EEC 289L – Introduction to Neuroengineering

2* units (A/F Letter Graded) [*change to 4 units under consideration]
Tuesday 1:10pm-3:00pm - Winter Quarter 2022
CRN: 45339

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 a potential projects.

Class Times/Location: 1:10pm-3:00pm Tuesday every week (Location TBA)

Prerequisite: Graduate Standing (or instructor approval)

Instructor(s): Profs. Erkin Seker (ECE; Instructor of Record), Mitch Sutter (NPB), Jochen Ditterich (NPB), Weijian Yang (ECE), Lin Tian (Biochemistry), Audrey Fan (BME), Zhaodan Kong (MAE), Sanjay Joshi (MAE), Jonathon Schofield (MAE), Karen Moxon (BME) Wil Joiner (Neurology), Carolynn Patten (Phys Med & Rehab)

Office Hours: No scheduled office hours will be held. 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 (50%), a final project report (30%), recorded presentations (15%), 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 NSF GRFP 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 5 minute-long 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.

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

1. Course overview, proposal structure, ungraded concept quiz (**Seker**)
2. The role of models to study the nervous system – from single cells to systems level (**Sutter**)

Neuroscience and Computational Tools Lectures

3. Monitoring and modulating brain activity via electrical means (**Ditterich, Fan**)
4. Monitoring and modulating brain activity via optical means (**Yang, Tian**)
5. Micro-/nano-technology for neural devices (**Seker**)
6. Computational tools and control system (**Kong, Ditterich**)

Prosthetics and Human Machine Interface

7. Repairing, restore and enhancing neural function (**Joshi, Schofield**)
8. Brain-machine interface (**Moxon**)

Human Performance and Rehabilitation

9. Sensorimotor integration in visual perception, motor learning and rehabilitation (**Joiner, Patten**)

Cognitive Neuroengineering

10. Cognitive neuroengineering (**Ditterich, Moxon**)

Neuroethics

Ethics discussions and assignments will be given throughout the course.