Course Title: EE599 Introduction to Bioelectricity and Biomimetic Electronics

Course Meeting Times
Lectures: 3:30pm-4:50pm MW
Office Hours: 2 session/week, 80 min/session

Course Objectives
The first half of this graduate course introduces students to the fundamentals of bioelectricity. We will discuss the basic circuit theory that has been develop to model the human nervous systems. The bioelectrical systems bear close similarity to silicon semiconductor circuits. The second half of the course will discuss the cutting-edge innovations in solid-state electronics inspired by bioelectrical systems and the emerging field of neuromorphic computation.

Grading Scale
5% participation
10% homework
10% project presentation
30% mid-term
45% final

Course Schedule
The schedule of the course is as follows:
Week 1: Introduction to the nervous system
Week 2: Basic Organization of CNS & PNS, and Simple neural circuits
Week 3: Electrical signals in cells
Week 4: Ion channels and Post-synaptic receptors
Week 5: Neurotransmitters
Week 6: Models of biological conductors
Week 7: The Hodgkin-Huxley model
Week 8: Applications of bioelectricity
Week 9: Numerical methods of solving differential equations
Week 9: Mid-Term Exam
Week 10: Memristor Basics
Week 11: Bio-inspired: Emulating synaptic behavior with electronic devices
Week 12: Bio-inspired: Emulating neurons behavior with electronic devices
Week 13: Artificial neural network
Week 14: Class presentation by students
Week 15: Final review

Prerequisites
The course requires knowledge in basic circuit theory to understand the principles of resistors, capacitors and inductor based circuits. It will also make use of the basic mathematical tools such as differential equations. It will be useful if the students also have a basic understanding of semiconductor devices such as operation of transistors, but is not required.
Lectures

Lectures will be held twice a week for 80 minutes each. The students are responsible for material presented in lectures, including oral comments made by the lecturer.

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism—presenting someone else’s ideas as your own, either verbatim or recast in your own words—is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in Scampus in Section 11, Behavior Violating University Standards https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/. Other forms of academic dishonesty are equally unacceptable. See additional information in Scampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu/ or to the Department of Public Safety http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community—such as a friend, classmate, advisor, or faculty member—can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information http://emergency.usc.edu/ will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.