Twin Cities Campus

Bioproducts and Biosystems Engineering B.B.E.

Bioproducts and Biosystems Engineering

College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2020
- Required credits to graduate with this degree: 125
- Required credits within the major: 109
- Degree: Bachelor of Bioproducts and Biosystems Engineering

The bioproducts and biosystems engineering curriculum provides a broad fundamental scientific and engineering background to harness the molecular building blocks of renewable resources for sustainable utilization, to design and develop biological systems, and to help improve the environment by developing solutions for environmental and natural resource issues affecting soil, water, and air. The curriculum offers three areas of specialization: bioproducts engineering, food engineering, and environmental and ecological engineering.

The program produces graduates who
Have a broad fundamental engineering background, including mathematics, physical science, biological science, and engineering science and design;
Serve the engineering needs of clientele in the areas of bioproducts, bioprocessing and food, and environment and ecology;
Are successfully employed in engineering jobs in industry, consulting, government, or academia;
Are engaged in professional development and lifelong learning.

The program is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

Students must complete 11 courses before admission to the program.

Freshman and transfer students students are usually admitted to pre-major status before admission to this major

For information about University of Minnesota admission requirements, visit the Office of Admissions website.

Required prerequisites
Mathematics
Calculus I
MATH 1271 - Calculus I [MATH] (4.0 cr)
or MATH 1371 - CSE Calculus I [MATH] (4.0 cr)
or MATH 1571H - Honors Calculus I [MATH] (4.0 cr)
Calculus II
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - CSE Calculus II (4.0 cr)
or MATH 1572H - Honors Calculus II (4.0 cr)
Linear Algebra & Differential Equations OR Multivariable Calculus
Both linear algebra and differential equations and multivariable calculus are required to graduate from the program. Only one is required for admission to the program.
Linear Algebra & Differential Equations
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - CSE Linear Algebra and Differential Equations (4.0 cr)
or MATH 2573H - Honors Calculus III (4.0 cr)
or **Multivariable Calculus**
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - CSE Multivariable Calculus and Vector Analysis (4.0 cr)
or MATH 2574H - Honors Calculus IV (4.0 cr)

Biological and Physical Sciences
BIOL 1009 - General Biology [BIOL] (4.0 cr)
CHEM 1061 - Chemical Principles I [PHYS] (3.0 cr)

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CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
or CHEM 1071H - Honors Chemistry I [PHYS] (3.0 cr)
CHEM 1075H - Honors Chemistry I Laboratory [PHYS] (1.0 cr)
CHEM 1062 - Chemical Principles II [PHYS] (3.0 cr)
CHEM 1066 - Chemical Principles II Laboratory [PHYS] (1.0 cr)
or CHEM 1072H - Honors Chemistry II [PHYS] (3.0 cr)
CHEM 1076H - Honors Chemistry II Laboratory [PHYS] (1.0 cr)
PHYS 1301W - Introductory Physics for Science and Engineering I [PHYS, WI] (4.0 cr)
or PHYS 1401V - Honors Physics I [PHYS, WI] (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II [PHYS, WI] (4.0 cr)
or PHYS 1402V - Honors Physics II [PHYS, WI] (4.0 cr)

Additional Requirements
BBE 2001 - Mechanics and Structural Design (4.0 cr)

General Requirements

All students are required to complete general University and college requirements including writing and liberal education courses. For more information about University-wide requirements, see the liberal education requirements.Required courses for the major or minor in which a student receives a D grade (with or without plus or minus) do not count toward the major or minor (including transfer courses).

Program Requirements

All freshmen in the College of Science and Engineering must complete CSE 1001: First-Year Experience.
At least 30 upper division credits in the major must be taken at the University of Minnesota Twin Cities campus.

Common Core
BBE 1001 - Bioproducts and Biosystems Engineering Orientation (1.0 cr)
BBE 2003 - Computer Applications in Bioproducts and Biosystems Engineering (3.0 cr)
BBE 3002 - Introduction to Engineering Design (3.0 cr)
BBE 3012 - Transport in Biological Processes I (4.0 cr)
BBE 3013 - Engineering Principles of Molecular and Cellular Processes (3.0 cr)
BBE 3033 - Material and Energy Balances in Biological Systems (3.0 cr)
BBE 3043 - Biological and Environmental Thermodynamics (3.0 cr)
BBE 4013 - Transport in Biological Processes II (3.0 cr)
BBE 4023W - Process Control and Instrumentation [WI] (3.0 cr)
BBE 4303 - Introduction to Bio-based Materials Science (3.0 cr)
BBE 4502W - BBE Capstone Design [WI] (4.0 cr)

Linear Algebra & Differential Equations OR Multivariable Calculus
Students must complete both linear algebra and differential equations and multivariable calculus to graduate from this program. One of these courses must be taken prior to enrollment in the program.
Linear Algebra & Differential Equations
MATH 2373 - CSE Linear Algebra and Differential Equations (4.0 cr)
or MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2574H - Honors Calculus IV (4.0 cr)
or **Multivariable Calculus**
MATH 2374 - CSE Multivariable Calculus and Vector Analysis (4.0 cr)
or MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2573H - Honors Calculus III (4.0 cr)

