

Neural Signals, Systems and Technology

EEL 5934 Sections 066A, 2308

Class Periods: Tu 3rd period, Th 3rd and 4th

Location: LAR 239

Academic Term: Spring 2018

Instructor:

Dr. Karim Oweiss

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Office Phone Number: 352-294-1898

Office Hours: Tuesdays and Thursdays 3-4 pm

Teaching Assistants:

- Seyed Mehrdad Hashemi (hashemi@ufl.edu)

Course Description

(3 credits) Biophysical principles of neural signaling, characterization of neural circuits and systems, technology design principles for interfacing with biological neural systems, overview of clinical applications and industrial opportunities for neurotechnology.

Course Pre-Requisites / Co-Requisites

Graduate standing in engineering and/or neuroscience or undergraduate senior standing with consent of instructor.

Course Objectives

The student will be able to describe the techniques for characterization of neural circuits and systems, and explain the principles of neurotechnology for interfacing with biological neural systems.

Materials and Supply Fees

N/A

Required Textbooks and Software

- None- Review articles provided by instructor

Recommended Materials

- Title: Statistical Signal Processing for Neuroscience & Neurotechnology
Author: Oweiss
Publication date and edition: 1st edition, 2010
ISBN number: 9780123750273
- Title: Principles of Neural Science (PNS)
Author: Kandel, Schwartz, Jessel, Siegelbaum, and Hudspeth
Publication date and edition: 5th edition, 2013, McGraw Hill
ISBN number: 9780071390118
- Title: Theoretical Neuroscience (TNS)
Author: Dayan Peter and Abbott, L.
Publication date and edition 2001
ISBN: 9780262318723
- Title: Cellular Biophysics, Vol 2 (CBP)
Author: Thomas Weiss
Publication date and edition: MIT Press 1996, 1st edition
ISBN 0-262-23184-0 (v.2)

Course Schedule

Week 1:	Excitable cells, ion channels, synapses, neurotransmitters & receptors/Oweiss/PNS Ch 4-5, CBP ch.1
Week 2:	Deterministic Neural Models/Oweiss/ PNS ch. 6; CBP ch. 2-3/HW 1 due
Week 3:	Neural Encoding/Oweiss/TNS ch. 1-2; SSPNT ch.3, 6-7/HW 2 due
Week 4:	Neural Decoding/Oweiss/SSPNT ch. 2-5, TNS ch. 3/HW 3 due
Week 5:	Neural Control: State Space and feedback control/Oweiss/in Class material/Quiz 1
Week 6:	Neurotechnology: microelectrodes and microsystems/Oweiss/in Class material/ HW 4 due
Week 7:	Fluorescent imaging of genetically encoded indicators/Oweiss/in Class material/Mini project 1
Week 8:	Electrical and Optogenetic Neurostimulation and Neuromodulation/Oweiss/in Class material/Project Pre proposals
Week 9:	Neural Systems: Sensory systems/Oweiss/PNS Part V/ Quiz 2
Week 10:	Neural Systems: Motor systems/Oweiss/ PNS Part VI/Mini project 2
Week 11:	Neural Systems: Cognitive systems/Oweiss/PNS Part VI/
Week 12:	Neural Interfaces: Sensory Prosthesis/Oweiss/ in Class material/ Project Proposal
Week 13:	Neural Interfaces: Motor Prosthesis/Oweiss/in Class material/ Quiz 3
Week 14:	Neural Interfaces: Cognitive and Memory Prosthesis/Oweiss/SSPNT ch.5
Week 15:	Clinical Applications: Bi-directional Interfaces for Movement Disorders and Impairment; Consumer Applications: Neuromorphic systems, Artificial Intelligence and Neurotechnology Ventures/Oweiss/in Class material/project previews
Week 16:	Final project presentation

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is required as a considerable portion of your grade depends on class participation and discussion. Because the class covers a multi-disciplinary topic, questions and discussions during class are strongly encouraged. You will need to notify me ahead of time if you will not attend class and provide a reasonable written explanation of your absence. I will record attendance randomly throughout the semester. You need 75% attendance to PASS the class.

Cell phones and other electronic devices are to be silenced. No text messaging during class or exams.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found in the online catalog at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx> .

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework (4)	20%
Quizzes (3)	15%
Mini projects (2)	25%
Final Project/Term Paper (1)	35%
Total	100%

Guidelines and Format

1) Mini-projects and homework guidelines

There will be four homework assignments distributed evenly throughout the semester. Some of these will make use of MATLAB®. There will be TWO mini-projects worth 12.5% each. Data for these mini-projects will be provided by the instructor. There will be 3 quizzes in class regarding reading assignments.

2) Final Project Guidelines

a) The Pre-proposal:

Write a brief description of the research topic that you plan to pursue for your project/term paper, as well as the specific problems or questions you plan to address in your proposal. You will be provided with guidelines and resources on how to gain access to data to be used for your project.

Limit: 2 pages, 12-pt font size, 1.5-line spacing (no references), font type: Arial, one-inch margins.

b) The Proposal:

Based on the feedback I give you on your pre-proposal, write a proposal that should attract “funding” (aka a good grade) from your “sponsor” (instructor). Your proposal should include:

- a) Background and Significance
- b) Preliminary studies (if any) or relevant work
- c) Research Design and Methods
- d) Timeline

You should introduce the area of investigation, explain the “big picture” or significance of the specific problem that you will tackle, provide a list of the particular questions you intend to address in your experiments/simulation, and the methods you will use to conduct these experiments/simulation. It is very important to include all the details about how the data you will be working with has been/will be collected. Limit: 4 pages (not including references), Single spacing, one-inch margins, 12-pt font size Arial font.

c) The Final report:

Based on the actual implementation of the proposal, write a concise, yet detailed summary of all your experimental findings in the form of a final report. A key element of this report is your discussion section and how it relates to topics learned in class and challenges specific to the problem you addressed in your project. Limit: 8 pages (not including references or figures), Single spacing, one-inch margins, 12-pt Arial font.

Grading Policy

Percent	Grade	Grade Points
92.4 - 100	A	4.00
88.0 - 92.3	A-	3.67
84.7 - 87.9	B+	3.33
81.4 - 84.6	B	3.00
78.0 - 81.3	B-	2.67
75.7 - 77.9	C+	2.33
71.4 - 75.6	C	2.00
68.0 - 70.3	C-	1.67
63.7 - 67.9	D+	1.33
60.4 - 63.6	D	1.00
58.0 - 60.3	D-	0.67
0 - 57.9	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 feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. 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/>.

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. 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.

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.

Campus Resources:

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>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

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 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>.