Failure of Materials in Mechanical Design

EML 5233 Sections 11816, 11817, 11818
Class Periods: T | Period 7 | 1:55 – 2:45 PM and R | Period 7-8 | 1:55 – 3:50 PM
Location: NEB 0201
Academic Term: Spring 2026

Instructor:
Alison C. Dunn
alisn@ufl.edu
(352) 392-0039
Office Hours: TBD

Grader:
Please contact through the Canvas website, and cc: Professor Dunn on all correspondence

- Vishaal RAMASAMY RAVICHANDRAN

Course Description
Evaluation of fatigue life of machine elements and aerospace structures. Steady and alternating multi-axial stress. High cycle fatigue and low cycle fatigue. 3 Credits.

Course Pre-Requisites / Co-Requisites
Status of 6EG, 7EG, 8EG, 9EG, or course EML3005

Course Objectives
Students will be able to do the following:

- Analyze a representative mechanical system under steady and time dependent 3D stresses to identify dominant failure modes and predict remaining life using the appropriate life-prediction method
- Apply multiaxial fatigue criteria to a metallic alloy in a 3D stress state with concentrations to estimate fatigue life and determine safety factors
- Analyze spectrum loading with rainflow counting and cumulative damage to predict overall fatigue life and propose maintenance or design adjustments
- Account for high temperature effects in life predictions by selecting appropriate models and integrating with fatigue or fracture mechanics to forecast life

Required Textbooks and Software

- *Failure of Materials in Mechanical Design*
- Jack A. Collins
- Second Edition, 1993
- ISBN 0-471-55891-5

Course Schedule
A tentative schedule is included at the end of this syllabus. Any schedule changes will be announced via Canvas "Course Announcement", and updated in the Canvas documentation.

Academic Policies & Resources
To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: https://go.ufl.edu/syllabuspolicies. Instructor-specific guidelines for courses must accommodate these policies. See below for specifics.

Academic Honesty
By becoming a member of the University of Florida community, a Student agrees to adhere to its Student Honor Code and its Student Conduct Code (https://policy.ufl.edu/regulation/4-040/). Suspected cases of dishonesty will be filed through the Dean of Students Office.

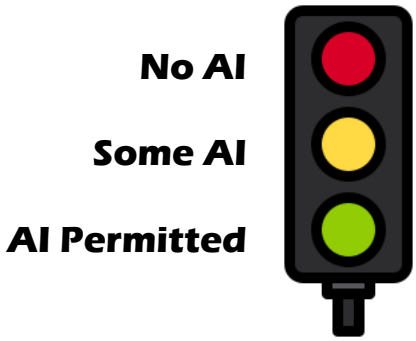
Important Dates
02/19/2026 Midterm Exam 1
03/26/2026 Midterm Exam 2
05/01/2026 Final Exam (10am – noon)
For students in the on-campus section (11816), midterm exams will be held in class on a Thursday in the assigned classroom. For students in the online sections (11817, 11818), take-home exams will be released and collected after 1 week.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Problem Sets (~4)	100 each	25%
Midterm Exam 1	100 each	20%
Midterm Exam 2	100	20%
Final Exam	100	30%
Article Critique	100	5%
		100%

Class Expectations, and Make-Up Policy
Late homework will receive a 10% penalty per day it is late. These rules apply unless advance written request has been submitted to the instructor and approved. Illegible homework is subject to being rejected by the instructor. Make-up Exam/Late Assignment Policy: Do not miss an exam. Make-up exams will only be given if prior approval is granted by the instructor and the student must make a reasonable attempt to take the exam before the scheduled exam date. The instructor will discuss any exam or homework within two weeks (excluding holidays) after return. After this time, grades are final.

Artificial Intelligence (AI) Statement
Generative AI is now widely available. UF students have expansive access to state-of-the-art LLMs through the NaviGator Chat, and are encouraged to explore their uses (https://it.ufl.edu/ai/navigator-chat/). That said, the charge of the instructor is to develop human intelligence, and to assign course grades based on the skills and competencies listed in the course objectives. To create a positive experience for both instructor and student, the instructor will make use of recommended resources and approaches shown at https://ai.ufl.edu/teaching-with-ai/expanding-the-ai-curriculum/guidance-for-instructors/. For example, each graded assignment will have clear guidelines on the acceptable use of AI tools using the stoplight system shown at right.



Commitment to a Positive Learning Environment
The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
- Your academic advisor or Graduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu

Week	Date	Day	Class No.	Topic	Assignment(s)
1	13-Jan	T	1	Elasticity	
	15-Jan	R	2	Stress States	
	15-Jan	R	3	Principal Stresses	
2	20-Jan	T	4	Stress State Example	
	22-Jan	R	5	Stress Strain Relations	
	22-Jan	R	6	Plastic Stress Strain Relations	Problem Set 1 Asssigned
3	27-Jan	T	7	Plastic Stress Strain Example	
	29-Jan	R	8	Static Failure Theories	
	29-Jan	R	9	Intro to Fatigue	Problem Set 1 Due
4	3-Feb	T	10	Stress Life S-N Curve	
	5-Feb	R	11	Stress-Life Nonzero Mean Strss	
	5-Feb	R	12	Stress-Life Example	Problem Set 2 Assigned
5	10-Feb	T	13	Fatigue in Multiaxial Loading	
	12-Feb	R	14	Cumulative Damage 1	
	12-Feb	R	15	Cumulative Damage 2	Problem Set 2 Due
6	17-Feb	T	16	Faigue Failure Case Study	
	19-Feb	R	17		Midterm Exam 1
	19-Feb	R	18		Midterm Exam 1
7	24-Feb	T	19	LEFM	
	26-Feb	R	20	Using LEFM in Design	
	26-Feb	R	21	EPFM	
8	3-Mar	T	22	Life Prediction Part I	
	5-Mar	R	23	Life Prediction Part II	
	5-Mar	R	24	Fatigue Simulation Example	Problem Set 3 Assigned
9	10-Mar	T	25	Using Ideas from Chapter 8	
	12-Mar	R	26	Fatigue Testing and Interpretation	
	12-Mar	R	27	Low Cycle Fatigue	Problem Set 3 Due
10	17-Mar	T	-	*Spring Break*	
	19-Mar	R	-	*Spring Break*	
	19-Mar	R	-	*Spring Break*	
11	24-Mar	T	28	Low Cycle Fatigue Examples	
	26-Mar	R	29		Midterm Exam 2
	26-Mar	R	30		Midterm Exam 2
12	31-Mar	T	31	Stress Concentrations Intro Part I	
	2-Apr	R	32	Stress Concentrations Part II	
	2-Apr	R	33	Stress Concentrations Part III	
13	7-Apr	T	34	Intro to Creep	
	9-Apr	R	35	Creep Basics	
	9-Apr	R	36	Creep Examples	Problem Set 4 Assigned
14	14-Apr	T	37	Creep Problems Part I	
	16-Apr	R	38	Creep and Fatigue	
	16-Apr	R	39	Creep Problem Turbine Blade	Problem Set 4 Due
15	21-Apr	T	40	Creep Closure	
Final Exam	1-May	F		10am - noon @ NEB 0201	