Upper Division Writing Intensive within the Major
Students are required to take one upper division writing intensive course within the major. If that requirement has not been satisfied within the core major requirements, students must choose one course from the following list. Some of these courses may also fulfill other major requirements.
Take 0 - 1 course(s) from the following:
•BBE 4023W - Process Control and Instrumentation [WI] (3.0 cr)
•BBE 4502W - BBE Capstone Design [WI] (4.0 cr)
•SSM 4407W - Sustainable Manufacturing Principles and Practices [WI] (3.0 cr)
•SSM 4504W - Sustainable Products Systems Management [WI] (3.0 cr)
•PMB 3007W - Plant, Algal, and Fungal Diversity and Adaptation [WI] (4.0 cr)
•CEGE 3402 - Civil Engineering Materials (3.0 cr)
•ESPM 3612W - Soil and Environmental Biology [WI] (4.0 cr)

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•ME 4431W - Energy Conversion Systems Laboratory [WI] (4.0 cr)

Program Sub-plans

Students are required to complete one of the following sub-plans.

Bioproducts Engineering

Chemistry

CHEM 2301 - Organic Chemistry I (3.0 cr)
CHEM 4501 - Introduction to Thermodynamics, Kinetics, and Statistical Mechanics (3.0 cr)

Emphasis Courses

BBE 4301 - Applied Surface and Colloid Science (3.0 cr)
BBE 4401 - Bioproducts Separation and Purification Processes (3.0 cr)
BBE 4402 - Bio-based Products Engineering Lab II (2.0 cr)
BBE 4403 - Bio-based Products Engineering Lab I (2.0 cr)
BBE 4713 - Biological Process Engineering (3.0 cr)
BBE 4001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products [ENV] (4.0 cr)
or CHEM 4001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products [ENV] (4.0 cr)

Emphasis Electives

Take 6 or more credit(s) from the following:
Take 3 or more credit(s) from the following:
•BBE 4404 - Biopolymers and Biocomposites Engineering (3.0 cr)
•BBE 4723 - Food Process Engineering (3.0 cr)
•BBE 4733 - Renewable Energy Technologies [TS] (3.0 cr)
•BBE 4753 - Air Quality and Pollution Control Engineering (3.0 cr)
•CEGE 4502 - Water and Wastewater Treatment (3.0 cr)
•IE 5513 - Engineering Safety (4.0 cr)
•Take 0 or more credit(s) from the following:
•BBE 4302 - Biodegradation of Bioproducts (3.0 cr)
•BBE 4305 - Pulp and Paper Technology (3.0 cr)
•BBE 5093 - Directed Study (1.0 - 4.0 cr)
•SSM 4504W - Sustainable Products Systems Management [WI] (3.0 cr)
•IE 5541 - Project Management (4.0 cr)

Technical Electives

Take 7 or more credit(s) from the following:
•BBE 3396 - Industry Assignment (1.0 cr)
•BBE 4608 - Environmental and Industrial Microbiology (3.0 cr)
•BBE 4900 - Intern Reports (2.0 cr)
•BIOC 3021 - Biochemistry (3.0 cr)
•CHEM 2302 - Organic Chemistry II (3.0 cr)
•CHEM 2311 - Organic Lab (4.0 cr)
•CHEM 4221 - Introduction to Polymer Chemistry (3.0 cr)
•CHEM 4412 - Chemical Biology of Enzymes (3.0 cr)
•CHEM 4601 - Green Chemistry [ENV] (3.0 cr)
•IE 5551 - Production and Inventory Systems (4.0 cr)
•MATS 3801 - Structural Characterization Lab (4.0 cr)
•ME 4431W - Energy Conversion Systems Laboratory [WI] (4.0 cr)
•STAT 5021 - Statistical Analysis (4.0 cr)
•CHEM 4223W - Polymer Laboratory [WI] (2.0 cr)
or CHEN 4223W - Polymer Laboratory [WI] (2.0 cr)
or MATS 4223W - Polymer Laboratory [WI] (2.0 cr)
•CHEM 4214 - Polymers (3.0 cr)
or CHEN 4214 - Polymers (3.0 cr)
or MATS 4214 - Polymers (3.0 cr)

Food Engineering

Emphasis Courses

BBE 4401 - Bioproducts Separation and Purification Processes (3.0 cr)
BBE 4402 - Bio-based Products Engineering Lab II (2.0 cr)
BBE 4713 - Biological Process Engineering (3.0 cr)
BBE 4723 - Food Process Engineering (3.0 cr)
BIOC 3021 - Biochemistry (3.0 cr)
CHEM 2301 - Organic Chemistry I (3.0 cr)
VBS 2032 - General Microbiology With Laboratory (5.0 cr)

Emphasis Electives

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Take 2 or more course(s) from the following:
- BBE 4404 - Biopolymers and Biocomposites Engineering (3.0 cr)
- BBE 4533 - Sustainable Waste Management Engineering (3.0 cr)
- BBE 4733 - Renewable Energy Technologies [TS] (3.0 cr)
- BBE 4753 - Air Quality and Pollution Control Engineering (3.0 cr)
- CEGE 4502 - Water and Wastewater Treatment (3.0 cr)
- IE 5513 - Engineering Safety (4.0 cr)
- IE 5541 - Project Management (4.0 cr)

Technical Electives

A single course may only fulfill one major requirement. A course taken as an Emphasis Elective may not also count toward the Technical Electives requirement.

