

**Fundamentals and Applications of Biosensors**  
**ABE 4033**

**Class Periods:** T Period 3 (9:35 AM - 10:25 AM), R Periods 4-5 (9:35 AM - 11:30 PM)

**Location:** Frazier Rogers Hall, Room 283

**Academic Term:** Spring 2024

**Email address:** [jireyes@ufl.edu](mailto:jireyes@ufl.edu) Office location: 273 Frazier Rogers Hall

**Instructor:** Dr. Jose Reyes

Telephone: 352-273-2181 (8-5 pm, M-F)

Office hours: Monday 9:00 - 11:00 am, or by appointment (preferably scheduled via email) in Room 273 Frazier Rogers or via Zoom as scheduled

**Teaching Assistant/Peer Mentor/Supervised Teaching Student:**

- TBD

**Course Description:**

*Credits: 3*

Provides a broad introduction to the field of biosensors, as well as an in-depth and quantitative view of biosensor design and performance analysis. Fundamental application of biosensor theory will be demonstrated, including biorecognition, transduction, signal acquisition, and post-processing/data analysis.

**Pre-requisites/Co-requisites**

MAP 2302 (Differential Equations) and BSC 2010 – Integrated Principles of Biology I and CHM 2200 Organic Chemistry

**Course Learning Outcomes:**

After taking this course students will be able to:

- Define and differentiate biosensors and biosensing.
- Explain the need for biosensors and biosensing.
- Explain biorecognition mechanisms.
- Quantify diffusion and reaction processes associated with biosensing.
- Explain the principles of electrochemical, optical, and acoustic transduction mechanism
- Classify biosensors according to their sensing and transduction mechanisms.
- Apply principles of biology and organic chemistry to the immobilization of biorecognition elements onto transducers.
- List biosensor performance characteristics and explain their relevance.
- Describe the principles of electric circuits used for sensor data acquisition.
- Apply basic principles of signal amplification and filtering to maximize sensor signal to noise ratio.
- Identify existing and potential applications of biosensors in the food, agricultural, environmental, and biomedical fields\*.
- Identify, read, critique, summarize, and present recent biosensor research

literature\*.

- Generate a list of development priorities for biosensor R&D\*.
- Propose sound experiments to test and validate biosensor performance applying sound statistical tools\*.
- Identify and analyze ethical conflicts associated to biosensors and biosensing and formulate sound guidelines for research and application of biosensors\*.

\*These learning outcomes involve group/team activities.

**Material and Supply Fees:** none

**Contribution of course to meeting the professional component for ABET:**

This course contributes 3 credit hours toward meeting the minimum 48 credit hours of Engineering Topics in the basic-level curriculum for the Bachelor of Science Degree in Agricultural and Biological Engineering.

**Relationship of course to ABET program outcomes:**

From the list of (1) through (7) program outcomes listed below, this course addresses mostly **1, 3, 4, 5, and 7.**

***This course addresses the following ABET outcomes.***

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	Low
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	Low
3. An ability to communicate effectively with a range of audiences.	Medium
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	Medium
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	Low
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	Low
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	Low

**\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not**

*part of the course outcomes that are addressed.*

**Required Textbooks and Software (see below)**

*Content will be available on Canvas or Provided by the Instructor*

*Other Recommended Resources: TBD*

**Course Schedule (topics vary by semester and may be modified with the intent of maximizing student learning)**

<b>Week</b>	<b>Topic</b>
Jan 9 & 11	Introduction & Sensor Principles
Jan 16 & 18	Sensor Performance
Jan 23 & 25	Biosensor Anatomy
Jan 30, Feb 1	Biorecognition I - Enzymes
Feb 6 & 8	Biorecognition II - Antibodies
Feb 13 & 15	Biorecognition III – Other – <b>Midterm exam 1</b>
Feb 20 & 22	Transduction I - Electrochemical
Feb 27 & 29	Transduction II - Optical
Mar 5 & 7	Transduction III – Acoustic – other
Mar 19 & 22	Fabrication I – Enzyme immobilization
Mar 26 & 28	Fabrication II – Immuno-magnetic beads – <b>Midterm exam 2</b>
Apr 2 & 4	Electronics, data acquisition, and analysis
Apr 9 & 11	Applications / Innovations
Apr 16 & 19	Ethics in Biosensors and Biosensing
Apr 23	<b>Student presentations / project</b>

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/> (Links to an external site.)

- As a general rule, any activity, action, or inaction that inhibits or limits a student's (self or other) learning is discouraged or prohibited.
- Attending and participating in class is required. Absences that are consistent with the university policies noted above will be excused. Attendance at classes will be taken at random and will be used for the attendance grade, each unexcused absence is 2.5% of the total grade up to 10%.
- Students are expected to abide by the deadlines for assignments. Late submissions will be penalized with a 20% deduction if submitted within 24 h of the deadline, a 50% deduction if submitted within 48 h, and will not be accepted afterward unless a valid justification that meets UF policies is provided.
- Use of office hours is encouraged. The instructor will try to accommodate other appointments that are scheduled via email at least one day in advance.
- The instructor will respond to emails typically, within a 24 h period during the work week.
- Students must adhere to the code of honor. In other words, no cheating is allowed. Students found copying, plagiarizing, etc. will be dismissed from the course with a failing grade. Activities in which students are expected to collaborate and share information will be clearly defined by the instructor.
- Students will make a final presentation at the end of the semester. The final presentation will represent 20% of the final grade. 10% will be assigned to the quality and comprehensiveness of the content of the presentation and 10% will be assigned to the communication quality and clarity. A detailed rubric for the presentations will be provided.

### **Grading Policy**

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
93.5 - 100	A	4.00
89.5 - 93.4	A-	3.67
86.5 - 89.4	B+	3.33
83.5 - 86.4	B	3.00
79.5 - 83.4	B-	2.67
76.5 - 79.4	C+	2.33
73.5 - 76.4	C	2.00
69.5 - 73.4	C-	1.67
66.5 - 69.4	D+	1.33
63.5 - 66.4	D	1.00
59.5 - 63.4	D-	0.67
0 - 59.4	E	0.00

Exams	30%
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Final Presentation	20%
Quizzes	20%
Homework	20%
Participation	10%

More information on UF grading policy may be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx> (Links to an external site.)

### ***Students Requiring Accommodations***

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/> (Links to an external site.). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/> (Links to an external site). Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/> (Links to an external site). Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/> (Links to an external site.).

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or

lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third-party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) (Links to an external site.) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against

University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html> (Links to an external site.) *Health and Wellness*

### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### **Academic Resources**

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

**Writing Studio**, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus**: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

**On-Line Students Complaints**: <https://distance.ufl.edu/state-authorization-status/#student-complaint>.

**Disclaimer**: The instructor reserves the right to modify this syllabus to improve student learning.