

**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

**Week 16:** Final exam

**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](mailto: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](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.