MAE 157W: BASIC MECHANICAL AND AEROSPACE ENGINEERING LABORATORY

Course Syllabus

Instructor: Prof. Neil Lin (neillin@g.ucla.edu)

Technical Teaching Assistants:
Writing II Teaching Assistants:

Class Time: MW 2:00 pm – 5:50 pm
Class Location: Engineering IV 43116. All class sessions will be held in person.
Office Hours: During class hours or by appointment.
Textbook: Electronic course manual only (no required textbooks). Note that students are strongly encouraged to reference other academic source materials as needed to support their technical reports.
Attendance: In-person attendance is required for all class sessions. However, life happens (for all of us). If circumstances make it impossible for you to attend (e.g. illness or emergency), please notify the course instructor and TAs by email so that you can attend remotely or otherwise make up the work.

Course Description and Learning Objectives

After years of foundational classes that focus on engineering theory, this course is designed to allow students to put theory into practice. Students will be introduced to practical engineering measurements and analysis in thermodynamics, solid mechanics, fluid mechanics, and heat transfer. This course has been developed to include writing instruction (and confer Writing II credit) because it seeks to replicate the experimental and communication processes that students can expect in engineering careers.

In this course, students can expect to learn:

- How to make scientifically rigorous, accurate, and (quantifiably) precise measurements. These are skills that practicing engineers use ALL the time!
- How to operate safely and professionally in a laboratory environment. This is, of course, an essential skill in both university and industry environments.
- How to analyze and interpret numerical data in a physical context with defensible claims and conclusions.
- How to write professional technical documents. Technical work is, of course, only useful if it is effectively communicated to key stakeholders, such as supervisors, funding sponsors, and the public.

Course Structure

1) Technical instruction (approximately 2 hours per week). During this time, the course professor will go over the key concepts of the labs as well as the requirements for the data analysis and discussion of results that students will write in their technical/lab reports.

2) Writing Instruction (1 hour/week on average, immediately following the professor's technical instruction). As a course that satisfies the UCLA Writing II requirement (more on this below), students will meet with a Writing TA each week for activity-based instruction in a variety of writing skills. Writing TAs will also offer feedback on drafts, supervise peer review of student-authored drafts, and contribute to evaluations of all major student writing projects.
3) Laboratory (4-5 hours/week). During this time, students will conduct the experiment, record data, and perform preliminary data analysis. The course will include five laboratory units that cover essential mechanical engineering topics such as measurement error analysis, fluid mechanics, and heat transfer. (See course schedule for more details.)

Writing II Course Component

Rationale: Engineering work in industry and academia requires a variety of reports on experimental and design work, formal proposals, explanations of technical background, and various other genres of writing. Practice writing and revising these genres is crucial to mastery of the forms of communication that are expected of engineers in their careers.

From a professional development perspective, technical expertise is fundamental for advancement in an engineering career, but engineers must also communicate in such a way that the significance of their results is understood by peers and managers. Therefore, technical writing and oral communication are essential skills for career advancement.

Writing also plays a crucial role in the experimental process, specifically organizing facts and their interpretations as well as the resolution of technical problems. Many ideas which seem plausible when just in the head are revealed to have flaws when written down. Therefore, writing is a critical tool to ensure the logical rigor of one's reasoning from hypothesis to conclusion.

Writing instruction will be directed at helping students:

1. Write clear and concise prose that is accessible to specialist and generalist audiences (as appropriate), and revise prose for structural efficacy, efficiency, and clarity.
2. Structure their writing according to the conventions of important genres commonly required of professional engineers, especially technical reports and project proposals.
3. Research and write about the technical background (and perhaps the societal context) of the experimental subject.
4. Design documents to foreground crucial information for readers. This will include strategies to report, analyze, and interpret experimental results as well as present it using effective infographics (e.g. figures, schematics, graphs, tables, etc.) that support content discussed in the text.
5. Offer effective feedback on peers' draft writing.

Structure: Writing II-trained TAs will lead regular classes ranging from 1 to 1.5 hours on writing skills during selected class sessions throughout the quarter. Writing instruction sessions will typically begin with a presentation of relevant concepts by the Writing TA and then transition into activities that ask students to practice skills, analyze samples of writing, and/or provide

feedback on peers' writing. Writing TAs will also provide individual feedback on drafts of student writing (see assignments below) and contribute to assessment of student final drafts. Students will be required to revise their written work, bearing in mind the feedback of their peers, their Writing TA, and the course instructor.

