MECH 430 Instrumentation and Measurements

Spring 2015-16

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Office hours: Thursdays (8:00 – 9:00 am), Bechtel 407

Class Meetings
Mondays, Wednesdays 10:00 – 11:00 Bechtel 107
Mondays, Wednesdays 12:00 – 1:00 Bechtel 111

Labs

Mondays	2:00 – 4:50 pm: SRB
Tuesdays	11:00 – 1:50 pm: SRB
Tuesdays	2:00 – 4:50 pm: SRB
Wednesdays	2:00 – 4:50 pm: SRB
Thursdays	11:00 – 1:50 pm: SRB
Thursdays	2:00 – 4:50 pm: SRB

Textbook
Figliola, R. and Beasley, D., Theory and design of Mechanical measurements, Wiley, 6th edition

Prerequisites
PHYS 211: Electricity and Magnetism.
EECE 312: Electronics and Electronic Circuits.

References
1. A. Smaili and F. Mrad, *Applied Mechatronics,* 2005.
2. Sedra, A. and Smith, K., *Microelectronic circuits*, Oxford University Press, 2004
3. R. Pallàs-Areny and J. Webster, *Sensors and Signal Conditioning*, Wiley, 2nd ed. 2001.
4. E. O. Doebelin, Measurement Systems Application and Design, Fifth Ed., McGraw-Hill, 2003.
5. P. Horowitz and W. Hill, *The Art of Electronics*, Cambridge University Press, 1989.
6. J. Wheeler and A. R. Ganji, *Introduction to Engineering Experimentation*, Prentice Hall, 1996.
7. W. Tompkins and J. Websters, *Interfacing Sensors to the IBM PC*, Prentice Hall, 1988.
8. J. Fraden, *Handbook of Modern Sensors: Physics Design and Application*, AIP, 1993.
9. W. deSilva, *Control Sensors and Actuators*, Prentice Hall, 1989.
10. J. W. Gardner, *Microsensors: Principles and Application*, Wiley, 1994.
11. H. R. Everett, *Sensors for Mobile Robots: Theory and Applications*, A K Peters, 1995.
12. John G. Webster, *The Measurement, Instrumentation, and Sensors Handbook* (Editor), CRC Press, 1998.
13. Gregory Kovacs, *Micrmachined Transducers Sourcebook*, McGraw-Hill Company, 1998.

Description
A course on the general concepts of measurement systems; classification of sensors and sensor types; interfacing concepts; data acquisition, manipulation, transmission, and recording; introduction to LabVIEW; application; team project on design, and implementation of a measuring device.

Tentative Schedule

1. Sensor Classification
2. Sensor characteristics and uncertainty analysis
3. System Response
4. Signal conditioning for analog devices
5. Sampling, A/D conversion, digital devices and data acquisition
6. Temperature measurements
7. Pressure and velocity measurements

Grading Rubric

Students will be graded according to the following rubric

Entry	Weight	Note
Drop Quizzes	10%	First 15 minutes
Lab	30%	See instructor
Midterm	20%	Closed-book
Final	20%	Closed-book
Project	20%	Detailed later

Course Policy

Class attendance and quizzes

The class is a place for the teacher and students to interact. Therefore, I design my lectures in such a way to foster interaction. In order for the synergy to work you must bring you books and class lecture notes with you to class and follow during the lecture. Quizzes will be held without notice during the first 15 minutes of class, so please come early to lectures. You will not be given extra time if you are late.

IMPORTANT: The frequency and timing of the quizzes vary. If you miss a quiz you will NOT be given an opportunity to make it up. Cutting classes is a risk you are willing to take.

Midterm and Final

For this course you will be required to write a midterm and final exam. I recommend you practice the assignment problems to get a flavor of problems that could be asked.

Project

The final measuring stick for this course is a team-oriented project that involves both the design of an instrumentation system and its implementation. You will be expected to write a report about your project. You can work on this project in groups of two or three (the exact number will be determined during the semester). More details of the project will be discussed at a later time.

Assignments

Assignment problems will be given in conjunction with lecture topics. Although assignment problems are not graded, you are highly encouraged to do them because the knowledge acquired through the solution of these assignments will prove to be invaluable for the solution of the exams, final, and project. I will be keeping track of assignments submitted and using this information for the final (if any) raise that is applied to the course.

Make-up tests and late homework policy

NO MAKE UP TEST WILL BE GIVEN. If you miss an exam for a justified cause (*e.g.*, with a doctor's report) I will change the weight of the grade accordingly to compensate for your missed exam.

Resources for the Course

- MOODLE: Includes a forum, which acts like a center of focus for the course. Any concerns you might have or ideas you want the entire class to hear you can post on

the forum. Furthermore, anything I want to relay to you such as assignments, solutions, homework will be posted on Moodle.

- The text and references for the course.
- The instructor; class notes and handouts; your teammates.
- The library, the web.

Course Outcomes specific to Instrumentation and Measurements

At the end of the course the students should be able to:

1. Understand the different stages of a measurement system
2. Understand the different types of sensors available and ability to properly select and use sensors for various forms of physical quantities (thermal, fluid, chemical, mechanical, etc.)
3. Ability to perform uncertainty analysis to estimate the accuracy of a measurement system
4. Understand signal conditioning concepts including amplification, filtering, and A/D conversion
5. Ability to automate data acquisition (lab)
6. Ability to interface hardware and software (lab)
7. Ability to use computer software to analyze and solve problems (lab)
8. Work in teams to design and build a real instrumentation and measurement system for a given application (lab)
9. Develop technical writing and oral presentation skills.