

UNIVERSITY OF FLORIDA
COLLEGE OF MEDICINE SYLLABUS
NEUROSCIENCE
GMS 6022, Neurophysiology from Cells to Systems (3 credits)

Semester: Spring 2021

Delivery Format: online via live Zoom

Tues and Thurs 10:00 – 11:30 am

Instructor Name: Erica Levitt
Drew Maurer

Room Number: NA

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Maurer 352-273-5092

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Office Hours: Dr. Levitt- available via Zoom on Monday/Wednesday, 10 – 11 am
Dr. Maurer- available via Zoom on Monday/Wednesday, 12-1 pm

Preferred Course Communications: Email

Prerequisites: Must be a graduate student in Neuroscience or related discipline (e.g., Psychology, Pharmacology, Clinical Health Psychology, Biomedical Engineering, Pharmacodynamics)

Purpose and Outcome: *This semester course provides the fundamental principles of electrical properties and synaptic signaling in excitable cells. Students will gain an understanding of the physiological properties of the nervous system, including how ions and ion channels govern the membrane potential and excitability, and how signaling properties arise at the single neuron level to manifest as larger networks that support behavior. Following the function of individual cells, the manner in which they are connected will be covered, including synaptic signaling between neurons. We will cover the molecular make-up of synapses, and different kinds of synapses, the quantal theory of transmission, and neuromodulation. Course material will also cover the different types of synaptic plasticity mechanisms that make synaptic strength use-dependent. The course includes a review of model systems and neural circuits in integrative neurophysiology, as well as the relation of neural circuits to behavior and cognitive processes.*

Course Overview: This course will focus on the physiology of the nervous system from the microscopic scale to the interaction of the brain with the body and environment.

Relation to Program Outcomes: This course fulfills the requirements for Academic Credits for graduate students in the Neuroscience program.

Course Objectives and/or Goals:

By the end of each semester, students will be able to:

- Describe the basic cellular physiology of neurons

- Describe different types of cellular communication
 - Identify the different types of ionic current and describe how that gives rise to resting membrane potential and action potential propagation.
 - Become familiar with Meta-Neuron
 - Describe the role of interneurons in shaping neural dynamics
 - Identify circuit level physiology in normal and disease states.
- Detail different molecular tools to study neuronal function

Instructional Methods: Instructors and students will attend via live zoom.

Description of Course Content:

Topical Outline/Course Schedule

Week	Day	Lecture	Lecturer
1	1/12/2021	Intro and course overview, Introduction to Metaneuron	Levitt and Maurer
	1/14/2021	Nernst and GHK equation, current voltage relationships <i>Kandel Ch 6; Hille Ch 1</i>	Papke
2	1/19/2021	Passive properties: capacitance, time and space constants <i>Kandel Ch 6</i>	Papke
	1/21/2021	Action potential/ Hodgkin-Huxley <i>Kandel Ch 7; Hille Ch 2</i> Distribute Metaneuron 1 problem set	Papke
3	1/26/2021	Metaneuron 1 Lab: Equilibrium potential, passive properties, action potentials Single channel currents <i>Kandel Ch 5; Hille Ch 12</i>	Levitt (Lab) Papke (Lecture)
	1/28/2021	Voltage-gated channels <i>Kandel Ch 5,7; Hille Ch 3,19</i> Distribute Metaneuron 2 problem set	Levitt
4	2/2/2021	Calcium channels and calcium indicators <i>Kandel Ch 12; Hille Ch 4, 9</i>	Levitt
	2/4/2021	Metaneuron 2 Lab: Voltage-gated channels (activation/inactivation/recovery); Review for exam	Levitt
5	2/9/2021	Exam I	
	2/11/2021	Neuromuscular junction and nAChRs <i>Kandel Ch 10; Hille Ch 6</i>	Papke
6	2/16/2021	Ligand-gated channels	Papke

