Bioelectronic Medicine

BME4931 – 23999/3A18
Class Periods: MWF, period 7, 1:55 pm – 2:45 pm
Location: Tur 2306
Academic Term: Spring 2020

Instructor:
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Office Hours: By Appointment

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

- N/A

Course Description

This course is focused on the emergent field of bioelectronic medicine. What is bioelectronic medicine? Consider the following questions:

- What if electronic devices could replace drugs?
- What advantages or disadvantages would these devices offer?

Bioelectronic medicine is poised to be a future therapy using electrical signals to modulate peripheral nerves innervating individual organs, delivering target and organ-specific effects. With recent advances in the field of molecular medicine, neurophysiology and biomedical devices, this novel way of treatment is within reach. Bioelectronic medicine has the potential to be superior to drugs in terms of efficacy, cost, and safety because it directly modulates the natural language of the body's nervous systems— electrical impulses and action potentials. To appreciate the full potential for bioelectronic medicine, consider that virtually all the cells in the body are directly or indirectly controlled by neural input. Through the use of bioelectronic medicine, it is now possible to modulate this neural input. Miniaturized devices can be implanted at selective nerve fibers to either stimulate or block neural activities as a therapeutic modality to treat a broad spectrum of conditions. By converging neurophysiology with data analysis and disease biology, it will be feasible to develop bioelectronic devices that can record and analyze neural and physiological data in real time and modulate the neural electric input to the target organs. Biomedical engineering is a key component of this interdisciplinary field that also includes clinicians and researchers from: neuroscience, disease biology, bioinformatics, materials science, nanotechnology, and neurosurgery.

In this course we will introduce, study, and design bioelectronic medicine technologies. This will progress by studying the following:

- autonomic nervous system introduction;
- existing bioelectronic medicine neural interface technologies;
- quantitative approaches for electrically activating the nervous system;
- existing bioelectronic medicine systems;
- developing bioelectronic medicine systems;
- future bioelectronic medicine systems.

Course Pre-Requisites / Co-Requisites

Pre-requisites:

- N/A

Course Objectives

- Define bioelectronic medicine
- Critically evaluate a bioelectronic medicine approach and system
- Identify opportunities for future bioelectronic medicine applications
- Design a bioelectronic approach and an evaluation framework for said system

Materials and Supply Fees

- N/A

Professional Component (ABET):

This course incorporates mathematics and basic sciences appropriate to Biomedical Engineering. Basic sciences are defined as biological, chemical, and physical sciences. It also incorporates engineering topics, consisting of engineering sciences and engineering design appropriate to Biomedical Engineering.

Relation to Program Outcomes (ABET):

ABET Outcome	Coverage*
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	
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	
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	
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	High
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	High

Required Textbooks and Software

- N/A

Recommended Materials

a. Integrative Action of the Autonomic Nervous System, Wilfrid Janig, ISBN # 9780511541667
b. Bioelectricity: A Quantitative Approach, Robert Plonsey and Roger C. Barr, ISBN # 978-0387488646
c. Bioelectromagnetism - Principles and Applications of Bioelectric and Biomagnetic Fields, Jaakko Malmivuo and Robert Plonsey, ISBN # 978-0195058239
d. MATLAB student edition (from the bookstore), OR access to a computer with MATLAB, OR use online at http://info.apps.ufl.edu

Course Schedule

Separate file will be made available via E-Learning during the semester.

Attendance Policy, Class Expectations, and Make-Up Policy

Class participation is required and part of the final grade. Exceptions are made conforming to university policies, but the instructor must be notified in advance.

Evaluation of Grades

Homework and quizzes will be assigned regarding material presented in lecture format. There will be a take-home midterm evaluation.

Students will work in groups on 3 major activities: a disease deep-dive, a literature review, and a proposal.

There will be various graded discussion boards and peer reviews of in-class presentations.

Assignments	10%
Quizzes	10%
Discussion Boards	10%
Peer Evaluations	10%
Disease Topic Presentation (Group)	10%
Journal Club Activity (Group)	20%
Proposal Presentation (Group)	10%
Written Proposal (Group)	10%
Proposal Review (Individual)	10%
Total	100%

Grading Policy

Percent	Grade	Grade Points
94.0 - 100	A	4.00
90.0 - < 94	A-	3.67
87.0 - < 90	B+	3.33
84.0 - < 87	B	3.00
80.0 - < 84	B-	2.67
77.0 - < 80	C+	2.33
74.0 - < 77	C	2.00
70.0 - < 74	C-	1.67
67.0 - < 70	D+	1.33
64.0 - < 67	D	1.00
61.0 - < 64	D-	0.67
< 61	E	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure 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.aa.ufl.edu/students/. 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/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

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://www.dso.ufl.edu/sccr/process/student-conduct-honor-code) specifies a number of behaviors that are in violation of this code and the possible sanctions. In adopting this Honor Code, the students of the University of Florida recognize that academic honesty and integrity are fundamental values of the University community. Students who enroll at the University commit to holding themselves and their peers to the high standard of honor required by the Honor Code. Any individual who becomes aware of a violation of the Honor Code is bound by honor to take corrective action. The quality of a University of Florida education and the value of your degree is dependent upon the community acceptance and enforcement of the Honor Code.

- **Plagiarism** is a common infraction to the UF Honor Code. If you are confused as to what constitutes plagiarism, see here: https://guides.uflib.ufl.edu/copyright/plagiarism. Plagiarism on any of your assignments **will be reported to the Dean of Students as a UF Student Honor Code violation.** Also, note that **copying solutions for any assignment, regardless of the source (e.g. other students, pirated website solutions), will be treated as plagiarism.** If you have any questions or concerns, please consult with the instructor in this class. Note that failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures.

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
• Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
• Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
• Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, 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

Campus Resources:

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 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: http://www.counseling.ufl.edu/cwc, 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

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

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.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://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints*:* http://www.distance.ufl.edu/student-complaint-process.

Disability Statement
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting disability.ufl.edu/students/get-started. 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.