BME 6350 Introduction to Neurotechnology
Fall 2023

Class time: Tuesday and Thursday, 1:25 – 2:40 pm
In-person, Phillips Hall 407

Office hours: Tuesday, 3 – 4 pm
Wednesday, 3 – 4 pm
In-person, 111 Weill Hall
(Based on poll at start of semester; mandatory attendance – see below*)

Instructor: Alex Kwan <alex.kwan@cornell.edu>
Associate Professor

Credit hours: 3 credit hours. Student option: Letter grade or S/U

BME 6350 includes engagement of 2,250 minutes in the semester, including 26x 75-minute class time (subtotal 1,950 minutes) and *300 minutes of office discussion during the semester. Students are expected to spend 6 hours per week on this course outside of scheduled meetings.

Pre-requisites: None

Required text: None

Course website: Course schedule and slides will be posted on Canvas.

Course description: This course provides a survey of the latest technologies for recording and controlling brain activity. The class has three parts. Part I consists of lectures to introduce the relevant concepts in neurobiology. Part II, in seminar format, discusses approaches to read out neural signals, such as large-scale electrophysiology and optical imaging. Part III, in seminar format, focuses on approaches to modify neural dynamics, including electrical, optical, and viral strategies. Emphases will be placed on how the technologies may be integrated into brain machine interfaces, and what promise they have for treating brain disorders. The course assumes no background in neuroscience. It is intended for engineers who want to know more about neural engineering and neurobiologists who are interested in the latest methods.

Learning objectives: To grasp the breadth of latest approaches to engineer the brain with emphases on the strengths and limitations of each method that inform their promise for science and commercialization.

Learning outcomes:

- Design strategies to characterize and drive brain activity at different spatial and temporal scales

- Compare recording and stimulation approaches given their strengths and limitations
- Explain the biological underpinnings behind the major methods in neurotechnology
- Execute a project to evaluate the use of neurotechnology for treating brain dysfunctions

Seminar + discussion:
At the beginning of the semester, students are scheduled as individuals or in teams to lead the "seminar + discussion" classes.

Before each class, leaders are expected to read the assigned paper, discuss with the instructor during office hour or at another mutually agreed time, and prepare a 40-minute slide presentation that draws from the paper and other relevant references. Everyone else in class is expected to have read the assigned paper.

During each class, for the seminar portion, leaders will present. The remainder of the class will be a round-table discussion of the topic, moderated by leaders and the instructor.

After the class, leaders will upload the slide presentation to Canvas.

Participation: Class attendance and engagement count towards in-class participation. Each student will be allowed two unexcused absences (on days other than their assigned presentation day) that will not affect their grade. If a student must be absent on the date of their assigned presentation, they are expected to switch presentation dates with another class member.

Problem set: There is one problem set – due at 5 pm on Canvas on the date indicated on schedule. For late submissions, there will be a 25% deduction of points for each extra day. Re-grade requests must be made within one week after the assignment is returned. You may work together on the problem set but please write your own code and answers to questions.

Final project: For the final project, the student will propose and motivate a neurotechnology solution for an unmet need in medicine or basic science. The student will describe this proposal in a 3-page report and prepare a 20-minute slide presentation.

Grading rubric:
20% Seminar + discussion (on weeks leading)
10% In-class participation
20% Problem set
20% Final essay
30% Final presentation

Grading scale:

A+ (96.7 – 100%)	A (93.3 – 96.7%)	A- (90 – 93.3%)
B+ (86.7 – 90%)	B (83.3 – 86.7%)	B- (80 – 83.3%)
C+ (76.7 – 80%)	C (73.3 – 76.7%)	C- (70 – 73.3%)

D+ (66.7 – 70%) D (63.3 – 66.7%) D- (60 – 63.3%)
F (<60%)

Scores will be tallied based on the grading rubric, may be curved, and convert to a letter grade at the end of the semester.

Academic integrity:
While you are encouraged to discuss content of the class with your peers, you must use your own words for any written assignments, problem sets, and exams. Do not copy or paraphrase from any source, either sources provided in the class or ones you find on your own. You should read the papers, listen to the lectures, and develop your own understanding of the material. You may discuss the questions with other people, but then answer the questions by describing your own understanding in your own words. You must adhere to Cornell University's Code of Academic Integrity. Violations of the Code of Academic Integrity will result in a 0 grade for all parties involved for the assignment or exam, and be referred to the Academic Integrity Hearing Board of the College of Engineering.

Inclusiveness in the Classroom:
Cornell is committed to creating an inclusive environment, see https://diversity.cornell.edu/. As your instructor, I will strive to create a classroom space where differences are respected and valued. Every student in the class is encouraged to speak up and participate in class discussions. At the same time, you are expected to demonstrate diligence in understanding how your peers' perspectives and worldviews may be different from your own.