Mechanics of Materials Lab

ME 354
University of Washington, Seattle — Winter Quarter 2008

Location: MEB 248 (Lecture)
MEB 127 (Lab)

Time: 9:30-10:20am MTWF (Lecture)
2:30-5:20pm TWThF (Lab)

Instructor: Nathan J. Sniadecki
MEB 318

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TAs: Daniel Flores dflores2@u.washington.edu Lab: 2:30-5:20pm TF
Onur Namli ocnamli@u.washington.edu Lab: 2:30-5:20pm WTh

Office Hours: NS: 10:30-11:30am MTW, MEB 318, or by appointment
DF: 1:30-2:30pm MW, MEB 127
ON: 1:30-2:30pm T, 9:30-10:30am Th, MEB 127

Website: `http://courses.washington.edu/nsniadec/ME354/W08`

Description: Properties and behavior of engineering materials including stress-strain relations, strength, deformation mechanisms, strength, deformation, fracture, creep, and cyclic fatigue. Introduces experimental techniques common to structural engineering, interpretation of experimental data, comparison of measurements to numerical/analytical predictions, and formal, engineering report writing. Lecture and laboratory.

Prerequisites: MSE 170 – Fundamentals of Material Science
CEE 220 – Introduction to Mechanics of Materials

Required Text:

[1] Dowling, N. E., 2007, *Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue*, *3rd edition*, Pearson/Prentice Hall, Upper Saddle Ridge, NJ (ISBN: 0131863126)

Recommended Texts:

[2] Callister, W. D. 2007, *Materials Science and Engineering: An Introduction, 7th edition*, John Wiley & Sons, New York, NY

[3] Hibbeler, R.C., 2005, *Mechanics of Materials, 5th edition*, Pearson/Prentice Hall, Upper Saddle Ridge, NJ

[4] Taylor, J.R., 1997, *An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements*, University Science Books, Sausalito, CA

Grading:

1)	Reports	55%	Formal Reports 30%, Memo Reports 20%, In-lab Report 5%
2)	Exams	35%	Midterm Exam 15%, Final Exam 20%
3)	Homework	10%	
4)	Quizzes	+1%	Fundamentals of Engineering Exam Questions

Table 1. Lecture Topics for ME 354

Week 1	**No Lab**		**Readings**	**Lecturer**
7-Jan	M	Course Overview, Review of Mechanics of Materials	Ch 1, Appendix A	NS
8-Jan	T	Review of Material Science	Ch 2 & 3	NS
9-Jan	W	Lab Procedure - Significant Figures, Statistical Analysis	Appendix B	NS, DF, ON
11-Jan	F	Beam Bending		NS
Week 2	**Lab: Strains, Deflections, and Beams in Bending (memo report)**			
14-Jan	M	Transformations, Mohr's Circle	Ch 6.1-2	NS
15-Jan	T	Lab Recitation - Strain Gages, Memo Report Style	Gage.pdf, Memo.pdf	DF, NS
16-Jan	W	Principal Stresses, 3D Stresses	Ch 6.3-4	NS
18-Jan	F	Failure Criteria, Max Normal, Tresca	Ch 7.1-4	NS
Week 3	**Lab: Curved Beams and Photoelasticity (in-lab report)**			
21-Jan	*M*	*No Class*		
22-Jan	T	Lab Recitation - Photoelasticity		NS
23-Jan	W	von Mises Stress, Failure Factors	Ch 6.5, 7.5-6, 7.9	NS
25-Jan	F	Mechanical Testing	Ch 4.1-2, 4.6-9	NS
Week 4	**Lab: Tension and the Mechanical Properties of Materials (formal report)**			
28-Jan	M	Stress/Strain - True vs. Engineering	Ch 4.3-5	NS
29-Jan	T	Lab Recitation - Instron, Formal Report Style	FormalReport.pdf	NS, ON
30-Jan	W	Hooke's Law in 3D	Ch 5.3-4	NS
1-Feb	F	Deformation Models	Ch 5.1-2, 12.1-2	NS
Week 5	**Lab: Fracture (memo report, due in 2 wks)**			
4-Feb	M	Lab Recitation	Ch 4.8, Ch 8.6	NS, DF
5-Feb	T	Plasticity in 3D	Ch 12.3	NS
6-Feb	W	Plasticity in Unloading/Cycling Loading	Ch 12.4-5	NS
8-Feb	F	Plasticity in Bending/Torsion	Ch 13.1-4	NS
Week 6	**Lab: Torsion and the Mechanical Properties of Materials (formal report)**			
11-Feb	M	*** Mid-Term Exam ***	Ch 1-7	NS
12-Feb	T	Lab Recitation	Ch 4.9.3-4, 13.4	ON
13-Feb	W	Fracture, Crack, and Stress Concentrators (Ch 8)	Ch 8.1-3	NS
15-Feb	F	Fracture, Crack, and Stress Concentrators (Ch 8)	Ch 8	NS
Week 7	**Lab: Stress Intensity Factors (in-lab report)**			
18-Feb	*M*	*No Class*		
19-Feb	T	Lab Recitation		NS
20-Feb	W	Creep	Ch 15	NS
22-Feb	F	Creep	Ch 15	NS
Week 8	**Lab: Structural Evaluation and Bike Frames (formal report)**			
25-Feb	M	Cyclic Fatigue	Ch 9.1-3, 9.5-6	NS
26-Feb	T	Lab Recitation		DF
27-Feb	W	Cyclic Fatigue, Stress Risers	Ch 9, 10.1-3	NS
29-Feb	F	Fracture Crack Growth	Ch 11	NS
Week 9	**Lab: Creep (memo report, due before Final Exam) & Fatigue (in lab report)**			
3-Mar	M	Lab Recitation		ON
4-Mar	T	Compression Testing, Hardness, Fracture	Ch 4.6-7, 7.7-8	NS
5-Mar	W	Compression, Yielding	Ch 12.4.1-2	NS
7-Mar	F	Buckling	Buckling.pdf	NS
Week 10	**Lab: Compression and Buckling (in-lab report)**			
10-Mar	M	Lab Recitation	Buckling.pdf	NS
11-Mar	T	Buckling	Buckling.pdf	NS
12-Mar	W	Review		NS
14-Mar	F	Review		NS
Final				
19-Mar	W	8:30-10:20 am	Cumulative	