		<i>Kandel Ch 9</i>	
		Central synapses <i>Kandel Ch 8, 10, 12; Hille Ch 6</i>	
	2/18/2021	Distribute Metaneuron 3 problem set	Levitt
		Metaneuron 3 Lab: synaptic currents GPCR and second messenger-gated ion channels	
7	2/23/2021	<i>Kandel Ch 11</i>	Levitt
		Mechanoreceptors and hearing	
	2/25/2021	<i>Kandel Ch 30</i>	Bird
		Receptors of smell and taste	
8	3/2/2021	<i>Kandel Ch 32</i>	McIntyre
	3/4/2021	Exam II	
		Dynamics of small circuits Readings: Sharp, A. A., Skinner, F. K., & Marder, E. (1996). Mechanisms of oscillation in dynamic clamp constructed two-cell half-center circuits. <i>Journal of Neurophysiology</i> , 76(2), 867–883. Bargmann, Cornelia I., and Eve Marder. "From the connectome to brain function." <i>Nature methods</i> 10.6 (2013): 483. Gutierrez, Gabrielle J., Timothy O'Leary, and Eve Marder. "Multiple mechanisms switch an electrically coupled, synaptically inhibited neuron between competing rhythmic oscillators." <i>Neuron</i> 77.5 (2013): 845-858.	
9	3/9/2021		Maurer
	3/11/2021	Interneurons and plasticity in spinal cord	Dale
		Interneurons and the important of network balance in brain Berg, Rune W., Alex Willumsen, and Henrik Lindén. "When networks walk a fine line: balance of excitation and inhibition in spinal motor circuits." <i>Current Opinion in Physiology</i> 8 (2019): 76-83.	
10	3/16/2021		Maurer
		Rhythms of the Brain 1 Buzsáki, György, Costas A. Anastassiou, and Christof Koch. "The origin of extracellular fields and currents—EEG, ECoG, LFP and spikes." <i>Nature reviews neuroscience</i> 13.6 (2012): 407-420.	
	3/18/2021		Mauer
		Rhythms of the Brain 2	
11	3/23/2021		Maurer

		<i>Kandel ch. 46</i>	
	3/25/2021	EXAM III	
12	3/30/2021	LTP/LTD, genes and memory	Burke
		Memory 1	
		Schwindel, C. Daniela, and Bruce L. McNaughton. "Hippocampal–cortical interactions and the dynamics of memory trace reactivation." <i>Progress in brain research</i> . Vol. 193. Elsevier, 2011. 163-177.	
	4/1/2021	Josselyn, Sheena A., Stefan Köhler, and Paul W. Frankland. "Heroes of the engram." <i>Journal of Neuroscience</i> 37.18 (2017): 4647-4657.	Maurer
13	4/6/2021	Memory 2	Maurer
	4/8/2021	Normal Aging in the Brain (focus on activity imbalance)	Burke
14	4/13/2021	Neurodegenerative disease and hyperexcitability	Abisambra
	4/15/2021	Manipulating neural circuits I: Optogenetics to manipulate cell type in brain slices	Levitt
15	4/20/2021	Manipulating neural circuits II: Virtual tour of optogenetics in brain slice electrophysiology	Levitt
		Manipulating neural circuits III: Optogenetics, DREADDS and other in vivo methods for assessing and manipulating neural circuits in vivo	
16	4/22/2021		Setlow
		EXAM (IV)	

Course Materials and Technology:

From Neuron to Brain, Fifth Edition by John G. Nicholls(Author), A. Robert Martin(Author), Paul A. Fuchs

Principles of Neuroscience, Fifth Edition, by Kandel, Schwartz, Jessel, Siegelbaum and Hudspeth

Supplemental reading: Ion Channels of Excitable Membranes, Third Edition, by Bertil Hille as well as readings assigned special readings corresponding to specific lectures.

For technical support for this class, please contact the UF Help Desk at:

- Learning-support@ufl.edu
- (352) 392-HELP - select option 2
- [UF eLearning](#)

Academic Requirements and Grading:

Assignments:

There will be 4 exams based on lecture content and will involve multiple choice, short answer and essay questions. There will be three Metaneuron problem sets. Grades will be determined from performance on 4 exams and completeness of 3 problem sets.

