BIONB/BME/ECE 4910: Principles of Neurophysiology
Spring 2015

General Objectives and Description: BIONB/BME/ECE 4910 is a course in experimental techniques of cellular electrophysiology. Its main objective is to give you direct insight into neuronal excitability and intercellular communication through hands-on examination of signal transmission in nervous systems. In addition, we’ll practice other important aspects of experimental science including critical thinking, data analysis and presentation, and reading and writing scientific papers. We’ll use the lecture periods to present background material for the labs, to discuss lab results and related research papers, to discuss experimental approaches in cellular/systems neuroscience, and for student presentations on diseases and neurotoxins.

Specific Learning Outcomes:

1) Students should understand the contemporary experimental paradigms in modern neurophysiology and become technically competent with extracellular and intracellular recording techniques to explore nervous system physiology.

2) Students should deepen their understanding of the ionic mechanisms underlying neuronal excitability and intercellular communication in the nervous system.

3) Students should refine their skills in communicating scientific results effectively through written lab reports and oral presentations.

4) Students should refine their critical reading skills of primary scientific literature.

5) Students should refine their abilities to develop testable hypotheses and become independent scientific thinkers.

Texts: Your required lab manual will be Crawdad: An Online Lab Manual for Neurophysiology. This CD contains instruction for most of the laboratory exercises, including detailed descriptions and videos of laboratory procedures. You can buy it directly from the publisher: (http://www.sinauer.com/crawdad-an-online-lab-manual-for-neurophysiology.html).

The other required “text” is: Moore, J.W. and A.E. Stuart (2007) Neurons in Action (for sale in the Cornell Store). It’s a simulation tutorial to review cellular neurobiology and provide a background to interpret your laboratory data. I’ll assign exercises from this tutorial to go along with the lab topics. Since we are not using a traditional textbook, material from other texts will also be useful as background for your lab reports. We assume that you have already had a course, like BIONB 2220, that introduced you to basic cellular neuroscience concepts. Texts for courses like 2220 also contain much of the necessary background material for 4910. We expect you to demonstrate your understanding of the concepts applicable to this course in your lab reports, midterm and final papers, and in classroom and lab discussions.
Grading: Your final grade will be determined from a combination of the following categories with their respective weights.

A.  35% - Lab Reports.

Your lab reports will be written as brief scientific papers, and will include all the usual sections of a scientific paper (see Writing.pdf and LabReportChecklist.pdf in the “scientific presentations” folder on the course web site). The emphasis for these assignments should be on the Results presentation and their interpretation. Only a brief Introduction is necessary, you will paraphrase the Methods from the lab manual’s directions, and the Discussion will be focused on the questions posed in the lab manual at the end of each exercise. The lab reports are your main opportunity to show us that you understand the course material. You’ll work in groups of 2 or 3, and turn in the lab reports as co-authored papers, alternating as the first author. Being first author means that YOU are responsible for writing the paper and turning it in. We expect other authors to be active at all stages of the data analysis and paper writing; all group members will receive the same lab report grade.

By the Thursday morning of the week after the end of a completed lab exercise, the first author will submit the Results section on Blackboard and to their lab partner(s). This will be reviewed and returned by the next day. Completed lab reports will be due the following Monday, giving you the weekend to make suggested corrections on the Results and to finish the report. **We expect each group’s lab reports to improve in quality as the semester progresses.** We’re looking for clear and brief presentation of a lab topic’s background (Introduction), Methods, Results, and their meaning (Discussion), in the standard scientific format. Include an abstract of the report on the first page and a bibliography in the style of the Journal of Neuroscience. Even if you were not the first author, pay attention to the corrections suggested for all graded lab reports. We are looking for improvement in a lab group’s reports; the reports will be graded more critically as the semester progresses. The instructors take turns grading the lab reports, so address questions or comments to the specific grader.

Our grading emphasis is on your presentation and interpretation of data, not necessarily on the amount of data you gathered for a lab exercise. All the exercises usually work to varying degrees for everyone. You can supplement your lab report by borrowing data from another lab group, as long as it’s acknowledged. We encourage you to discuss your ideas and reports with other students and the instructors as you analyze your data and write the report. We will suggest references especially pertinent to your lab report and post them on the course web site.