Writing Assignments and Presentations

1) **Pre-Lab Reports.** These will be individually completed and must be submitted by the start of the associated laboratory experiment. Students are encouraged to work with others to review the lab process, understand the theory, and prepare for analysis. However, each student must prepare their own pre-lab report. Specifically, the pre-lab report should be within one page and include the following four sections: introduction, theory, experimental procedure, and analysis workflow.
2) **Technical Reports.** Learning how to write effective technical reports is one of the principal objectives of this course. Each of these reports will follow the standard IMRaD (Introduction, Methods, Results, and Discussion) format.

   Detailed instructions for preparing these reports will be covered in lecture and writing instruction sessions. These should be polished, comprehensive summaries of the experiment that was performed that include one calculation example, results, and analyses. There will be five reports in total, as follows:
   - One 2-page Technical Report for the basic measurement experiment.
   - Four 5-page Technical Reports for the remaining experiments. Two of these 5-page reports will be submitted first as an initial draft for peer and TA/instructor feedback and then as a revised (final) draft.
3) **Group Design and Measurement Project (Proposal and Presentation):** During the final 3 weeks of the quarter, students will work in groups to design, propose, and perform a microcontroller-based (e.g., an Arduino kit and associated electronics) experiment, which involves data acquisition and signal processing techniques. Specifically, students will design a signal measurement (e.g., light intensity of LEDs) task to develop automation and post-acquisition analysis strategies to improve the throughput and sensitivity of measurements.

   Because this course focuses essentially on *measurements*, projects should emphasize the ability to acquire accurate signals and to characterize the fidelity of the measurements in space and/or time. At the end of the quarter, groups will make a final presentation that includes a demonstration of the hardware and code developed in the project.

   The project proposal will go through a drafting and revision process in consultation with the Writing and Technical TAs. It will be a collaboratively-authored team document (~4-6 pages) in which students present their design and rationale for their project. Proposals should narrate a vision of what the project's end result will be and the value proposition for which the project is being developed. Proposals should include the following three main sections:
      1. **Introduction**: This section should provide information about the need for the experiment. In other words, here is where you state why you are proposing the experiment in the first place. At the beginning of this

section, you should depict the problem/situation that led to your proposed experiment. Here, you should justify how your experiment addresses the problem. At the end of this section, you should also provide an overview of what the rest of the proposal includes.

2. **Experiments and Methodology**: In this section, you should inform your audience of exactly what you are proposing. You should also include what you aren't proposing. For example, if you are proposing partial work on a project, state this and then verify what your work will not include. Also, you should present the specific measurement and analysis techniques that will be implemented to achieve the proposed goal. This is similar to a Lab Report's Procedures section in that you have to discuss the steps you will take to reach a final goal.
3. **Anticipated Results**: In the Results section, you should discuss the intended outcome of your project. The types of outcomes resulting from a proposal cover a wide range. For example, you may be creating a design, building an actual construction, or even producing a lengthy report. Be sure to state exactly what the results will be.

- **Draft Proposal**: Due Week 8. You will receive feedback on this draft from both the Technical and Writing TAs and revise it for final submission in Week 10.
- **Revised Proposal:** Due Week 10.
- **Individual Reflection Piece** (approximately 250 words): Due with submission of Revised Proposal. In narrative form, address the following questions: 1) What section or sections of the final draft did you take primary responsibility for writing? 2) What did you learn about your strengths and weaknesses as a technical writer from working with your collaborators and reviewing their writing?
- **Presentation**: Each group will make a 10-minute presentation to accompany their proposal.

Evaluation Rubrics for written work and presentations in MAE 157W: Click Here.

Grading

- **Five 1-page Pre-lab Reports**: 2% each (graded by Technical TAs). 10% total
- **One 2-page Technical Report** (Basic Measurement Lab): 8% (graded by Technical TAs).
- **Four 5-page Technical Reports**: 10% each (collaboratively graded by Professor and TAs). 40% total
- **Two revised 5-page Technical Reports**: 8% each (collaboratively graded by Professor and TAs). 16% total
- **Group Design and Measurement Project Proposal**: 10% (collaboratively graded by Professor and TAs)
- **Group Design and Measurement Project Presentation**: 12% (collaboratively graded by Professor and TAs)
- **Participation**: 4% (collaboratively graded by Technical and Writing TAs)

A Note on Participation

Students should demonstrate that they are intellectually engaged with the class through:

1. their dedication to studying the course material
2. the care with which they perform the laboratory experiments
3. the thoughtfulness of their comments and questions during lecture, lab, and writing instruction sessions
4. the commitment of time and effort spent working on the course assignments.

