

BIOENGINEERING 2009-10



UNIVERSITY OF CALIFORNIA, SANTA CRUZ

THE BIOENGINEERING MAJOR

The B.S. degree program in bioengineering provides students with fundamental knowledge of mathematics, science, and technology. Students also gain advanced training in engineering principles and practice at the molecular, cellular, and organismal levels. Graduates will be prepared to work as engineers solving problems in the biomedical and biomolecular domains and to pursue advanced degrees in engineering, medicine, or science.

STUDY AND RESEARCH OPPORTUNITIES

- ◆ Interdisciplinary B.S. program offered by the Departments of Biomolecular Engineering, Computer Engineering, Electrical Engineering, and Molecular, Cell & Developmental Biology, and including over 30 faculty from 10 departments
- ◆ Three concentrations: biomolecular, bioelectronics, and rehabilitation
- ◆ Research foci include biomolecular sensors and systems, assistive technologies for the elderly and disabled, bioinformatics, bioelectronics, protein design and drug development, and other areas at the junction between engineering, medicine, and science.
- ◆ Summer and academic year research in faculty labs and through the SURF-IT program (surf-it.soe.ucsc.edu)

PROGRAM OBJECTIVE

The UC Santa Cruz B.S. in Bioengineering program prepares graduates for a rewarding career at the interfaces between engineering, medicine, and biology. UCSC Bioengineering graduates will have a thorough grounding in the principles and practices of bioengineering and the scientific and mathematical principles upon which they are built; they will be prepared for further education (both formal and informal) and for productive employment in industry.

The bioengineering major has three concentrations: biomolecular, for students interested in drug design or the use of biological molecules in nanotechnology applications, bioelectronics, for students interested in the interfaces between electronics and biology, and rehabilitation, for students interested in designing hardware and software to help individuals with special needs.

ADMISSION TO THE JACK BASKIN SCHOOL OF ENGINEERING (BSOE)

Freshman Applicants: Admission into a BSOE major is based on high school grade point average, test scores, courses completed in mathematics and sciences, and the personal statement. Applicants who are not accepted into the major may apply for admission to the major after coming to UC Santa Cruz. Admission to the major as a UCSC student is based on grades in courses from engineering and the physical and biological sciences and the completion of lower-division requirements.

Transfer Applicants: For transfer students, admission into the major is based on academic college record. Applicants are expected to take and excel in all courses that are equivalent to the department's lower-division requirements (see *Transfer Preparation* section).

Please see the current *UC Santa Cruz General Catalog* for a full description of the BSOE admissions policy or visit ugrad.soe.ucsc.edu/admissions.

HIGH SCHOOL PREPARATION

High school students intending to apply to the bioengineering major should have completed at least four years of mathematics (through advanced algebra and trigonometry, and ideally including calculus) and three years of science, including one year each of chemistry, biology, and physics. Comparable college mathematics and science courses completed at other institutions may be accepted in place of high school preparation. Students without this preparation may be required to take additional courses to prepare themselves for the program. Students who are not well prepared to take calculus in their first quarter are strongly advised to take precalculus at a local community college the summer before coming to UCSC.

TRANSFER PREPARATION

The prerequisite structure for upper-division courses at UC Santa Cruz requires that many courses be taken sequentially. Because of this, it is necessary for prospective transfer students to have completed as many of the lower-division required courses as possible before transferring.

Transfer students **should not** follow the Intersegmental General Education Transfer Curriculum (IGETC) because it will not provide enough mathematics and science courses to allow them to complete the bioengineering program in two years. Most students find it easier to spread the general education requirements out over four years.

Transfer admission will be based on GPA and the level of completion of lower-division requirements. Most importantly, transfer students should have completed articulated calculus and differential equations, as well as at least three of the four other introductory areas (biology, chemistry, physics, and computing). Students may satisfy the bioethics requirement if they have completed a suitable ethics course at their community college.

Lower-division requirements in bioengineering are:

Mathematics:

- Mathematics 19A and 19B, *Calculus for Science, Engineering, and Mathematics* (two quarters); Mathematics 23A, *Multivariable Calculus*
- Applied Mathematics and Statistics 7/L, *Statistical Methods for the Biological and Environmental Sciences with Laboratory*
- Applied Mathematics and Statistics 27/L, *Mathematical Methods for Engineers with Laboratory* or Mathematics 21, *Linear Algebra*, and Mathematics 24, *Ordinary Differential Equations*; or Applied Mathematics and Statistics 10, *Mathematical Methods for Engineers I*/Applied Mathematics and Statistics 20, *Mathematical Methods for Engineers II*

Science:

- Chemistry 1A, 1B/M, and 1C/N, *General Chemistry with Laboratory*
- Biology 20A, *Cell and Molecular Biology*, and 20B, *Development and Physiology*
- Physics 5A/L and C/N, *Introduction to Physics*

Computing:

- Biomolecular Engineering 60, *Programming for Biologists and Biochemists*, or Computer Science 12A/L, *Introduction to Programming*; or Computer Science 12B/M, *Introduction to Data Structures* or Computer Engineering 12/L, *Computer Systems and Assembly Language*
- Computer Engineering 9, *Introduction to Statics, Dynamics, and Biomechanics*

Lower-division articulation is listed on the ASSIST web site (www.assist.org). For a complete list of lower-division courses for the major, visit beng.soe.ucsc.edu/program-description.

A SAMPLING OF RESEARCH

Baskin Department Chair of Biomolecular Engineering Phillip Berman is a pioneer in the development of recombinant vaccines for AIDS and other infectious diseases. He recently joined UCSC after 25 years of experience in the biotechnology industry, bringing with him a knowledge of what employers are looking for in new graduates, shared with students in his new undergraduate course on drug development.

Sri Kurniawan mentors engineering and psychology students in assistive technology research. Her focus is on the design and evaluation of interactive systems that help people with special needs, including older persons, people with disabilities, and children. She joins professor Roberto Manduchi, who designs computer and cell-phone-based systems to assist the blind, and teaches an innovative course in universal access and disability. Jacob Rosen, who joined our campus in fall 2008, designs robotic systems for bioengineering, including rehabilitation and remote surgery.

Kevin Karplus is applying his knowledge of protein structure prediction to the problem of protein engineering. Collaborating with several research groups, he is working to design proteins that can sort carbon nanotubes according to their properties. Professor Karplus is a recent recipient of a campus teaching award and chair of the education committee of the International Society for Computational Biology, the lead professional society in bioinformatics.

Professor David Haussler has developed one of the world's premier tools for comparative genomics, the UCSC Genome Browser (genome.ucsc.edu). Using this tool, researchers around the world can better understand human genetics and disease through comprehensive analysis of multiple genomes. Professor Haussler was recently elected to the National Academy of Sciences, in part due to his outstanding contributions to the Human Genome Project.

UNDERGRADUATE RESEARCH OPPORTUNITIES

More information about bioengineering research and undergraduate research opportunities can be found on the web at www.cbse.ucsc.edu, biomedical.ucsc.edu, marcmbrs.ucsc.edu, surf-it.soe.ucsc.edu, and graddiv.ucsc.edu/ucleads.

EDUCATION ABROAD OPPORTUNITIES

BSOE students may wish to develop their cross cultural competency, typically via the Education Abroad Program (EAP). Interested students must work very closely with the faculty and academic advisers in their major very early during the first or second year to create a plan for transferability of course work toward graduation. For more EAP information, visit eap.ucop.edu/our_programs/countries.

FOR MORE INFORMATION

The bioengineering page of the BSOE web site can be found at:

beng.soe.ucsc.edu

If you have other questions, contact:
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