

## ABE 447/547 Sensors and Controls, Fall 2007

<http://ag.arizona.edu/~jyoon/abe447.htm>

W 1:30-2:50 Shantz 440 (lecture)

M 1:00-3:30 (section 1) 3:30-6:00 (section 2) Marley 218 (lab)

Instructor: Jeong-Yeol Yoon (Forbes 132A, 621-3587, [jyoon@email.arizona.edu](mailto:jyoon@email.arizona.edu))

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### Overview

This course is a brief overview on sensing variables in a specific system (more emphasis will be given to biosystems), and subsequent controlling of it. A typical sensor generates an electrical signal in response to a variable. Because of this, one needs to have some fundamental knowledge on electronics and circuitry in developing successful sensors. Digital interfacing is also important in modern sensors, since signals from almost all sensors are transferred to computers or other equivalent devices. Modern sensors are now implementing DNA probes or antibodies to recognize other DNAs or antigens, which forms an exciting new area of biosensors. Basic theory on bioprocess control will be briefly discussed as well. This will be, at best, only an introduction to these subjects and each laboratory will likely contain elements of all these topics. The course is open-ended, and you will need to look beyond each topic to the broader picture.

### Grading Criteria

Lab reports	20%
Mid-term exam	25%
Final exam	35%
Term paper (team effort)	20%

### Grading Scale

90.0 – 100.0	A
80.0 – 90.0	B
70.0 – 79.9	C
60.0 – 69.9	D
< 60.0	E

### Class Policies

1. Attendance in each lecture/lab session is required.
2. A valid excuse from taking a scheduled exam can only be obtained by calling or e-mailing the instructor no later than 48 hours before the exam is given. A letter, note or notice made by a responsible third-party should be submitted to the instructor.
3. A valid excuse from making a scheduled term paper presentation can only be obtained through switching the presentation with the other presenter(s).
4. Each lab report (due Mon 1 pm or 3:30 pm) that is submitted late will be penalized by reducing its score by 25% for each day that it is late. Lab report submitted after Friday 5 pm will not be accepted.
5. Lab reports are to be turned in individually, except where explicitly noted.
6. Term paper (due 12/3 Mon 1 pm) that is submitted late will not be accepted.
7. Adherence to official university rules and regulations pertaining to the classroom is mandatory.
8. The office hour of the instructor is right after the lecture (Wed 2:50 pm).

### Text (recommended but not required)

Paul Scherz, "Practical Electronics for Inventors," McGraw-Hill, 2000 (ISBN 0-07-058078-2).

Brian R. Eggins, "Chemical Sensors and Biosensors," Wiley, 2002 (ISBN 0-471-89914-3).

### Lab Reports

1. Every student is required to write a short lab report after each lab sessions.
2. Up to the photodiode experiment, every student has their own individual experimental station and conducts their own experiments. After that, student conduct experiments in teams (usually of three or four), but individual lab reports are still expected.
3. Introduction, theory, materials and experimental methods should not be included in a lab report. It should contain only results and discussion. Students also need to attach answers to the questions

assigned every week (this is your homework). The combined lab report and homework should not exceed more than 3 pages.

### **Term Paper**

1. Term paper is a team effort, comprised of 2-3 students. 4-student team is not allowed without the instructor's consent. 447 students cannot make a team with 547 students. Likewise, 547 students cannot make a team with 447 students. Each team will make a single presentation and submit a single term paper, although all team members should participate in both presentation and term paper writing.
2. The format of term paper will be different for 447 and 547 students. 447 students will make a professional presentation of soliciting new investment in starting a new biotech venture company; extensive theoretical background is not required, but the feasibility as a profitable business model should be addressed. 547 students will write a grant proposal to the external funding agencies, such as NSF or NIH. Preliminary data using the resources used in lab are strongly encouraged.

### **Special Needs and Accommodations**

Students who need special accommodation or services should contact the SALT (Strategic Alternatives Learning Techniques) Center for Learning Disabilities (SALT Center, Old Main PO Box 210021, Tucson, Arizona 85721-0021, (520) 621-1242 FAX (520) 621-9448 TTY (520) 626-6072), <http://www.salt.arizona.edu>, and/or the Disability Resources Center, 1540 E. 2 nd Street, PO Box 210064, Tucson, Arizona 85721-0064, (520) 621-3268, FAX (520) 621-9423, <http://drc.arizona.edu>. The need for accommodations must be documented by the appropriate office.

### **Student Code of Academic Integrity**

The University's Code of Academic Integrity (Section 2.1a) states that students shall not "represent the work of others as their own." This policy will be applied to all work submitted for a grade, including exams, term papers, homework assignments and journal club presentations. You are welcome to work with your classmates on the homework. The minimum penalty for cheating on exams is an E grade.

### **Confidentiality of Student Record**

<http://www.registrar.arizona.edu/ferpa/default.htm>

### **Schedule**

Mondays: Lab (Marley 218)	Wednesdays: Lecture (Shantz 440)
08/20 Introduction to the course	08/22 Sensors & biosensors
08/27 Resistors	08/29 Circuit analysis
09/03 <i>Labor day; no lab</i>	09/05 Measurements in circuit
09/10 Diodes	09/12 Diodes & temperature sensors
09/17 Temperature sensor (I)	09/19 Transistors & temperature sensors
09/24 Temperature sensor (II)	09/26 Wheatstone bridge
10/01 Wheatstone bridge	10/03 Signal amplification
10/08 Op-amp	10/10 Optoelectronics
10/15 Photodiode	10/17 Mid-term exam
10/22 Water quality sensor	10/24 Data acquisition / piezoelectric sensor
10/29 Datalogger	10/31 Lab-on-a-chip
11/05 Piezoelectric sensor	11/07 Electrochemical sensor
11/12 <i>Veteran's day; no lab</i>	11/14 Glucose sensor
11/19 Glucose sensor	11/21 Fluorescence & optical fibers
11/26 Fluorescent microscope	11/28 Term paper presentations
12/03 Optical fiber spectrometer	12/05 Term paper presentations
Final exam: 12/10 Monday, 11:00 am – 1:00 pm, Shantz 440	