ME 310

Instrumentation and Theory of Experiments

Fall 2017

LECTURE: A1, M-W 12:20-2:05, **PHO** 211

LAB: Rm 113, 110 Cummington Mall
6 sections:
B8 (Mon 8-12), B5 (Tues 5:30 – 9:30), B7 (Weds 8-12),
B6 (Thurs 5:30-9:30 pm), B9 (Fri 8 – 12), B4 (Fri 2:30 – 6:30)

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
110 Cummington, Rm 303
Office hours Thursday, 10-12:00, or by appointment

GSTs:

Mark Cops (mcops@bu.edu)	(Thurs 6-10, Fri 1-5)
Joseph Degolia (jdegolia@bu.edu)	(Thurs 2-6, Fri 9-1)
Mustafa Karakan (karakan@bu.edu)	(Tues 6-10, Weds 6-10)
Tharanga Jayaranthe (tharanga@bu.edu)	
Abigail Rendos (alrendos@bu.edu)	(Thurs 2-6, Fri 1-5)
Sean Sanchez (srsanche@bu.edu)	
Michelle Sugimoto (msugi@bu.edu)	(Tues 6-10, Thurs 6-10)
Zhikuan Zhu (zkzhu@bu.edu)	(Weds 6-10, Fri 9-1)

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 hourly exams, roughly 8 homework sets, 4 labs plus 1 design project, 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. They are due at the BEGINNING of class on the due date listed. Late homework will not be accepted unless circumstances merit the exception.

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 viva. Do not under any circumstance schedule trips or flight home during or prior to exams.

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

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.

MATLAB ACCESS:
I **highly** recommend the use of Matlab for analysis and plotting for ME310, and will require it for some of the homework analysis.
You can access it online through the BU ENG Grid. Check out the instructions at:
http://collaborate.bu.edu/engit/MatlabRemoteAccess

Course 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.