Mechanics of Materials Lab

ME 354
University of Washington, Seattle — Winter Quarter 2010

Location: MEB 238 (Lecture)
MEB 127 (Lab)

Time: 9:30-10:20am MTuWF (Lecture)
2:30-5:20pm TuWThF (Lab)

Instructor: Nathan J. Sniadecki
MEB 318

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Office Hours: NS: 2:30-3:20pm M MEB 318
TAs: 3:30-4:20pm M MEB 127

Website: `http://courses.washington.edu/nsniadec/ME354/W10`

GoPost: `https://catalysttools.washington.edu/gopost/board/nsniadec/2275/`

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

[5] Humphrey, J.D., Holmes, J.W, 2009, *Style and Ethics of Communication in Science and Engineering*, Morgan & Claypool, http://tiny.cc/hVdRi

Grading:

1)	Reports	60%	Formal Reports 45%, In-lab Report 15%
2)	Exams	30%	Midterm Exam 15% each
3)	Homework	10%	
4)	Quizzes	+1%	Fundamentals of Engineering Exam Questions

Course Policies:

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

Lab Report Policy: Late lab reports will not be accepted. All reports are to be turned into the TA of your section. Formal reports are due after two weeks and are to be turned in at the start of the lab period. The semi-formal report is due in one week. In-lab reports are due by the end of the lab period. Please cite any figures or material that you copied, reproduced, or rewrote in your own words.

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 report or homework the name of the person(s) that collaborated with you on the effort.

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 Development:

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.

ME 354 **MECHANICAL BEHAVIOR OF MATERIALS**

Winter Quarter 2010

			Readings
Week 1	**Lab 1**	**Beam lab (semi-report)**	
4-Jan	M	Course Overview, Review of Mechanics of Materials	Ch 1-3, Appendix A
5-Jan	T	Lab Recitation: Strain Gages, Statistics	Gages.pdf, Appendix B
6-Jan	W	Mechanics: 3D Stress/Strain, Plane Stress, Transformation Eqns	Ch 6.1-2
8-Jan	F	Mechanics: Principle Stresses, Mohr's Circle	Ch 6.1-2
Week 2	**Lab 2**	**Bike Lab (report)**	
11-Jan	M	Mechanics: 3D Principle Stresses, Stress Invariants	Ch 6.3-4
12-Jan	T	Lab Recitation: Method of Joints, Unit Load Method	Structure.pdf
13-Jan	W	Failure Criteria: Max Normal, Tresca	Ch 7.1-4
15-Jan	F	Failure Criteria: von Mises Stress, Stress Risers	Ch 6.5, 7.5-6, 7.9
Week 3	**Lab 3**	**Photoelasticity Lab (in-lab)**	
18-Jan	*M*	*No Class (MLK Day)*	
19-Jan	T	Lab Recitation: Photoelasticity	
20-Jan	W	Hooke's Law: 3D eqns, thermal expansion	Ch 5.3-4
22-Jan	F	Hooke's Law: examples	
Week 4	**Lab 4**	**Tensile Test Lab (report)**	
25-Jan	M	Tensile Testing: Anatomy of the Stress-Strain Curve	Ch 4.1-2, 4.6-9
26-Jan	T	Lab Recitation: Instron, Extensometer, LVDT	
27-Jan	W	Tensile Testing: True Stress/Strain	Ch 4.3-5
29-Jan	F	Deformation Models: Elasticity, Plasticity, Creep	Ch 5.1-2, 12.1-2
Week 5	**Lab 5**	**Charpy Impact Lab (in-lab)**	
1-Feb	M	Deformation Models: Relaxation, Stress-Strain Curves	Ch 12.3
2-Feb	T	Lab Recitation: Notch Impact Tests, Brittle-Ductile Transition	Ch 4.8
3-Feb	W	Plasticity: Bending	Ch 13.1-2
5-Feb	F	Plasticity: Residual Stress	Ch 13.3
Week 6	**Lab 6**	**Torsion lab (report)**	
8-Feb	M	*** Exam #1 ***	Ch 1-7
9-Feb	T	Lab Recitation: Plasticity in Torsion	Ch 4.9.3-4, 13.4
10-Feb	W	Midquarter CELT evaluation	
12-Feb	F	Fracture: Stress Concentrators	Ch 8.1-5
Week 7	**Lab 7**	**Fracture Lab (in-lab)**	
15-Feb	*M*	*No Class (President's Day)*	
16-Feb	T	Lab Recitation: Fracture Toughness Testing	Ch 8.6-7
17-Feb	W	Fracture: Plastic zone size	Ch 8.1-5
19-Feb	F	Creep	Ch 15.1-3
Week 8	**Lab 8**	**Creep Lab (report)**	
22-Feb	M	Creep: Linear Viscoleastic Models	Ch 15.6-7
23-Feb	T	Lab Reciation: Creep Testing	Ch 15.2
24-Feb	W	Creep: Time-Temperature Parameters	Ch 15.4
26-Feb	F	Fatigue: Mechanisms	Ch 9.1-6
Week 9	**Lab 9**	**Fatigue Lab (in-lab)**	
1-Mar	M	Fatigue: Life-estimates	Ch 9.7-9
2-Mar	T	Lab Recitation: Fatigue	
3-Mar	W	Fatigue: Crack Growth	Ch 11.7
5-Mar	F	Buckling: Euler's Formula	*Ch 13.1-3
Week 10	**Lab**	**Buckling Lab (in-lab)**	
8-Mar	M	Buckling: Eccentricity loads	*Ch 13.4
9-Mar	T	Lab Recitation: Buckling	
10-Mar	W	Video: UWTV Building the Boeing 787	
12-Mar	F	*** Exam #2 ***	