Excellent participation includes students asking substantive questions and also actively responding to the instructor's questions and comments. In class discussion formats, such as the writing instruction sessions, they do not respond only to the instructor. They also respond to the comments of the other students by first demonstrating that they've heard and understood what others have said and then building on or respectfully challenging what others have said. Students should also be thoughtful about when to refrain from speaking so that they can concentrate on listening to and understanding what others are saying.

Course Schedule

Week	Day	Lecture and Lab	Writing Instruction (additional details below)
Week 1	M	Introduction, Syllabus, Group Formation, Final Projects	Identifying Audience and Purpose / Structural Concerns
	W	Data & Error Analysis, Report Writing, Making Scientific Graphs	Strategies for Technical Reports, Part 1
Week 2	M	Holiday	-
	W	Lab 1: Basic Measurements - Lecture and Lab	Strategies for Technical Reports, Part 2
Week 3	M	Lab 2: Strain Measurements – Lecture	The Craft of Presenting Data
	W	Lab 3: Flow Measurements – Lecture	Stylistic Concerns
Week 4	M	Lab 2: Strain Measurements – Lab Lab 3: Flow Measurements – Lab	-
	W		-
Week 5	M	Lab 1 Report Review / Final Project Instructions / Basics of microcontrollers	Peer Review 1 (of Technical Report for Lab 2 or 3)
	W	Preliminary Design Reviews / Project Preparation	Strategies for Engineering Proposals, Pt. 1

Week 6	M	Lab 4: Pipe flow – Lecture	Strategies for Engineering Proposals, Pt. 2 / Collaborative Authorship
	W	Lab 5: Data Acquisition – Lecture	Strategies for Presentations
Week 7	M	Lab 4: Pipe flow – Lab Lab 5: Data Acquisition – Lab	-
	W		-
Week 8	M	Project Work Preparation with Teaching Team – Session 1	Peer Review 2 (of Technical Report for Lab 4 or 5)
	W	Project Work Preparation with Teaching Team – Session 2	Group conferences with Writing TA
Week 9	M	Project Work Preparation with Teaching Team – Session 3	Group conferences with Writing TA
	W	Project Work Preparation with Teaching Team – Session 4	Group conferences with Writing TA (as needed)
Week 10	M	Project Work Preparation with Teaching Team – Session 5	-
	W	Final Project Presentations	-

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Writing Instruction Lesson Topics and Objectives

Writing instruction and class activities to support the composition of the writing assignments will include:

Writing Lesson Topics	Lesson Objectives
Identifying Audience and Purpose	Developing awareness and identifying the purpose for writing; considering multiple possible audiences (e.g. technically proficient and general audiences).
Structural Concerns	Paragraph construction, transitions, topic sentences.
Strategies for Technical Reports, Part 1	Key elements of Technical Reports, e.g. IMRaD structure (Introduction, Methods, Results, and Discussion).

Strategies for Technical Reports, Part 2	Analysis of effective Technical Reports; focus on what constitutes an effective discussion section.
The Craft of Presenting Data	Presenting and explaining experimental results for easy comprehension; effective use of visual figures; effective commentary on the data and graphs.
Stylistic Concerns	Strategies and practice for achieving clarity and concision.
Peer Review 1 (of Technical Report for Lab 2 or 3)	Best practices for peer review and in-class peer review of Technical Report drafts.
Strategies for Engineering Proposals, Pt. 1	Writing about the background and significance of the technical task as well as its significance in a wider societal context.
Strategies for Engineering Proposals, Pt. 2	Analysis of effective Engineering Proposals.
Collaborative Authorship	Best practices for collaborative authorship.
Strategies for Presentations	Writing a script, designing slides, delivering a presentation.
Peer Review 2 (of Technical Report for Lab 4 or 5)	In-class peer review of group proposal drafts.
Group conferences with Writing TA	Feedback session on Draft Proposal