

ABE/BME 447/547 Sensors and Controls (Fall 2016)

Designation:	Required
2016-2017 catalog description:	(3) Principles of electric circuits towards sensor and biosensor design and fabrication. Selection, interfacing and calibration of digital and analog sensors to measure physical, chemical, and biological variables. Optical, electrochemical, and piezoelectric biosensors. Advanced biosensors.
Prerequisite(s):	CHEM 151/152 (or equivalent).
Textbook(s) and/or other materials:	Introduction to Biosensors: From Electric Circuits to Immunosensors, Second Edition, By Jeong-Yeol Yoon (Springer). ISBN 978-3-319-27411-9 (print) 978-3-319-27413-3 (online)
Course objectives:	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. Modern sensors are now implementing DNA probes or antibodies to recognize other DNAs or antigens, which forms an exciting new area of biosensors. Topics related to advanced biological sciences also include optical fibers, fluorescence, pulse oximeter, immunosensors, lateral flow assays, glucose sensors, lab on a chip, and nano biosensors.
Topics covered:	See page 2.
Class/laboratory schedule:	Lecture (Henry Koffler 216): WF 2-2:50 (all sections) Lab (Marley 218): M 1-3:30 (section A); M 3:30-6 (section B); W 11:00-1:30 (section C); W 3:00-5:30 (section D) Lab reports with homework questions (every week) 20% One mid-term exam (1-hr, closed) 25% One final exam (1-hr closed + 1-hr open) 35% Term paper (team effort) 20%
Contribution to professional component:	Math and basic science: 25% Engineering topics: 50% Design experience: 20%
Relationship to program outcomes:	(a) apply knowledge of math, science & engineering: moderate; (b) design & conduct experiments: saturation (c) design a system, component, or process within realistic constraints: saturation; (d) multidisciplinary teams: saturation; (e) identify, formulate & solve engineering problems: saturation; (f) professional & ethical responsibility: exposure; (g) communicate effectively: saturation; (h) broad education in a global, economic, environmental & societal context: moderate; (i) life-long learning: none; (j) contemporary issues: saturation; (k) techniques, skills & modern engineering tools: saturation; (l) agricultural and biological sciences, chemistry & natural resource sciences: saturation; (m) electronic control systems: moderate; (n) computer and information systems: moderate; (o) soil & water resource systems: limited; (p) biological processes and systems: saturation.
Person preparing syllabus and date:	Jeong-Yeol Yoon, Fall 2016

Class policies:

1. Attendance in each lecture/lab is required.
2. A make-up exam or term paper presentation can be scheduled only when a student has a valid excuse and submits a written note made by a responsible person.
3. Late lab report will be accepted with penalty (25% for each day that it is late). Late written term paper will not be accepted.
4. Students shall not represent the work of others as their own. The minimum penalty for cheating on exams is an E grade.
5. Adherence to official university rules and regulations pertaining to the classroom is mandatory.

Lab reports (individual reports):

Students will conduct experiments in teams (usually of two to four, depending on the nature of experiments). Individual lab report is still expected. Introduction, theory, materials and methods should not be included in a lab report. It should contain only results and discussion. Students also need to attach the answers to the questions in the textbook. Data interpretation, discussion, and answers to homework questions must be different among the team members.

Term paper (presentation/paper):

A professional team presentation and a written proposal of soliciting new investment in starting a new biotech venture company (447) or a research grant proposal (547). For 447, extensive theoretical background is not required, but the feasibility as a profitable business model should be addressed.

Special needs and accommodations:

SALT Center www.salt.arizona.edu
(520) 621-1242; (520) 621-9448 FAX
Disability Resource Center drc.arizona.edu
(520) 621-3268; (520) 621-9423 FAX

Confidentiality of student record:

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

Schedule:

Mon lab (sections A & B)	Wed lab (sections C & D)	Wed lecture (all)	Fri lecture (all)
08/22 <i>No lab</i>	08/24 <i>No lab</i>	08/24 Introduction	08/26 Resistor
08/29 Resistor	08/31 Resistor	08/31 Thevenin's theorem	09/02 Diode/transistor
09/05 <i>Labor day</i>	09/07 Diode/transistor	09/07 Diode/transistor	09/09 Temperature sensor
09/12 Diode/transistor	09/14 Temperature sensor	09/14 Temperature sensor	09/16 Wheatstone bridge
09/19 Temperature sensor	09/21 Wheatstone bridge	09/21 Wheatstone bridge	09/23 Op-amp
09/26 Wheatstone bridge	09/28 Op-amp	09/28 Op-amp	09/30 Light sensor
10/03 Op-amp	10/05 Photodiode	10/05 Light sensor	10/07 Review for midterm
10/10 Photodiode	10/12 <i>No lab</i>	10/12 Midterm exam	10/14 Spectrometry
10/17 Spectrometry	10/19 Spectrometry	10/19 Spectrometry	10/21 Fluorescence
10/24 Fluorescence	10/26 Fluorescence	10/26 Electrochem. sensor	10/28 Electrochem. sensor
10/31 pH/ion electrode	11/02 pH/ion electrode	11/02 Glucose sensor	11/04 Immunosensor
11/07 Glucose sensor	11/09 Glucose sensor	11/09 Immunosensor	11/11 <i>Veterans day</i>
11/14 ELISA kit	11/16 ELISA kit	11/16 Lab on a chip	11/18 Lab on a chip
11/21 Paper microfluidics	11/23 Paper microfluidics	11/23 Arduino	11/25 <i>Thanksgiving recess</i>
11/28 Arduino	11/30 Arduino	11/30 Nano biosensor	12/02 Nano biosensor
12/05 Term paper	12/07 Term paper	12/07 Review for final	

Mid-term exam 10/12 Wed 2:00-2:50 (closed, first half) @ Henry Koffler 216

Final exam 12/14 Wed 1:00-1:50 (closed, second half) + 2:00-2:50 (open, cumulative) @ Henry Koffler 216

Office hour: Fri 3:00-3:50 @ Marley 541H

Instructor: Jeong-Yeol Yoon, Professor, Marley 541J, jyoon@email.arizona.edu

TA's: Soo Chung (sect. A), soochung@email.arizona.edu, Chunan Liu, (sect. B), chunanliu@email.arizona.edu,

Collin Gilchrist (sect. C), collingilchrist@email.arizona.edu, Tiffany Ulep (sect. D), tulep@email.arizona.edu.