Biological Engineering, BS, APE

Department: Biological Engineering Department
College: College of Engineering

Overview

About This Degree

Biological engineering is an emerging discipline that combines science and engineering principles. The program at USU provides students with fundamental engineering knowledge and problem-solving skills that can be applied to a variety of fields, including medicine, law, food, the environment, and more.

USU's biological engineering program is research intensive and focuses on the application of research to solve current problems. Students are introduced to the scope of projects through an introductory research class required of all incoming freshmen. In the class, students meet faculty, learn about their research projects, and have opportunities to get involved with lab work if they haven't already.

Building on these research experiences, students begin to focus on an interest area as they near their senior year. It is not uncommon for students to present their research at national conferences, publish in peer-reviewed journals, and even apply for patents.

The biological engineering degree is accredited by the Engineering Accreditation Commission of ABET. It has a first-time pass rate of nearly 100% on the mandatory Fundamentals of Engineering examination (usually taken during a student's junior year), while the national pass rate is close to 50%. Additionally, the job placement rate for students graduating from USU's engineering programs is extremely high.

Students may study in the following areas:

- **Biomedical Engineering:** Biomedical engineering is the application of engineering principles and techniques to the medical field. Biomedical engineers may be involved with developing pharmaceuticals, biomaterials with antimicrobial properties, artificial organs or working with prostheses, instrumentation, health care delivery systems, etc. This field is expected to be the fastest growing occupation through 2020, according to the U.S. Bureau of Labor Statistics.
- **Bioprocess Engineering:** Bioprocess engineers design and develop specialized bioreactors and thermochemical reactors for biomass, equipment, and processes for manufacturing products made of biological materials, including biofuels.
- **Synthetic Biological Engineering:** Synthetic biological engineering is a new area of research focused on the design and construction of new biological parts and devices utilizing genetic BioBricks to develop new useful functions and systems not found in nature. Examples include engineering the microbial synthesis and secretion of bioplastics and biofuels.
- **Metabolic Engineering:** Metabolic engineering is the practice of optimizing genetic and regulatory processes within cells to increase the cells' production of a certain substance. Producing beer, wine, cheese, pharmaceuticals, and other biotechnology products often involves metabolic engineering.
- **Tissue Engineering:** Tissue engineering is closely associated with applications that repair or replace portions of or whole tissues and also includes the effects of environmental and industrial chemicals on human tissues that lead to illnesses, including cancer.
- **Biosensing:** Biosensing is the use of nanoscale or microscale biological sensors, which are used to measure environmental chemicals in water, air, and soil, or monitor the operation and performance of bioreactors.
- **Biomaterials Engineering:** Biomaterials engineering encompasses elements of medicine, biology, chemistry, tissue engineering, and materials science to develop biomedical devices that perform, augment, or replace a natural function.
- **Synthetic Biophotonics:** Biphotonics is a combination of biology and photonics (the science and technology of generation, manipulation, and detection of photons, quantum units of light). Applications of biophotonics include engineering photosynthetic systems to produce products, development of non-invasive methods to measure the physiological health of organisms, and design and testing light systems for communication among microorganisms, including instructions for producing specific bioproducts.
- **Bionanotechnolgy:** Bionanotechnology is a new area that focuses on biotechnology at the nano scale. Researchers develop processes that can be applied to various disciplines. Examples of current nanobiotechnological research involves developing particles that could be introduced into the human body to track down metabolities associated with tumors and other health problems, and the development of sensing devices for rapid diagnosis of impending heart attacks (myocardial infarction) from saliva.

Concurrent Bachelor's/Master's Program:

The department also offers a concurrent bachelor's/master's program, which allows USU engineering students to

begin taking graduate classes during their senior year as an undergraduate and to complete requirements for both the bachelor's degree and the master's degree concurrently over two years.

Career Options

With a degree in biological engineering, students may pursue careers in the following areas:

- Pharmaceuticals
- Biochemical Engineering (reactor design, performance, monitoring for bioproducts)
- Medical devices
- Food processing
- Disease research
- Environmental (water, wastewater treatment, bioplastics, biofuel)
- Biotechnology (diagnostics methods for diseases, cures, and environmental health)
- Graduates often go on to research-based graduate programs or attend professional schools (law, medicine, public health, dentistry, veterinary, business, etc.)

Career Services provides counseling and information on hundreds of job and internship opportunities and even helps students apply and interview.

What it takes

Admissions Requirements

In addition to Utah State University's admissions requirements, the biological engineering program has additional requirements:

- **Freshmen:** Students that meet the USU admission requirements can be admitted as pre-engineering majors. In order to get into the professional engineering program, students must complete two years of prerequisite coursework, have a C- or better in every required class, no more than three classes repeated, and entrance GPA of 2.3 or above.
- **Transfer Students:** Students transferring from other institutions will be referred to the Engineering Admission Committee for evaluation. Evaluations will include transfer GPA and evaluation of the program of the former college or university. Students transferring from other USU majors must be approved by the Engineering Admission Committee before transferring to the College of Engineering. Students in this category must have demonstrated a potential to succeed in engineering through courses taken at USU.
- Recommended high school courses: two or three years of algebra, one year of geometry, one-half year of trigonometry, four years of English, and courses in computer programming, chemistry, and physics are preferred.

