EEC 244 – Introduction to Neuroengineering

CRN: 45612
4 units (A/F Letter Graded)

Tuesday 1:10pm-3:00pm (Lecture)
Thursday 1:10pm-2:00pm (Discussion/Office Hour)
Winter Quarter 2023

Objective: Neuroengineering is emerging as the field where engineering, medicine and neuroscience come together to produce innovative research and impactful solutions that address the broad range of pathologies of the central and peripheral nervous system. The unifying objective of this team-taught interdisciplinary course is to introduce students to the key research areas and tools in neuroengineering, and employ NIH-style proposal writing exercises to integrate course content into potential projects.

Class Time: 1:10pm-3:00pm Tuesday (Lecture) and 1:10pm-2:00pm Thursday (Discussion) weekly

Class Location: 108 Hoagland

Prerequisite: Graduate Standing (or instructor approval)

Instructor(s): Profs. Erkin Seker (ECE; Instructor of Record), Mitchell Sutter (NPB), Jochen Ditterich (NPB), Weijian Yang (ECE), Christina Kim (Neurology), Audrey Fan (Neurology), Zhaodan Kong (MAE), Lee Miller (NPB), Jonathon Schofield (MAE), Sergey Stavisky (Neurosurgery), Wil Joiner (Neurology), Carolynn Patten (Phys Med & Rehab), Mark Fedyk (Neuroethics)

Office Hours: The discussion session will generally be used as an office hour. Please contact Prof. Seker for course administration-related questions and contact each instructor for questions specific to their lectures and assignments.

Grading: Letter; final grade will be based on homework assignments (45%), a final project report (40%), recorded presentations (10%), and ethics discussion (5%).

Homework: There will be homework for each module, which will be assigned approximately a week before they are due.

Proposal Development: Students will be asked to write a mini proposal for a project (e.g., device, technology, computation) that addresses a neuroscience or neurobiology question, or clinical need. The proposal will use a National Institutes of Health proposal structure or National Science Foundation Graduate Research fellowship structure and will be formatted to serve as a foundation for pre-doctoral fellowship applications, thereby training students on essential proposal writing skills. The proposal development will be broken into individual assignments and will occur throughout the course. Students are encouraged to get input from their mentors on this and to discuss with fellow graduate students. The proposals will be reviewed by the instructor as well as the peers. The students will then write a rebuttal in response to the reviewer comments and revise the proposal accordingly as the final proposal.

Presentations: Students will be asked to present their proposal following a structure that includes (Significance, Innovation, Approach, and Ethical Considerations). These elevator-pitch-style presentations will be pre-recorded for peer review outside the class.

Attendance & Late Submission Policy: Assignment submissions (including homework, proposal, peer-reviews) will be done electronically on Canvas. Assignments submitted after deadline up to 24

hours will have 20% deducted; between 24 hours and 48 will have an additional 20% deducted. Any submission later than 48 hours will not be accepted.

Textbooks: Relevant reading material and exercises will be provided by the instructor.

COVID-Related: Please follow all campus requirements (i.e., vaccination, testing, daily symptom survey, face coverage indoors) for all students and instructor's safety.
https://campusready.ucdavis.edu/

Academic Integrity: Cheating and plagiarism will absolutely not be tolerated. Professional integrity is an important aspect of all engineering disciplines and understanding the material in these courses is integral to becoming a proficient and productive engineer. As such, it is imperative that you spend the time and effort to fully understand the material, and seek help when necessary. Please read the UC Davis "Code of Academic Conduct" at participate.ucdavis.edu .

Approximate Course Content, Timeline, and Instructors

Introductory Lectures
- WEEK 1 (Jan 10): Course overview, proposal structure, ungraded concept survey (**Seker**)
- WEEK 2 (Jan 17): Survey of the nervous system and relevant models (**Sutter**)

Neuroscience and Computational Tools Lectures
- WEEK 3 (Jan 24): Monitoring and modulating brain activity via electrical means (**Ditterich, Fan**)
- WEEK 4 (Jan 31): Monitoring and modulating brain activity via optical means (**Yang, Kim**)
- WEEK 5 (Feb 7): Micro-/nano-technology for engineering neural interfaces (**Seker**)
- WEEK 6 (Feb 14): Computational tools and control systems (**Kong, Ditterich**)

Prosthetics and Human-Machine Interface
- WEEK 7 (Feb 21): Brain-machine interfaces, restoring neural function (**Stavisky, Schofield**)
- WEEK 8 (Feb 28): Cochlear implants, speech restoration (**Miller, Stavisky**)

Human Performance and Rehabilitation
- WEEK 9 (Mar 7): Sensorimotor integration in visual perception and rehabilitation (**Joiner, Patten**)
- WEEK 10 (Mar 14): Translational neuroscience (**Patten**)

Neuroethics
Ethics discussions and assignments will be distributed throughout the course. (**Fedyk**)