ME 310

Instrumentation and Theory of Experiments

Spring 2022

LECTURE: A1, M-W 10:10-11:55, **SCI** 117

LAB: Rm 113, 110 Cummington Mall
4 sections:
C1 (Mon 2:30-6:15pm), C2 (Tues 5:30 – 9:15), C3 (Weds 2:30-6:15pm), C4 (Thurs 5:30-9:15 pm), C5 (Fri 8:00 – 11:45am), C6 (Fri 2:30 – 6:15pm)

TEXT: Figliola and Beasley, *Theory and Design for Mechanical Measurements,* 6th ed., 2011. Wiley. ISBN: 9780470547410. 5th and 4th ed's are ok if you can find them, but the page numbers may be different.
(optional) Taylor, *An Introduction to Error Analysis*, 2nd edition, Univ. Sci. Bks., 1997.

LAB NOTEBOOKS: Any bound and page-numbered notebook is fine, you will normally need only one

PROFESSOR: Brian Walsh bwalsh@bu
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Office hours Tuesdays, 10-12:00, or by appointment

GSTs:

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GRADING:

5%	(Class and Lab performance)
20%	(Design Project)
15%	(Homework Sets)
25%	(Labs and Lab Reports)
35%	(In-class Exams)

There will be 2 in-class exams, roughly 6 homework sets, 4 labs plus 1 design project. There will be no final.

CLASS: Class will be PART OF YOUR ASSIGNED GRADED WORK. Come to class and be prepared to use the knowledge you already have as upperclass students, and to think on your feet.

HOMEWORK: Homework assignments are given out (roughly) every other week in class. Assignments will be announced in class and posted to Blackboard. Homeworks will be submitted digitally through GradeScope. Late homework will not be accepted unless circumstances merit the exception. It's the responsibility of the student to confirm they have appropriate access to Blackboard and GradeScope.

EXAMS: The exams will cover a specific section of the course material. They will be thorough and challenging. "Make-up" exams will rarely be given. In the case of prior knowledge of a time conflict (you must arrange to take the test before you are away). A "make-up" exam will be different from the exam given in the class, and will possibly be live. Do not under any circumstance schedule trips or flight home during or prior to exams.

LABS: See "ME310_S22_Lab_Report_Policy.pdf" for a full description of expectations for Lab reports. If a lab is due on a week when you do not have a regularly scheduled lab section, the lab report must be handed into the ME office in the labeled bin at the assigned due date and time.

DESIGN PROJECT: You will design and implement a complete transduction system to measure the frequency-dependent displacement of a damped mass on a spring. This will occupy roughly the final 5 weeks of laboratory meetings. Note that it is a design as well as lab project, and as such there will be significant work done OUTSIDE and BEFORE lab.

DROP DATES: Pay attention to the University's schedule of drop dates. You cannot drop this course after the last "W" date because of an impending low grade – you will receive your current grade if you drop after the official W date. "Incomplete" grades are reserved for the most extreme of circumstances, and are a negotiated contract between the student and myself.

PREREQUISITES: EK 301, ME303, ME366 and EK307.

COLLABORATION:
A. Homework: Do it individually. However, you are encouraged to consult with classmates on general concepts. This means all answers must be written in your own words.
B. Lab reports: Also to be done individually. Pre-labs should be done individually. This policy extends to **ALL** components (text, figures, tables, etc) of the document. For some experiments, there will only be one copy of your raw data/results, which you must copy later for inclusion in your own reports. Your

lab report should be a stand-alone document, and therefore you may not 'reference' any section in one of your lab partners' reports. However, you must consult with your lab partners even after the lab period to discuss findings and results.
C. Design project: This is a group collaborative project, and I expect to see some division of labor here, and there will only be 1 report per group, so each group member will receive the same grade. Despite the division of labor, since this is a class, each member of the group must understand the other member's contributions.