B. 15% - Problem Sets and Other Assignments.

Through the semester we’ll ask you to complete a variety of problem sets and other assignments. These exercises are designed to help you gain more insight into course topics and to stimulate your critical thinking. These will include the simulation exercises mentioned above, and short “inquiry” questions for lecture discussion.
C. 20% - Midterm Paper.
Each of you will choose one, or a substantial part of one lab exercise, that you complete before the middle of the term and write it up as a single author scientific paper. We expect this paper to be more detailed than your lab reports, with a more descriptive but focused 
Introduction, and an extended Discussion of your results that is not strictly based on the lab report questions you answered. Don’t make the mistake of simply rehashing a lab report. See Midterm&FinalPaperChkList.pdf in the “scientific presentations” folder on the course web site. This assignment will be due around Spring Break. You may submit a rough draft to us for critique up to three days before the paper is due. It will be treated like our own work, in that we circulate our papers to colleagues for their constructive criticism before we send it for publication. The more refined the draft, the more detailed our constructive criticisms can be.

D. 30% - Final Paper (25%) and Class Presentation (5%).
At the end of the semester, you’ll have two laboratory sessions to complete experiments that you design with your lab partner(s). We suggest you pick one of the lab exercises that you especially liked, using techniques you feel comfortable with, and design experiments to explore the topic more deeply. Instead of a final exam, you will write a scientific paper based on the results of your special project. These final papers will be single authored and due at the University’s scheduled time for the 4910 final exam. See Midterm&FinalPaperChkList.pdf in the “scientific presentations” folder on the course web site. Again, you may submit a rough draft to us for a critique up to three days before the final exam time. Remember, the more refined the draft, the more detailed our constructive criticisms can be. During this University-scheduled final exam period, each lab group will give a presentation (refreshments provided!) of their final project results to the entire class. The class presentation will be graded separately from the final paper.

In summary, you’ll share the grade earned for the lab reports. You’ll earn individual grades for most problem sets and other assignments, the midterm and the final paper. When an assignment is late, variable points will be deducted, depending on the type of assignment, its tardiness, and the circumstances. When a co-authored lab report is late, points are usually deducted only from the first author’s grade. You can earn extra credit for your final course grade by helping the instructors lead recording workshops for students in a biomedical engineering classes the third week in February. This is a chance to demonstrate your depth of understanding of the course material and techniques as you teach them to someone else. Your participation in class discussion will also be acknowledged as extra credit for your final course grade. These extra credit points will be especially helpful to boost your final grade if it is on the border between two grade categories (B+ to A- for example).

Academic Integrity: We expect our students to uphold the highest standards of academic integrity in their own work, and to refuse to tolerate violations of academic integrity by others. The University’s Code of Academic Integrity can be reviewed at: http://cuinfo.cornell.edu/Academic/AIC.html.
What do I need to do to make an A in this class?

Based on past experience and student input, the following list describes student knowledge and skills as they relate to a final grade of “A” in BioNB/BME/ECE 4910.

In general, "A" students show a scientific curiosity about physiological processes and the techniques designed to explore them. They demonstrate through the semester that they understand the concepts of signal transmission in the nervous system and the neurophysiological techniques used to study the physiology of neurons. They consistently attend lectures and turn in lab reports, midterm and final papers, and simulation assignments on time. They are willing to take chances to ask and answer questions posed in lecture class (and sometimes be wrong), and contribute activity to class discussions. They participate in extra credit activities, like helping teach a BME lab class during the semester. Questions posed in simulation assignments are answered fully enough and with appropriate screen captures to convince the grader that the student knows what they are talking about. “A” students come to lab sessions familiar with the lab exercise protocol and its goals, and are consistently engaged with and focused on lab work. Time permitting, they will perform additional experiments such as those suggested in the “Further Explorations” section of each lab exercise. Their student class presentations are well organized and thoughtful. They turn in drafts of their midterm and final papers for pre-grading. An “A” student who does not already have a strong background in neurobiology or experience in scientific paper writing at the beginning of the semester shows significant progress during the semester in their knowledge and scientific writing abilities. Their lab reports and other papers demonstrate that they understand the structure of a scientific paper including the importance of proper citations to acknowledge previous work.

"B" students weakly demonstrate many of the qualities listed above for an “A” student. They miss lectures, do exactly what’s asked of them in the lab class and not more, even if they finish early. In lecture, they are usually quiet, and sometimes not paying attention. They often do not turn in papers for pre-grading, and may not show significant progress in their lab report writing or understanding of cellular/systems neuroscience.

It is very rare to earn a grade below a “B” in 4910 (but don’t push your luck!).