International students have additional admissions requirements.

Major Requirements

Click here to see course requirements for the **Bachelor of Science**.

Click here to see course requirements for the **Associate of Science in Pre-Engineering**.

Students majoring in biological engineering have to complete a capstone design project their senior year. Students are able to customize their projects to fit with their research and academic interests. Projects may stem from work students are already engaged in with a professor. Projects change each year and range from production of pharmaceutical chemicals to biodiesel generation from algae to biosensor design for environmental or medical applications.

Passing the Fundamentals of Engineering examination, which is the first step in becoming a licensed professional engineer, is desired for graduation. USU engineering students have a first-time pass rate of nearly 100% on the FE, while the national average is close to 50%.

Contact

Advising

All new USU students participate in a New Student Orientation program, where they receive detailed information about major requirements, registering for classes, and other important advising information.

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Get Involved

Professional Organizations, Honor Societies, and Clubs

American Council of Engineering Companies: ACEC is the voice of America's engineering industry. Council members, numbering more than 5,300 firms throughout the country, are engaged in a wide range of engineering works that propel the nation's economy and enhance and safeguard America's quality of life. The council's mission is to contribute to America's prosperity and welfare by advancing the business interests of member firms.

American Society of Agricultural and Biological Engineers: The ASABE is an educational and scientific organization dedicated to the advancement of engineering applicable to agricultural, food, and biological systems. Founded in 1907 and headquartered in St Joseph, Michigan, ASABE comprises 9,000 members in more than 100 countries.

Engineers without Borders: The USU chapter of Engineers without Borders is a nonprofit organization. Contributions help the organization build projects that developing communities will own and operate. EWB works with communities worldwide to improve the quality of life by promoting sustainable development in water supply, housing construction, food production, energy, sanitation, transportation, communication, and employment. EWB's vision is a world where all people have the knowledge and resources needed to meet basic human needs. It involves international professionals and students in all fields as they build this vision together.

National Engineers Week Foundation: This foundation strives to be the global leader in cultivating and celebrating the engineering profession. Its cornerstone program is Engineers Week. All programs are designed to reach out to current and future generations of engineering talent.

Utah Engineers Council: The UEC is an umbrella organization of 14 different local chapters and sections of engineering societies. The purpose of the UEC is to advance the art and science of engineering and to provide a forum for communication between the varying engineering societies.

Biological Engineering Club: The Biological Engineering Club provides an opportunity for students to unite, network, meet professors, and learn about research opportunities and potential industry careers and internships. The club also strives to provide mentoring opportunities for entering students so that they can be successful in the program.

Engineering Student Council: The Engineering Council is an organization of engineering students. The council provides students with the opportunity to communicate opinions and suggestions to the College of Engineering administration, university administration, and the Associated Students of Utah State University. The Engineering Student Council represents students who are in the College of Engineering, communicates with engineering students about concerns, and publicizes programs and activities.

Future Association of Tomorrow's Engineers: FATE is the USU regional campus engineering club. It aims to promote and support engineering throughout the USU regional campus system via social networking, community outreach, recruitment, and fun (possibly geeky) activities.

National Society of Black Engineers Student Chapter: NSBE has more than 35,700 members and is one of the largest student-governed organizations in the country. Founded in 1975, NSBE now includes more than 450 colleges, pre-college, and technical professional/alumni chapters in the United States and abroad. NSBE's mission is to increase the number of culturally responsible black engineers who excel academically, succeed professionally, and positively impact the community. NSBE offers its members leadership training, professional development, mentoring opportunities, career placement services, and more.

Society of Hispanic Professional Engineers Student Chapter: SHPE is a national organization that aims to build unity through diversity of engineering students. The club holds fund-raising and service activities, participates in engineering-related campus-wide activities and competitions, and hosts activities with local middle and high school students aimed at science and technology. The national organization holds an annual conference, which is the major event and the largest technical and career conference for Hispanics in the country. The conference is an opportunity for engineering companies and corporations to recruit top talent from SHPE.

Society of Women Engineers: Utah State University's Society of Women Engineers is open for both male and female members. SWE is committed to encouraging women engineers to attain high levels of educational and professional

achievement, serve as a center of information for women in engineering, and promote the value of diversity.

