ECE 437: Sensors and Instrumentation

Fall Semester 2007

Meeting Time/Place: Tuesday, 3:00-4:20pm / 203 Nuclear Engineering Lab
Lab Times: W 2-5, F 9-12, F 2-5/ Room 235 Everitt Laboratory
(Lab will also be available via I-card at most other times.)

Text: Necessary course notes will be available for download from the Course Web Site and should be read before attending lecture.

References: Noted in Laboratories and Lectures as needed.

Instructor: Prof. Jonathan J. Makela
Office: 316 Coordinated Science Laboratory
Phone: 265-9470
e-mail: jmakela@uiuc.edu

Office Hours: M 2:00-4:00pm in 316 CSL

Teaching Assistant: Shaun Armstrong, sjarmstr@uiuc.edu
W 12:00-2:00pm in 235 EL

Course Web Site: http://www.ece.uiuc.edu/ece437
http://airglow.csl.uiuc.edu/Teaching/ECE437/

Goals: In this course, senior and graduate students in Electrical and Computer Engineering experience a hands-on introduction to the fundamental technology and practical application of sensors and instrumentation. Instrumentation techniques incorporating computer control, sampling, and data collection and analysis are reviewed in the context of real-world scenarios. Capacitive, inductive, optical, thermal, and other sensing methods are examined in terms of their capabilities, limitations, and possible applications. The course also features several guest speakers from both industry and academia that describe unique sensing problems and solutions.

Prerequisites: ECE 329 or consent of the instructor. 3 credits.

Course Goals and Instructional Objectives can be found on the Course Web Site

*Course development was sponsored through generous grants from Kimberly-Clark, Inc. and Ford

ECE 437: Policies and Announcements

Grading:	Laboratory Reports	50%
	Midterm Exam	10%
	Sensor System Design Project	20%
	Final Exam (Cumulative)	20%

Safe Laboratory Practice: All students are expected to conform to safe laboratory practices and procedures while in the laboratory. This includes making sure that the currents and voltages that you use are safe and appropriate for the laboratory. For several of the labs, the sensors and equipment are very expensive and difficult to replace on short notice, so have the TA check your connections before you turn on the power. We will be sharing the lab with other students and other courses, so please be considerate and return components, instruments, etc., to where you found them when you are finished with the laboratory.

Laboratory Reports: Laboratory reports are due from **each student individually** one week from the date the laboratory was performed, as noted on the schedule. Students are expected to conduct themselves according to the University's policies on academic integrity (see http:// http://www.admin.uiuc.edu/policy/code/article_1/a1_1-402.html). Violation of these rules will be handled according to University policy. All laboratory reports **must be typed**. **Late laboratory reports will be penalized 20% for each day late.** Each laboratory has a maximum of 100 points. If you have a question or problem with how any laboratory report has been graded, please submit within one week of being returned a **written** description to your TA explaining in detail why you think a correction should be made.

Evaluation Criteria: The laboratory reports will be graded on their completeness, so all procedures, results, and conclusions should be documented and all questions answered. In particular, your designs and results for all **Mini-Experiments should be detailed thoroughly.** For all laboratory reports, spelling, grammar, and organization are taken into account in the final grade. Spell-checking is a good first step, but it does not replace proof-reading.

Exams: The midterm and final exams will be used to evaluate how well you have learned from your experiences with sensors and instrumentation in the laboratories. That is, using your laboratory experiences, you will be asked to analyze sensing problems, evaluate and decide on choices for sensors for particular applications, design tests for measurement accuracy and reliability, and draw conclusions about the results that you obtained for each of the laboratories.

The midterm exam will cover the first 6 lectures and Labs 1-5. The final exam will be cumulative. If you have a question or problem with how any exam has been graded, please submit to Prof. Makela the exam under question and a separate **written** description explaining in detail why you think a correction should be made. Requests must be made within one week of the exams being returned.

Sensor System Design Project: The course culminates in a project in which each student develops a design for a sensing system that may use one or more types of sensors explored in the ten course laboratories. Students will have a choice between two sensing scenarios and then will have to design a complete sensing system to perform the desired function. The final report on the sensing system design system will be no longer than 5 pages (not including any references, data sheets, etc.) but must include a detailed block diagram of the system. Issues of sensor sensitivity, sensor error or failure, and practical issues of cost and deployment must be addressed in the design. More details on the complete project requirements will be distributed by Tuesday, November 13th.

Tentative Course Schedule for ECE 437

Week	Lecture Date	Topic
1	8/28	Course Introduction and Sensor Applications
2	9/4	Noise, Shielding, and Signal Processing Fundamentals (Lab #1)
3	9/11	Introduction to Laboratory Control Software (Lab #2) *Guest Lecture: Jonathan Hildyard (National Instruments)*
4	9/18	RS232 and Wireless Communication and Control (Lab #3) *Guest Lecture: Shaun Armstrong*
5	9/25	Thermal Sensors (Lab #4)
6	10/2	Optical Sensors (Lab #5)
7	10/9	Proximity Sensors I *Guest Lecture: Prof. Michael Oelze (ECE)* **Midterm Handed Out**
8	10/16	Proximity Sensors II (Lab #6) **Midterm Due**
9	10/23	Encoders (Lab #7) *Guest Lecture: Prof. Patrick Chapman (ECE)*
10	10/30	Accelerometers (Lab #8) *Guest Lecture: Prof. Dan Kuchma (CEE)* *Lecture will be in 1234 Newmark Lab*
11	11/6	Electromagnetics for Sensing and Wireless Networks (Lab # 9) *Guest Lecture: Prof. Jennifer Bernhard (ECE)*
12	11/13	Project Overview
13	11/27	More Sensor Applications *Guest Lecture: ???* **Project Outline Due**
14	12/4	More Sensor Applications *Guest Lecture: ???*

Please note that the order of topics for Laboratories 4-9 may change depending on the availability of guest speakers on some topics.