Course Policies:

Homework Policy: All assignments must be handed in before class starts on the due date. Late homework will be excepted if and only if (iff) arrangements are made in advance of the due date.

Lab Report Policy: Late lab reports will not be accepted. In general, in-lab report are due by the end of the lab period, memo reports are due at the start of the next lab period, and formal reports are due in two weeks and are to be turned in at the start of lab period.

Collaboration Policy: You may discuss lab reports and homework with your fellow students, and even collaborate on the solution, but you must list on the homework or report the name of the person(s) that collaborated with you on the effort. Please properly cite* any material that you copied, reproduced, or rewrote in your own words.

Exam Policy: All exams must be completed on the specified date. Only under proven, extraordinary circumstances will a makeup exam be permitted. Engineering calculators are permitted.

Classroom Policy: Please consider the learning mission of the course and refrain from activity that is disruptive during the lectures or lab sessions.

I have a zero-tolerance for cheating or plagiarism. Please refer to UW's Student Conduct Code.
http://www.washington.edu/students/handbook/conduct.html

Course Outcomes and Assessment:

By the end of this course, the student will be able to:

1. List and explain applicable experimental methods for characterizing material and component behavior
2. Compare (and quantify differences) measured experimental results and calculated theoretical values.
3. Predict component behavior using experimental test results and engineering formulae
4. Analyze experimental data, theoretical models and their scalability to components
5. Analyze (deduce) the inherent variability of materials subjected to multiple modes of loading and apply the results to component behavior.
6. Formulate a solution path for analyzing an actual multi-component structure using experimental, theoretical, and numerical tools/methods.
7. Evaluate the limits of structures by extending the experimental measurements using theoretical and numerical methods

Contribution of Course to Professional Component:

The aim of the course is to prepare students for engineering practices by familiarizing them with mechanical testing systems, conducting experimental work, advancing their fundamental engineering knowledge, cultivating professional engineering standards, and developing their technical communication abilities.

Subject to Change Statement (a/k/a 'Living Syllabus'):

Information contained in the ME 354 course syllabus, other than the grade and course policies, may be subject to change, as deemed appropriate by the instructor. Advanced notice will be given during the lecture times and changes will be updated to the course website.

* We will use ASME-style citations: http://www.asme.org/Publications/ConfProceedings/Author/References_2.cfm