Syllabus for BIOEN 6440 Neural Engineering

BIOEN 6440 Neural Engineering
3 credit hours

Meeting Time
M/W 1:25pm to 2:45pm

Primary Instructor
Christopher R. Butson PhD
WEB 3686
Office hours during lab sessions or by appointment
801-587-3711
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Teaching Assistant
Jacob George
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Location

- The regular class location is LNCO 2850
  - LNCO location on the U campus map (Links to an external site.)
  - Room 2850 location in LNCO
  - Note that in this map the building is rotated 90 degrees relative to the campus map (north is up in the campus map, west is up in the LNCO map)
- COMSOL labs will be held in the Engman Lab, WEB L210
- Some lectures will be held in the conference room on the 3rd floor of the Clinical Neurosciences Center (CNC) (Links to an external site.). These will be announced ahead of time.

Course Description
This course will cover tools and applications in the field of Neural Engineering, which is an interdisciplinary field that overlaps with many other areas including neuroanatomy, neurophysiology/electrophysiology, electrochemistry, bioelectric field theory, biomedical instrumentation, circuit theory, computational neuroscience, medical devices, neurology, neurosurgery, clinical trials, biomaterials and cellular neuroscience. This course is designed around the central idea that neural engineering is the study of transferring electromagnetic energy into and out of the nervous system. With this framework, the course is divided into three broad segments: neurostimulation, neurorecording and closed-loop neuromodulation. Tools and techniques covered in the course will include: strength-duration curves, safety analysis, optogenetics, cyclic voltammetry, bioelectric field modeling. Applications covered in the course will include deep brain stimulation (DBS), spinal cord stimulation (SCS), cortical stimulation (CS), transcranial direct current stimulation (TDCS), micro electrode recording, cortical mapping, electrode arrays, closed loop neuromodulation.
Teaching & Learning Methods

- The course will consist of about 75% lectures/discussions and 25% in-class labs (about every 4th class session).
- During lectures we will review material to supplement understanding and we will perform in-class exercises, simulations and labs.
- Each class ends with an exercise to identify the most important issues and what experiments we might do if we could.
- **Attending course lectures is not a passive exercise. You need to be ready to work when you come to class!**

Readings
Journal articles and online textbook chapters will be assigned for most classes
Reading assignments will be posted on Canvas

Grading & Evaluation Methods
Overall, you will be graded on critical thinking and communication. These will be assessed in the following categories:

- **Homework: 25%**
  - A homework assignment will accompany each reading assignment, and will be posted about a week in advance via Canvas.
  - *Homework assignments are due by 8pm the evening prior to class.* The reason for this is because I (and guest lecturers) review your submissions when preparing class material for the next day.
  - In the homework, you will provide a brief (1 page maximum) summary of each reading assignment.

- **Lab Reports: 20%**
  - Lab reports will be written based on data collected during in-class labs. There is not a prescribed format for lab reports, but these should be written as mini-manuscripts that include the following sections: Introduction, Methods, Results, Discussion.

- **Class Participation and In-Class Presentations: 15%**
  - Class participation: includes attendance and engagement during in-class discussions.
  - In-Class Presentations: For each lecture I will ask a few students to each present a figure or idea from the homework reading assignment. I will make assignments during the lecture beforehand, and we will rotate through the class roster so that everyone presents at least once during the semester. In these presentations you will be asked to give a brief (2-3 minute) description of the figure or idea that has been assigned to you. Describe the figure in your own words and explain what information is being conveyed. Point out the key insights you learned from the figure and aspects (if any) that you found confusing.
• Take-home exams (2): 25%
  ○ Two take-home exams will be assigned instead of reading/homework. The exams are a combination of short answer and essays.
• Final Project: 15%
  ○ Each student will conduct a semester-long project on a neural engineering subject of their choice. The components of the project include (but are not limited to): history, safety, description of the neural interface, acute/chronic performance, theoretical analysis, clinical applications, mechanisms (if any) and how technique might be clinically evaluated. The project will be evaluated based on the final written report and in-class presentation.

Late Submission of Homework or Lab Reports
Two late submissions are permitted during the semester, no explanation is necessary. Additional late submissions will result in a lowered grade for that assignment. Assignments that are more than two weeks late will not be accepted.

Lecture Materials
• Lecture notes will be posted on the course home page in Canvas after each class.
• Most lecture materials will be provided as Evernote notes (https://evernote.com) that are available via a web browser. I chose Evernote because of the flexibility it provides for expressing ideas, and how gracefully it handles almost all types of multimedia.
  ○ You do not need an Evernote account to access the lecture materials.
  ○ If you are an Evernote user then you can save the material to your own account.
  ○ If you are not an Evernote user then you can print the content to a PDF file.

Plagiarism
• From the University of Utah Student Code (http://regulations.utah.edu/academics/6-400.php):
  ○ “Plagiarism” means the intentional unacknowledged use or incorporation of any other person’s work in, or as a basis for, one’s own work offered for academic consideration or credit or for public presentation. Plagiarism includes, but is not limited to, representing as one’s own, without attribution, any other individual’s words, phrasing, ideas, sequence of ideas, information or any other mode or content of expression.
• All submissions are checked for plagiarism using a detection tool.
• It is ok to work in pairs or small teams.
• It is ok to help your classmates learn new skills and concepts.
• It is ok to quote published work from others if it is appropriately referenced. When I ask for a citation, I mean one of the form you might find in the References section of a journal article. For example: Zhou, N., and Pfingst, B.E., 2014, “Effects of site-specific level adjustments on speech recognition with cochlear implants,” Ear Hear, 35(1), pp. 30-40.
• **However, you must do your own work. This includes all writing, figures and reports.**

**Attendance**

• "The University expects regular attendance at all class meetings. Instructors must communicate any particular attendance requirements of the course to students in writing on or before the first class meeting. Students are responsible for acquainting themselves with and satisfying the entire range of academic objectives and requirements as defined by the instructor." PPM, Policy 6-100III-O
• I will periodically record class attendance and this will be incorporated into your class participation grade.

**The Americans with Disabilities Act**
The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 801-581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

**Addressing Sexual Misconduct**
Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677 (COPS).

**Student Names & Personal Pronouns**
Class rosters are provided to the instructor with the student’s legal name as well as “Preferred first name” (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your UID card, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

**College of Engineering Guidelines**
Make sure you are familiar with the College of Engineering guidelines which contain important dates regarding adding, dropping and withdrawing from classes as well as the College Policy regarding repeating courses: https://www.coe.utah.edu/wp-content/uploads/pdf/faculty/semester_guidelines.pdf.