Biological Engineering, MS, PhD

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 department is research intensive and focuses on the application of research to solve current problems. Faculty members have expertise in the following broad areas: health and medicine, the environment, and renewable energy.

Research in the department ranges from developing biodiesel and bioplastics from algae to developing non-invasive bionanotechnologies that could help detect health problems before they progress to terminal diseases.

Faculty members in the department are nationally recognized. The department is even home to a USTAR professor. USTAR positions are funded by an initiative from the state of Utah aimed at bringing in the best researchers to address issues that solve current problems and can lead to economic development in the state.

Students may study in the following areas:

- **Bioenergy Engineering:** This focuses on the development and production of biofuels from algae and from other microorganisms, including bacteria and fungi. This area also includes thermochemical conversion of biomass into bio-oil.
- **Bioprocess Engineering:** Students in bioprocess engineering study bioreactor design, operation, monitoring, and control for industrial, medical, and environmental applications.
- **Bioproducts Engineering:** This involves the research, design, and development of microbe-based products, such as bioplastics, bioenergy chemicals, and health-related chemicals.
- **Biomedical Engineering:** Biomedical engineering is the application of engineering principles and techniques to the medical field. Biomedical engineers may be involved with developing 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.
- **Synthetic Biomanufacturing:** Students in synthetic bio-manufacturing study the development of genetic engineering tools and platforms for production and scale-up of microbial-based new products.
- **Bioenvironmental Systems Management:** This is concerned with the reuse of municipal and industrial byproducts and microbial remediation for the protection of public health and the environment.

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 graduate degree in biological engineering, graduates can work in a wide variety of critical fields, including:

- Development and production of alternative fuels
- National security
- Product development and manufacturing
- Health and medicine
- Academia
- Industry
- Law
- Sales
- Research

Employers of biological engineers include:

- Energy companies
- Chemical companies
- Engineering companies

- Equipment and systems manufacturers
- Pharmaceutical companies
- National Security/defense organizations
- Academia
- Municipalities

What it takes

Admissions Requirements

Students without an undergraduate degree in biological engineering must complete makeup courses. For students with degrees in biology or chemistry, makeup work in engineering is required, and for students with degrees in another area of engineering, biology and chemistry courses will be required. An individual makeup course plan for each student will be decided upon by the Biological Engineering Department and shared with students before they begin their coursework.

Application Requirements:

- Complete the online application
- Pay the $55 application fee
- Score at or above the 40th percentile on in the GRE
- Have a 3.0 or higher GPA on your last 60 semester or 90 quarter credits
- Provide transcripts of all college/university credits
- Provide three contacts for letters of recommendation

International students have additional admissions requirements.

Admissions Deadlines

The biological engineering graduate program has rolling admission, meaning the department will continue to consider and accept applications until the program is full. The time it takes to process an application is primarily dependent on the speed with which the School of Graduate Studies receives letters of recommendation, transcripts, and test scores. For most students, this process may take six to eight weeks. Applicants should plan accordingly.

Master's Degree Plan Options

Students can receive the MS by pursuing one of two options:

- In the **Plan A** option, students complete graduate-level coursework and must write a thesis.
- The **Plan B** option requires the production of a paper or creative work of art and is expected to reflect equivalent scholarship standards as a thesis.

Financial Assistance

A variety of funding opportunities are available, including fellowships, scholarships, assistantships, tuition awards, and travel support. Additionally, students may be eligible for subsidized health insurance through qualifying assistantships.

Program Requirements

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

Click here to see course requirements for the **Doctor of Philosophy**.

PhD Qualifying Exams:

All PhD students must participate in a dissertation proposal with their faculty committee before they can proceed with their dissertation. Students meet with their committee and present their proposed research and discuss the findings they expect. The committee will ask the student questions and then decide if the student may proceed with their dissertation.

Contact

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Get Involved

Professional Organizations, Honor Societies, and Clubs

American Society of Agricultural and Biological Engineers: This is a professional society of people interested in the engineering approach to food, agriculture and biological concerns. ASABE seeks methods for the development of producing food and renewable resources.

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

Biomedical Engineering Society: The Biomedical Engineering Society is a leading professional organization for biomedical engineering and bioengineering. Its goal is to advance human health and well being by advancing the latest research and technology in the biomedical engineering field.

Engineers Without Boarders: EWB is a group of engineers volunteering in more than 45 developing countries throughout the world to help establish basic human needs in various communities such as clean water, power, sanitation and education. EWB-USU has many university chapters throughout the country so that engineering students can become aware and involved. USU's chapter has programs in Peru, Uganda, and Mexico.

Institute of Biological Engineering: The Institute of Biological Engineering is a professional organization that is concerned with research and educational pursuits as well as professional and technical information in the profession of biological engineering.

International Genetically Engineered Machine Competition: This is the premier synthetic biology student competition and the largest synthetic biology conference in the world. The purpose of iGEM is to determine if simple biological systems can be built from standard, interchangeable parts. The broader goals of iGEM are to enable systematic engineering of biology, to promote the open and transparent development of tools for engineering biology, and to help construct a society that can productively apply biological technology.

Society of Women Engineers: This society is a national society whose mission is to stimulate women to achieve full potentials in careers as engineers and leaders, expand the image of the engineering profession as a positive force in improving the quality of life, and demonstrate the value of diversity. The SWE student chapter at USU has more than 40 participants (both men and women). Members not only enjoy the association with each other but also enjoy various activities and service projects designed to support female students studying engineering.

Labs, Centers, Research

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 Center: The Biofuels Center is distributed across two colleges, Engineering and Science, and has three locations that include on-campus, Innovation Park, and the Logan Water Reclamation Facility. The center addresses the utilization of algae, in single-culture and mixed-culture approaches that include both enclosed- and open-pond systems, for the production of biofuels including biodiesel and biomethane. Both temporal (mixing) and spatial (fiber optic) distribution of light are evaluated with regard to productivity of biomass and lipid content.

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 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.

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.

Sustainable Waste-to-Bioproducts Engineering Center: The center develops new bio-based sustainable engineering technologies that convert wastes into bioproducts for municipalities and industries in Utah, the Intermountain West, and the nation.

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 On-Site Wastewater Training Center: This center provides education, training, and technology transfer to installers, inspectors, regulators, and homeowners within the Rocky Mountain Region on the proper design and use of wastewater treatment systems.

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.