

Biosensors and Bioelectronics Course Syllabus EECE 7032

Spring Semester 2025

This syllabus is subject to modification.

Instructor: Professor Chong H. Ahn
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Office hours: Wednesday 2:00-3:00 PM in 900 Rhodes (9th floor)

Lectures: T/Th 3:30 – 4:50 pm, BALDWIN 757

Textbooks: Class notes and handouts

References: Introductory Bioelectronics, R. Pethig and S. Smith, Wiley, 2013.
Biosensors and Bioelectronics, C. Karunakaran, et. al., Elsevier, 2015.

Course Goal: This course is to provide multi-disciplinary knowledge required for the design, fabrication and characterization of biosensors and bioelectronics for biochemical, biomedical, clinical and environmental applications. The fundamentals of molecular recognition and surface science, biomolecular immobilization, transduction mechanism, and non-specific interactions with of enzymes, antibodies, proteins and DNA will be covered in the discussion of various biosensors. In addition, the basic electronic biosignal conditioning circuits and processing methods will be introduced. The integration of bioelectronics with biosensors and bioarrays will be discussed to build lab-on-a-chips and micro total analytical systems (uTAS).

Quizzes, Exams and Grading: Your grade will be composed of class attendance (10%), two quizzes (20 %), a late mid-term exam (40 %) and a term project (30 %). The format of the exam will be open book and notes. A grade of zero will be given for any missed exams for which there have been no arrangements made beforehand, unless you have a written medical excuse.

Quiz and mid-term examinations schedule:

Quiz #1: 20 minutes, Thu, Feb. 13

Quiz #2: 20 minutes, Thu, Mar. 13

Mid-term Exam: 90 minutes, Thu, April 10

The format of all quizzes and exams is OPEN books and class notes/materials. All face-to-face exams will be given in our regular classroom, Cell phones and personal communications are not allowed during quiz and examination, only allowing to access all the class materials using your personal computer or iPad. There is no restriction on calculators, except smart phone calculators. There will be no make-up examination and a grade of zero will be given for any missed exams for which there have been no arrangements made ahead, unless you have a written medical excuse.

Individual Term Project:

The purpose of this term project is to help your understanding on biosensors and bioelectronics, to build your insight for a specific biosensor and bioelectronic topic, and to discipline your logical reasoning, literature survey and presentation. Thus, the project is composed of a written report and a brief presentation.

- (1) Please select a specific topic related to biosensors and bioelectronics, and then get approval from Dr. Ahn for your topic by the end of 4th week.

- (2) First search and choose essential 10 reference papers related to the topic.
- (3) Comprehensively summarize the papers for the topic as a project report within 20 pages, and the 10 papers should be quoted and listed in the project report.
- (4) The project will be presented at the class in the final 2 weeks. Each presentation is scheduled 10 minutes presentation (around 22 slides) and 5 minutes discussion.
- (5) Submission of report: a final report in an electronic version with the attachment of electronic copies of the 10 reference papers (stored in CD or USB). The final report will be composed of the following format:

- Cover page (title and your name)
- Introduction
- Comprehensive summary for the topic
- Conclusion
- Suggestion for future direction
- References
- Attached 10 papers in pdf.

- (6) Submission of presentation of slides: an electronic version of your presentation slides (around 22 slides) in power point format.

The following criteria will be used in grading your term project (written report (15 %) and presentation (15 %)).

- Organizing and reasoning steps for the topic
- Logical consistency
- Overall quality of the summary
- Productive comments and creative suggestions for the prospective future research on the topic.
- Neatness

The term project report should be submitted after the individual presentation of project by April 25, including term project report, 10 papers in pdf, and presentation slides in ppt.

Attendance: You are required to attend all classes except for emergencies.

Religious Accommodations:

Ohio law and the University's Student Religious Accommodations for Courses Policy 1.3.7 permits a student, upon request, to be absent for reasons of faith or religious or spiritual belief system or participate in organized activities conducted under the auspices of a religious denomination, church, or other religious or spiritual organization and/or to receive alternative accommodations with regard to examinations and other course requirements due to an absence permitted for the above-described reasons. Not later than fourteen days after the first day of instruction in the course, a student should provide the instructor with written notice of the specific dates for which the student requests alternative accommodations. For additional information about this policy, please contact the Executive Director of the Office of Equal Opportunity and Access at (513) 556-5503 or oeohelp@UCMAIL.UC.EDU.

Conduct: The University Rules, including the Student Code of Conduct (SCC), and other documented policies of the department, college, and university related to academic integrity will be enforced. Any violation of these regulations, including acts of plagiarism or cheating, will be dealt with on an individual basis according to the severity of the misconduct. Unless explicitly stated, the SCC applies to any assignment that counts towards a student's course grade.

Withdrawal: Check Catalyst for the last day to withdraw from this course and receive a “W” grade.

Grading: Your grade will be composed of class attendance (10%), two quizzes (20 %), a late mid-term exam (40 %) and a term project (30 %). The format of the exam will be open book and notes. A grade of zero will be given for any missed exams for which there have been no arrangements made beforehand, unless you have a written medical excuse.

Please note that Point Totals (or Average) shown on the CANVAS Grade book ARE NOT CALCULATED using the Grading Scheme listed above, and therefore do not correspond to student’s actual Course Score. However, points for individual assignments (*homework assignments and exams*) displayed in the CANVAS Grade Book correspond to student’s correct score on these assignments. Individual assignment scores are usually displayed on a maximum 10-point scale. Letter grades for the course will be assigned using the following approximate guidelines:

$x \geq 93$	A
$90 \leq x < 93$	A-
$87 \leq x < 90$	B+
$83 \leq x < 87$	B
$80 \leq x < 83$	B-
$77 \leq x < 80$	C+
$73 \leq x < 77$	C
$70 \leq x < 73$	C-
$67 \leq x < 70$	D+
$63 \leq x < 67$	D
$60 \leq x < 63$	D-
$x < 60$	F

Topics to be Covered.

1. Fundamentals of biosensors and bioelectronics
2. Molecular recognition and bio-immobilization principles and procedures
3. Physicochemical transduction mechanisms for biotransductions
4. Electrochemistry and electrochemical biosensors
5. Metabolic and clinical biosensors
6. Ion selective field effect transistor (ISFET)-based biosensors
7. Electronic noses and electronic tongues
8. Biosignal conditioning circuits for biosensors
9. Biosignal processing methods
10. Lab-on-a-chips and micro total analytical systems (uTAS)