Once per semester, students will be permitted to replace their lowest exam score by writing a single "Journal Club" on a paper of their choice that published within the last 12 months. This will follow the Journal of Neuroscience format (http://www.jneurosci.org/site/misc/ifa_features.xhtml) and should have three components: a short overview of the background of the reviewed paper, a critical data-based review of the key findings, and a brief summary of the significance relative to the concept in the current course. The Journal Club should focus on the most important results (it is not necessary to discuss each figure), and a successful paper will offer a critical evaluation the results in the context of other work. The length should be between 1200 and 1500 words.

Grading:

Requirement	Percent Final Grade
Participation	10%
Problem sets	10%
Exam 1	20%
Exam 2	20%
Exam 3	20%
Exam 4	20%

Point system used (i.e., how do course points translate into letter grades).

Percent age Earned	Letter Grade
93-100	A
90-92	A-
87-89	B+
83-86	B

80-82	B-
77-79	C+
73-76	C
70-72	C-
67-69	D+
63-66	D
60-62	D-
Below 60	E

Exam Policy: There are four exams in this course. Exams will be administered online at the date and time specified in the syllabus.

Policy Related to Make up Exams or Other Work: You are expected to notify the course directors of any anticipated absences. You should make every effort to take the exams on the days they are scheduled. If extenuating circumstances prevent you from taking a scheduled exam, and you have an excused absence, you will need to schedule an appointment to meet with the course directors to identify an alternative exam date.

Please note: Any requests for make-ups due to technical issues MUST be accompanied by the UF Computing help desk (<http://helpdesk.ufl.edu/>) correspondence. You MUST e-mail me within 24 hours of the technical difficulty if you wish to request a make-up.

Policy Related to Required Class Attendance: You are expected to attend each lecture and actively participate in the problem sets. Participation is incorporated into the problem set grading.

Expectations Regarding Course Behavior: We expected all students to be in attendance for every lecture and participate in class discussions. Students should meet with the instructors as soon as possible regarding University-excused absences so that accommodations can be made on a case by case basis.

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>.

Communication Guidelines:

Please see the NETIQUETTE GUIDE FOR ONLINE COURSES: <http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf>

Academic Integrity:

Students are expected to act in accordance with the University of Florida policy on academic integrity. As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge:

“We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.”

You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit 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.”

It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For additional information regarding Academic Integrity, please see Student Conduct and Honor Code or the Graduate Student Website for additional details:

<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>

<http://gradschool.ufl.edu/students/introduction.html>

Please remember cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.

Online Faculty Course Evaluation Process:

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/>.

Accommodations for Students with Disabilities:

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/>. 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. The College is committed to providing reasonable accommodations to assist students in their coursework.

Counseling and Student Health:

Students sometimes experience stress from academic expectations and/or personal and interpersonal issues that may interfere with their academic performance. If you find yourself

facing issues that have the potential to or are already negatively affecting your coursework, you are encouraged to talk with an instructor and/or seek help through University resources available to you.

- The Counseling and Wellness Center 352-392-1575 offers a variety of support services such as psychological assessment and intervention and assistance for math and test anxiety. Visit their web site for more information: <http://www.counseling.ufl.edu>. On line and in person assistance is available.
- You Matter We Care website: <http://www.umatter.ufl.edu/>. If you are feeling overwhelmed or stressed, you can reach out for help through the You Matter We Care website, which is staffed by Dean of Students and Counseling Center personnel.
- The Student Health Care Center at UF Health is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at UF Health offers a variety of clinical services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: <https://shcc.ufl.edu/>
- UF Health Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32698, ufhealth.org/emergency-room-trauma-center.
- University Police Department: Visit police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).
- Crisis intervention is always available 24/7 from:

Alachua County Crisis Center:

(352) 264-6789

<http://www.alachuacounty.us/DEPTS/CSS/CRISISCENTER/Pages/CrisisCenter.aspx>

Do not wait until you reach a crisis to come in and talk with us. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.

Academic Resources

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services career.ufl.edu/.

Library Support: cms.uflib.ufl.edu/ ask various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall 352-392-2010 or to make an appointment 352 392-6420.
General study skills and tutoring. teachingcenter.ufl.edu/

Writing Studio: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. writing.ufl.edu/writing-studio/

Student Complaints On-Campus: sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

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