Take 8 or more credit(s) from the following:
- BBE 3396 - Industry Assignment (1.0 cr)
- BBE 4001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products [ENV] (4.0 cr)
- BBE 4301 - Applied Surface and Colloid Science (3.0 cr)
- BBE 4404 - Biopolymers and Biocomposites Engineering (3.0 cr)
- BBE 4533 - Sustainable Waste Management Engineering (3.0 cr)
- BBE 4733 - Renewable Energy Technologies [TS] (3.0 cr)
- BBE 4900 - Intern Reports (2.0 cr)
- CEGE 4502 - Water and Wastewater Treatment (3.0 cr)
- CHEM 2302 - Organic Chemistry II (3.0 cr)
- CHEM 2311 - Organic Lab (4.0 cr)
- FSCN 1102 - Food: Safety, Risks, and Technology [CIV] (3.0 cr)
- FSCN 1112 - Principles of Nutrition [TS] (3.0 cr)
- FSCN 3102 - Introduction to Food Science (3.0 cr)
- FSCN 4112 - Food Chemistry and Functional Foods (3.0 cr)
- FSCN 4121 - Food Microbiology (3.0 cr)
- FSCN 4332 *{Inactive}*(3.0 cr)
- IE 5513 - Engineering Safety (4.0 cr)
- IE 5541 - Project Management (4.0 cr)
- STAT 5021 - Statistical Analysis (4.0 cr)

Environmental and Ecological Engineering

Biochemistry

BIOC 2011 - Biochemistry for the Agricultural and Health Sciences (3.0 cr)
or BIOC 3021 - Biochemistry (3.0 cr)
or CHEM 2301 - Organic Chemistry I (3.0 cr)

Emphasis Courses

BBE 3023 - Ecological Engineering Principles (3.0 cr)
BBE 4523 - Ecological Engineering Design (3.0 cr)
BBE 4533 - Sustainable Waste Management Engineering (3.0 cr)
BBE 4535 - Assessment and Diagnosis of Impaired Waters (3.0 cr)
BBE 5513 - Watershed Engineering (3.0 cr)

Emphasis Electives

Take 3 or more course(s) totaling 9 or more credit(s) from the following:
- BBE 4753 - Air Quality and Pollution Control Engineering (3.0 cr)
- CEGE 3202 - Surveying & Mapping (2.0 cr)
- CEGE 3402 - Civil Engineering Materials (3.0 cr)
- CEGE 4351 - Groundwater Mechanics (3.0 cr)
- CEGE 4352 - Groundwater Modeling (3.0 cr)
- CEGE 4502 - Water and Wastewater Treatment (3.0 cr)
- CEGE 4511 - Hydraulic Structures (3.0 cr)
- CEGE 4512 - Open Channel Hydraulics (3.0 cr)
- CEGE 4561 - Solids and Hazardous Wastes (3.0 cr)
- CEGE 4562 - Environmental Remediation Technologies (3.0 cr)
- CEGE 5511 - Urban Hydrology and Water Quality (4.0 cr)
- IE 5513 - Engineering Safety (4.0 cr)
- **Maximum of one if selected**
  - CEGE 4101W - Project Management and Engineering Economics [WI] (3.0 cr)
  - *or* IE 5541 - Project Management (4.0 cr)

Technical Electives

Take 3 or more course(s) totaling 9 or more credit(s) from the following:
Take 1 or more course(s) totaling 3 or more credit(s) from the following:
- PMB 3007W - Plant, Algal, and Fungal Diversity and Adaptation [WI] (4.0 cr)
- EEB 3807 - Ecology (4.0 cr)
- EEB 3001 - Ecology and Society [ENV] (3.0 cr)

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- EEB 5601 - Limnology (3.0 cr)

- Take 0 or more credit(s) from the following:
  - BBE 3396 - Industry Assignment (1.0 cr)
  - BBE 4608 - Environmental and Industrial Microbiology (3.0 cr)
  - BBE 4900 - Intern Reports (2.0 cr)
  - CEGE 3111 - CADD for Civil Engineers (2.0 cr)
  - ESPM 3111 - Hydrology and Water Quality Field Methods (3.0 cr)
  - ESPM 3612W - Soil and Environmental Biology [WI] (4.0 cr)
  - FNRM 3131 - Geographical Information Systems (GIS) for Natural Resources [TS] (4.0 cr)
  - SOIL 3416 - Plant Nutrients in the Environment (3.0 cr)
  - SOIL 4111 - Introduction to Precision Agriculture (3.0 cr)
  - STAT 5021 - Statistical Analysis (4.0 cr)

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