

UNIVERSITY OF FLORIDA
COLLEGE OF MEDICINE SYLLABUS
NEUROSCIENCE
GMS 6022, Principles of Neurophysiology (2 credits)
Semester: Fall 2024
Delivery Format: in-person
Tuesdays 1:00 – 3:00 PM

Instructor Name: Drew Maurer, PhD, and Karina Alviña, PhD.

Room Number: L1-101 McKnight Brain Institute (MBI)

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Office Hours: Upon request

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 way 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.

- 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 and recent technological advances used in research

Instructional Methods: Instructors and students will attend in-person.

Description of Course Content:

Topical Outline/Course Schedule

Week	Day	Lecture	Lecturer
1	8/27/24	<p>Intro and course overview Nernst and GHK equation, current-voltage relationships <i>Kandel Ch 6; Hille Ch 1</i> Passive properties: capacitance, time and space constants <i>Kandel Ch 6</i></p>	Maurer Alviña
2	9/3/24	<p>Action potential and Synaptic Transmission Intro <i>Kandel Ch 7; Hille Ch 2</i></p> <p>Touch and Proprioception, Receptors, Signal Transduction <i>Kandel Ch 21, 23. Nadeau Ch 7, cycle 1</i></p>	Alviña Mandel
3	9/10/24	<p>Central synapses <i>Kandel Ch 8, 10,12; Hille Ch 6</i></p>	Moehle
4	9/17/24	<p>Dynamics of small circuits Readings:</p> <ul style="list-style-type: none"> • 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. 	Maurer

5	9/24/24	<p>Interneurons and plasticity in spinal cord</p> <p>Interneurons and the importance of network balance in the brain</p> <p>Reading</p> <ul style="list-style-type: none"> 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. 	<p>Dale (confirmed)</p> <p>Maurer</p>
6	10/1/24	<p>Glymphatic System, Blood Brain Barrier, Choroid Plexus, and CSF</p> <p><i>Kandel Ch 1,2,4, and Appendix D</i></p> <p><i>Nadeau Ch-1 cycle 3, Ch-3 cycles 1-4</i></p> <p>Introduction to Neuroimmunology</p>	Mandel
7	10/8/24	<p>No lecture due to SfN Annual Conference</p> <p>PAPER 1 DUE by 11:59 PM</p>	
8	10/15/24	The Neurophysiology of Breathing (2h)	Sabhya Rana (confirmed)
9	10/22/24	<p>The Visual System</p> <p>LTP/LTD and cortical neuroplasticity</p>	<p>Mandel</p> <p>Burke (confirmed)</p>
10	10/29/24	<p>Rhythms of the Brain 1 and 2</p> <p>Reading</p> <ul style="list-style-type: none"> 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. <p><i>Kandel Ch. 46</i></p>	Maurer
11	11/5/24	<p>Memory 1</p> <ul style="list-style-type: none"> 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. Josselyn, Sheena A., Stefan Köhler, and Paul W. Frankland. "Heroes of the engram." <i>Journal of Neuroscience</i> 37.18 (2017): 4647-4657. 	<p>Burke (Confirmed)</p> <p>Maurer</p>

		Memory 2	
12	11/12/24	Human Neurophysiology (2h)	Keil
13	11/19/24	Manipulating neural circuits: Optogenetics, DREADDS and other in vivo methods for assessing and manipulating neural circuits in vivo Decision making	Setlow (confirmed)
14	11/26/24	Physiology of the Prefrontal Cortex (2h) AI for Neuroscience	Padilla-Coreano (confirmed)
15	12/3/24	Computational Neuroscience: Pros and Cons	Maurer
PAPER 2 DUE 12/6/23 at 11:59PM			

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 **2 written assignments (papers) during the semester**. Final Grades will be determined from performance on 2 papers and class participation.

Written assignment (paper). Students will write a “Journal Club” on a paper of their choice that was published within the last 12 months (the topic is the student's choice but should be pre-approved by course directors prior to submission). This “Journal club” 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 of the paper, and a brief summary of the significance relative to the concept in the current course. A successful Journal Club assignment should focus on the most important results (it is not necessary to discuss each figure) and should offer a critical evaluation of the results in the context of previous work in the field and the content being discussed in this course. The length should be between 1200 and 1500 words.

Grading:

Requirement	Percent Final Grade
Participation	33.4%
PAPER 1	33.3%
PAPER 2	33.3%
Total	100.0%

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

Percentage 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: Exams or deadlines will be administered at the date and time specified in the syllabus. Paper due dates scheduled from the beginning of the course cannot be moved.

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 the course directors within 24 hours of the technical difficulty if you wish to request a make-up exam.

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 expect 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 accommodation 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.

A note on the Socratic Method. Per Wikipedia, “The Socratic method (also known as method of Elenchus, elenctic method, or Socratic debate) is a form of cooperative argumentative dialogue between individuals, based on asking and answering questions to stimulate critical thinking and to draw out ideas and underlying presuppositions.” To fully explore all ideas, sometimes it is necessary to visit the unpopular positions and opinions. To the end, lectures and students may present a “devil’s advocate” position, defending ideas that they do not necessarily believe in (again, Wiki’s *Devil’s advocate*). This activity is welcomed, and students are encouraged to explore the veracity of ideas in both the exams and in the final project.

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>. Online 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