberg, Chapter 9 Hertzberg, Chapter 10	
Week 7 2/21, 2/23	Fatigue Crack Growth Tests	Hertzberg, Chapter 10	
Week 8 2/28, 3/2	Fatigue Crack Growth of Polymers and Ceramics; Environmentally Induced Fracture	Hertzberg, Chapter 10 Hertzberg, Chapter 8	
Week 9 3/7, 3/9	Environmentally Induced Fracture; Second Exam (3/9)	Hertzberg, Chapter 8	
Week 10 3/14, 3/16	<i>Spring Recess</i>		
Week 11 3/21, 3/23	Environmentally Induced Fracture; Creep	Hertzberg, Chapter 8 Hertzberg, Chapter 4	
Week 12 3/28, 3/30	Creep; Superplasticity	Fundamentals of Creep in Metals and Alloys, M. E. Kassner; Superplasticity in Metals and Ceramics, Nieh, Wadsworth, and Sherby	
Week 13 4/4, 4/6	Failure Analysis; Creep-Fatigue Interactions	Hertzberg, Chapter 11 S. Suresh, Fatigue of Materials, Cambridge	
Week 14 4/11, 4/13	Fretting and Fretting Fatigue Fatigue of Aerospace Bolts Hertzian Contact Fracture Fracture of Nanomaterials	ASM Handbook, Volume 19; Papers by Olsen et al. (posted on Desire2Learn); Various Sources	

Week 15 4/18, 4/20	Fracture in Composites	ASM Handbook, Volume 19	
Week 16 4/25, 4/27	Fatigue of Springs; Overview of Fracture Control; Summary	ASM Handbook, Volume 19	
FINAL 5/10	FINAL EXAM, ROOM TBD, 2-4 PM	Final Exams May 3-10	

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu> or to the *Department of Public Safety* <http://capsnet.usc.edu/departments/departments-public-safety/online-forms/contact-us>. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

Support Systems

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.