

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 developed 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/departments/departments-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.