Syllabus: Mechanical Behavior of Materials

Class Structure

Lecture	Recorded and Posted Monday via Canvas
Active Learning Sessions	9:30-10:20am MWF
Lab sessions	2:30-5:20pm MTWTh & 1:00-2:20pm M

Teaching Team

Name	Role	Contact	Office Hours
Lucas Meza, PhD	Instructor	lmeza@uw.edu	TBD
TBD	TA	TBD	TBD
TBD	TA	TBD	TBD
TBD	TA	TBD	TBD
Bill Kuykendall	Lab Engineer	billkuyk@u.washington.edu	N/A

Course Description

This combined lecture/lab course will provide a theoretical and applied look into the mechanics of materials, data analysis and technical writing. Students will learn about topics including elasticity, plasticity, bending, buckling, fracture, and fatigue. These will be applied to real-world problem-solving exercises where students will explore current engineering challenges and develop solutions to them using mechanics of materials principles. Instruction will be done in a flipped class format, and students will watch short videos ahead of class to prepare for active learning sessions.

Course Materials

Website – Canvas LMS

Textbook – **ME 354 Course Notes**, Prof. Meza

Recommended Textbook – **Mechanical Behavior of Materials**, M. Meyers and K. Chawla, *2nd Ed.*

Discussions - Slack https://me354autumn.slack.com/

We will use Slack to manage questions and course discussions. This will help avoid repeat questions and let your classmates get involved.

Data Analysis

This class will require the analysis of experimental data and it is recommended that students take AMATH 301 or ME 303 at least concurrently. We will provide instructions in Python, but you can use any program including Matlab or Excel. To help get started with Python, we have set up a JupyterHub for the class where you can access Jupyter and run Python using a web browser.

Learning Goals

By the end of the course, students will:

- Understand the fundamentals of material deformation and failure.
- Know how to conduct tests to probe mechanical properties.
- Be able to analyze and understand laboratory data to draw conclusions about material properties.
- Examine how the mechanics of materials is intertwined with modern engineering problems.
- Be capable of writing to different audiences on how to use mechanics to solve engineering problems.
- Understand how experimental uncertainty affects and is accounted for in engineering design.

GRADING

Homework……... 40%
Labs & Data Analysis..……30%
Design Proposal……...30%
EC: Class Participation…...2%
Total…… 102%

Final grades will be rounded to the nearest decimal point based on the following formula:

$$GPA = \max\big((Total - 40)/14.5, 0\big)$$

This means the cutoff for a 4.0 is 98%, a 3.0 is 83%, a 2.0 is 69%, etc. We reserve the right to curve the grades to increase overall GPA but will not curve to lower people's grades.

HOMEWORK

Homework assignments contain conceptual and analytical problems from the lecture topics along with practice coding assignments. **Your lowest homework grade will be dropped**.

LABS & DATA ANALYSIS

There are 8 laboratory experiments throughout the course designed to expose students to mechanical test methods and to build a corresponding understanding of material properties and their uncertainty. Labs will require students to conduct experiments, record experimental data, and perform analysis of that data to obtain material properties.

All labs will require students to complete a **worksheet** related to the analysis of the lab data and to answer a set of conceptual questions on the experiments. All labs additionally require a **prelab** that will constitute 5% of the grade.

DESIGN PROPOSAL

Students will be asked to apply their knowledge of mechanics of materials to create a **proposed solution to a current engineering problem** related to the mechanics of materials. This open-ended project is intended to give students freedom to explore a range of challenges facing the modern world, from repairing failing infrastructure, creating lighter weight transportation, developing new energy storage solutions, creating biomedical devices, or designing durable consumer products.

The proposal consists of a series of progressive written reports. Students will first write a white paper (~1 page) describing a problem they see as important. It will be followed by a letter (2-3 pages) to a supervisor about the materials (or properties) needed to solve the problem, a letter (2-3 pages) to their peers/colleagues addressing technical details of the solution, and finally a long form proposal (6 pages) to a relevant governing body describing their solution. Proposals will be evaluated on creativity and thoroughness in solving their identified problem.

PARTICIPATION

Participation credit will be awarded based on students engaging with in class polls and discussions as well as engaging with their peers in online discussions via Slack or the Canvas LMS.