Failure to meet any of the above conditions could constitute plagiarism and will be considered cheating in this class. If you are not sure whether something is permitted by the course policy, ASK! (it's much more awkward to explain your actions after the fact to the college disciplinary committee).

COVID 19 & BU Community Health Expectations: Masks are required and face coverings must be worn over the mouth and nose at all times when in public spaces on campus, including classrooms. Students should be prepared to show proof that they are compliant with appropriate testing in order to attend class. All students are expected to follow all university guidelines with respect to testing, social distancing, and mask wearing when they leave their dorm or home. For a detailed description of official BU policies regarding COVID, please visit: http://www.bu.edu/dos/policies/lifebook/covid-19-policies-for-students/

There may be situations where class needs to be canceled or moved to an online format due to COVID-related situations. These will be rare and hopefully non-existent. In the event that they arise, they will be handled as they come up and changes in the class format will be communicated to the class via email when the situation arises.

Accommodations for students with documented disabilities: If you are a student with a disability or believe you might have a disability that requires accommodations, please contact the Office for Disability Services (ODS) at (617) 353-3658 to coordinate any reasonable accommodation requests. ODS is located at 19 Deerfield St, on the second floor. I will make every effort to accommodate such requests but (a) please notify me at the beginning of the semester if you've received approved accommodations in previous semesters (even if you haven't received your paperwork for this semester yet!) and (b) my policy is that I need at least one week's notification prior to each exam so we can make the necessary arrangements. For more information: http://www.bu.edu/disability/accommodations/

Ethical Responsibilities

Cheating on homework, quizzes, exams, project reports, or any form of assignment, may be a form of plagiarism and is an infringement of every code of engineering ethics. Plagiarism is a serious academic offense and should not be taken lightly. Understanding your ethical responsibilities is an integral part of becoming a professional. A copy of the Code of Ethics of engineers, promulgated by the Accreditation Board for Engineering and Technology (ABET) and the National Society of Professional Engineers, can be found on the main course web site.

Please recall that when you enrolled at Boston University, you agreed to an Academic Honesty Pledge. The Academic Conduct Code details your responsibilities as well as the results of code violations, and is posted at:
https://www.bu.edu/academics/policies/academic-conduct-code/

Course Teaching Goals:
1. To teach basic techniques for designing experiments and analyzing data
2. To introduce the operating principles and uses of transducers, output devices and signal conditioning elements of measurement systems
3. To introduce the concepts of signals and systems and their interaction in both static and dynamic measurements
4. To provide hands-on experience in professionally conducting experiments in a modern, real laboratory setting with emphasis on safety, documentation, computer use and uncertainty analysis. The uncertainty analysis reflects standardized practice, providing an introduction to professional codes and standards and elementary probability and statistics.

Course Learning Outcomes:
As an outcome of completing this course, students will:
i. Become proficient in designing and implementing experimental solutions to engineering problems, including static and dynamic mechanical, electrical and thermal measurements, and understanding the tradeoffs between cost, performance and complexity of measurement schemes.
ii. Become proficient in analysis of uncertainty of experimental results, including identification of sources & types of uncertainty, combination & propagation of uncertainties, & application of proper statistical models for precision uncertainty.
iii. Become proficient in reporting and documentation of experimental work through use of standardized lab reporting policies and requirements.
iv. Gain experience in the operating principles and uses of transducers, output devices, and signal conditioning elements of measurement systems for flow, pressure, temperature, velocity, strain, and force.
v. Gain experience with the concepts of signals and systems and their interaction in both static and dynamic measurements, including mathematical modeling of such systems' static and time-dependent behavior.
vi. Gain experience and confidence in self-instruction on the use of data acquisition software and hardware systems, including standard analog-digital

conversion boards, and MATLAB and LabVIEW interface data acquisition control software.
vii. Gain experience in efficient organization and teaming by performing labs and projects in both self-organized and instructor-organized groups.
viii. Gain experience in oral presentation of experimental design, & results.