BME 6360: Neural Engineering
Spring 2020

Catalog Description: Applying engineering to neuroscience including such diverse areas as neural tissue engineering, models of neural function, and neural interface technology. Focuses mainly in the context of neural interfaces and prosthetics, from basic neural physiology and models of neural mechanisms to advanced neural interfaces currently in development or produced commercially.

Credits: 03

Prerequisites: BME3508-Biosignals and Systems, or equivalent Signals and Systems class

Instructor:
- Aysegul Gunduz, Ph.D. (agunduz@ufl.edu)
  Biomedical Sciences Building J283   (352) 273-6877

Office Hours:
- Aysegul Gunduz: M 4PM

Class Meetings: **MWF, Period 3; 9:35-10:25am**

Meeting Location: **MSB6120 (Stetson Medical Sciences Building).** *On the following four Fridays the class will be held in HSC C1-9 (Communicore Building) instead: 1/17, 2/21, 3/20, 4/17.*

Class Homepage: eLearning Canvas

Required textbook and software:
No textbooks are required. Slides will be posted on the class website. Students are responsible for material presented on black board. MATLAB software will be used for some assignments and all projects.

Recommended reading:
- *Neural Engineering,* He
- *Neuroengineering,* DiLorenzo
- *Principles of Neural Science,* Kandel
- *Biological Psychology,* Kalat

Course Objectives:
- Understand the basic principles of brain anatomy, chemistry and function
- Learn about the principles of neurophysiologic recording and imaging technologies
- Learn about the applications of neural engineering in sensory, motor, neurological and mental disorders
- Understand the current challenges in neural engineering and the directions in which the area is headed

Course Outline:
- Basic principles of brain anatomy (~1 week) – Week 1
- Neurons and neural signaling (<1 week)
- Hodgkin-Huxley models (<1 week) – Week 2
- Spike sorting (PCA) (1 week)
  - Project I – Week 3
- The Motor System (~1 week) – Week 3
- The Motor System Engineering Application: Brain-Machine Interfaces (Firing rate estimation, Population vectors) (~1 week)
  - Project II – Week 5
- The Visual System (~1 week) – Week 6
- The Visual System Engineering Application: Retinal Implants (~1 week) – Week 7
- Recording from the Brain: Electroencephalogram (EEG) (~1 week) – Week 8
- Visual EEG Brain-Machine Interfaces (~1 week) – Week 9
  - Project III
- The Auditory System (<1 week)
- The Auditory System Engineering Application: Cochlear Implants (<1 week) – Week 10
- Sensorimotor EEG Brain-Machine Interfaces (~1 week) – Week 11
  - Project IV
- Functional Electrical Stimulation (Muscular FES, Peripheral FES, Electrocortical Stimulation) – Week 12
- Noninvasive Neuromodulation Methods and Functional Applications (TMS, rTMS, TDC) (~1 week) – Week 13
- Neuroimaging and Functional Applications (fMRI, fNIRS) – Week 14
- Neural Engineering Poster Day

Grade Determination:
14% Homeworks, 19% Project I, 19% Project II
19% Project III, 19% Project IV, 10% Poster Day Presentation
Poster presentation: 10% -- Students will present the results of one of the projects of their own choice in April. The poster day will be publicly announced and be held in the BMS atrium.

Grading Scale: All component grades will be on an A(4), B(3), C(2), D(1), F(0) basis (with + (0.33) and – (-0.33) modifiers. These will be assigned on a curve based on the raw numerical score (homeworks, projects and poster presentation) For information on current UF grading policies for assigning grade points, please visit:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx .

Policies:
Class participation is required, as well as attending the poster day in which students will present. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

Academic Honesty:
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 (http://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. 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.

Plagiarism
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.

Students with Disabilities:
Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, 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.

UF Counseling Services:
Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
Health and Wellness
- U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392- 1575 so that a team member can reach out to the student.
- Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc/Default.aspx , 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.
Sexual Assault Recovery Services
- Student Health Care Center, 392-1161.
- University Police Department, 392-1111 (or 9-1-1 for emergencies). 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 Resource Center, Reitz Union, 392-1601. Career assistance and counseling. http://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. http://teachingcenter.ufl.edu/

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

Student Complaints
- https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf
- On-Line Students Complaints: http://www.distance.ufl.edu/student-complaint-process

Software Use:
All faculty, staff and student 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.

Faculty Evaluation:
Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/ .

Sexual Discrimination, Harassment, Assault, or Violence:
The University of Florida has zero tolerance for sexual discrimination, sexual harassment, sexual assault, dating violence, domestic abuse or stalking. Sexual harassment and sexual violence are forms of gender discrimination that are prohibited by Title IX, including when the incident(s) occur off-campus or involve people who are not students.
The University of Florida Office of Title IX Compliance is committed to ensuring equal access to University programs and activities, as well as to promoting inclusion of all genders, sexual orientations, and gender identities. The University of Florida Student Title IX Process Flowchart can be found here: https://titleix.ufl.edu/wp-content/uploads/2018/02/10-17-University-of-Florida-Title-IX-Process-1.pdf. Further resources can be reached here: https://titleix.ufl.edu/title-ix-resources/.
When a student or employee has experienced a hostile environment such as sexual assault or severe, pervasive, and offensive sexual harassment, the University of Florida is responsible to stop the discrimination, prevent its recurrence, and address its effects. This includes retaliation from other students, school administrators, or faculty.
If you or a friend has been subjected to sexual discrimination, harassment, 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
For **Sexual Assault Recovery Services** reach the **Student Health Care Center** at (352) 392-1161.
For any type of harassment, assault, or violence contact **University Police** at (352) 392-1111, or **911 for emergencies**.