COURSE CONDUCT EXPECTATIONS

Everyone in this class **deserves to be treated with respect and have their contributions valued**. Engineering is about working collaboratively to find solutions to the world's problems, and an environment that excludes any persons cannot achieve that. We all bring a different experience to the table, and our different backgrounds provide unique perspectives on the problems that need to be solved.

Throughout this course, I encourage you all to:

- Attribute positive intent.
- Listen before answering.
- Balance advocacy with inquiry.
- Be present.
- Respect different backgrounds and styles of learning.

Remember that your classmates today will become your colleagues in the future, and when you bring up everyone around you, we are all better off.

COURSE POLICIES

Assignment Submission

All work should be submitted through the Canvas submission portal as PDF files. Rubrics are included there for each assignment.

Late Policy

Students are allowed 3 automatic days of extension in total. It must be indicated at the top of the assignment that a late day is being used. Late assignments past that will be *penalized 1% per hour they are late*, barring previous arrangements with the professor or TAs.

Collaboration Policy

You may discuss homework with your fellow students, but *you must list the name(s) of any person(s) that you collaborated with*. Individual assignments should be solely the work of the individual. **Any copying or plagiarism will result in zero credit being given for the assignment**. Please refer to UW's Student Conduct Code.

Slack

This is intended to be a communal resource to promote discussion and engagement in the course. If discussing coursework, **don't post answers to problems**, only post suggested methods or resources to find a solution.

Extra Credit

Up to 2% extra credit will be given for participation in class or on the Slack page for the class.

RESOURCES AND ACCOMMODATIONS

Religion

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form.

Access and Accommodations

Your experience in this class is important to me. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so we can discuss how they will be implemented in this course.

If you have not yet established services through DRS but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), contact DRS directly to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Contact DRS at disability.uw.edu.

Safety/Bias Reporting

Unequivocally, there is no place for sexism, racism or other bias in the ME department. If you do experience, witness, or know of anyone facing bias, discrimination, or harassment, please take advantage of the department, college, or university resources available to you. Report the events to trusted professors, contact the department chair and student advisers, contact the College of Engineering's Bias Incident, Bias Concern, Non-Discrimination, and Sexual Harassment Resources (Bias Reporting Tool), or use one of the university's resources. The ME Graduate Student Association (MEGA) has created a guide (link here and PDF on Canvas) to help you understand and navigate possible options for dealing with any incidents of harassment or bias as an ME student.

Finally, for immediate assistance, call SafeCampus at 206-685-7233 anytime – no matter where you work or study – to anonymously discuss safety and well-being concerns for yourself or others. SafeCampus's team of caring professionals will provide individualized support, while discussing short- and long-term solutions and connecting you with additional resources when requested.

Land Acknowledgement

The University of Washington acknowledges the Coast Salish people of this land, the land which touches the shared waters of all tribes and bands within the Duwamish, Suquamish, Tulalip and Muckleshoot nations.

SCHEDULE OVERVIEW

Week	Date	Topics	Reading	Labs	Assignments Due
0	9/25-9/27	Intro to Materials and Mechanics	Ch. 1	-	-
1	9/30-10/4	Beam Bending, Strain Gauges, Data Analysis	Ch. 2, Appendix A	-	-
2	10/7-10/11	Stress and Strain, Photoelasticity, Error Analysis	Ch. 3.1-3.3, Appendix B	Beam Bending	HW 1
3	10/14-10/18	Elasticity and Yield Criteria	Ch. 3.4, 4.1-4.2	Tension	Problem Proposal
4	10/21-10/25	Plasticity Models, Technical Writing	Ch. 4.3-4.5	Charpy Impact	HW 2
5	10/28-11/1	Stress Concentrations and DIC	Ch. 5, Appendix C	Torsion	Materials Challenges
6	11/4-11/7	Fracture Mechanics	Ch. 6.1-6.5	DIC	HW 3
-	11/11	Veterans Day Holiday – No Class on Monday			
7	11/12-11/15	Fracture Mechanics (cont.)	Ch. 6.6-6.10	Fracture	Technical Solution
8	11/19-11/20	Fatigue, Technical Writing	Ch. 7	-	HW 4
-	11/28-11/29	Thanksgiving Holiday – No Class on Thursday or Friday			
9	11/25-11/27	Buckling	Ch. 8	Fatigue	Design Proposal
10	12/2-12/6	Extra Topics	Extra	Buckling	HW 5
Finals	12/9-12/13	No Final Exam			