Tau Beta Pi Honor Society: Tau Beta Pi is the only engineering honor society representing the entire engineering profession. It is the nation's second-oldest honor society. It marks, in a fitting manner, those who have conferred honor upon their alma mater by distinguished scholarship and exemplary character as students in engineering, or by their attainments as alumni in the field of engineering. There are now collegiate chapters at 236 U.S. colleges and universities, active alumnus chapters in 16 districts across the country, and a total initiated membership of more than 500,000.

Labs, Centers, Research

With the second oldest undergraduate research program in the nation, USU offers students a wide range of opportunities to gain hands-on research experience. The Undergraduate Research and Creative Opportunities program allows students to apply for grants and receive funding. USU's Honors Program prepares students for excellent graduate programs by helping them build relationships with professors, participate in research projects, take smaller, more intensive classes, and develop leadership skills.

Advanced Bioprocessing Laboratory: This laboratory focuses on the development of new bioprocessing technologies to enhance production and purification of biologically derived compounds.

Algae Test and Evaluation Pilot Facility: Research and testing conducted at the AT&E facility, located at the City of Logan Water Reclamation Plant, addresses algae-based engineered systems for water-quality improvement and production of biofuels for power that could fuel transportation vehicles, produce heat, and generate electricity for Logan city.

Biochemical Engineering Laboratory: Research conducted at this lab addresses chemical mass transport, biotransformation kinetics, and mechanisms and downstream processing related to microbial-based photoautotrophic and heterotrophic systems.

Biofuels Photobioreactor Laboratory: This facility includes a 1,000-square-foot biochemistry laboratory and an adjacent 1,000-square-foot engineering laboratory, as well as offices for 30 students and faculty.

Center for Advanced Nutrition: The CAN provides a multi-disciplinary venue for the discussion, discovery, and dissemination of information about the biological, physiological, and psychological mechanisms of proper nutrition. The scope of discovery is broad and falls into four distinct but overlapping focus areas: bioactive foods, nutrition and the brain, ingestive behavior, and personalized nutrition.

Center for Integrated BioSystems: The CIB leads a progressive, interdisciplinary effort in research, core services, and education serving agriculture and life sciences. The CIB is where the first hybrid animal, a mule, was cloned, and was named one of "30 Awesome College Labs" by Popular Science magazine. The CIB has a research program with several active projects in diverse areas of life science that encompass plant, animal, and microbe functional genomics.

Energy Laboratory: This lab seeks to develop solutions to America's most intractable energy problems through scientific and technological innovation. It provides a cohesive framework permitting faculty, students, and partnering institutions to focus on contemporary energy-related research issues.

Environmental Management Research Group: EMRG is a research unit of the Utah Water Research Laboratory focused on integrated watershed management and systems analysis of environmental problems. EMRG provides software development, watershed and water quality modeling, and GIS data analysis service to internal and external entities directed at solving integrated watershed and environmental management-related problems of a variety of scales.

Institute for Antiviral Research: The IAR is comprised of a recognized team of scientists representing a spectrum of disciplines, who are researching ways to control viral diseases. The IAR has been involved with the pre-clinical development of several FDA-approved drugs, including Tamiflu, which was recently used to combat H1N1. The main

areas of emphasis are respiratory diseases such as influenza and infections caused by emerging viruses, including West Nile virus.

Integrated Tissue Engineering Laboratory: Research focuses on 3D-engineered tissues in both static and dynamic environments for the study of tissue development, specific target diseases, and toxicity assessment.

Metabolic Engineering Laboratory: Research areas in this lab include the discovery and identification of bioactive natural products, biosynthetic mechanisms of pharmaceutically important compounds, characterization and development of biocatalysts for structural modification, as well as improvement of useful enzymes using protein-engineering approaches. Combinatorial biosynthesis of novel biologically significant compounds for drug discovery is also being investigated.

Molecular and Cellular Sensing and Imaging Laboratory: Research here focuses on the integration of state-of-the-art instrumentation methods and new chemo/bio-sensing technologies for biomolecular surface engineering applications.

Synthetic Biomanufacturing Center: SBC uses the chemical makeup present in single-cell organisms to transform raw materials into environmentally friendly products, such as low-cost bioplastics, biodiesel, light energy, and pharmaceuticals.

Synthetic Biophotonics Laboratory: Research here addresses the design, construction, testing, and simulation of natural and biosynthetic biophotonics systems using phototrophic and heterotrophic microorganisms.

Synthetic Engineering Laboratory: This lab focuses on cellular engineering, synthetic biological engineering, biosensors, and bioremediation. Recent projects include using synthetic biological engineering techniques to improve bioplastic production, developing molecular tools in mycobacteria to create biosensors for use in bioremediation, using natural products as antimicrobials, and monitoring microbial diversity of bioreactors using metagenomic approaches.

Utah Water Research Laboratory: The UWRL works on nearly 250 water-related projects a year and has projects in all of Utah’s 29 counties and more than 40 countries. The lab is one of the go-to places that addresses the technical and societal aspects of water-related issues, including quality, quantity, and distribution of water.