

Biological Engineering (BS): Environmental Engineering Concentration

To see more about what you will learn in this program, visit the Learning Outcomes website (<https://apps.oirp.ncsu.edu/pgas/>)!

The BE curriculum is jointly administered by the College of Agriculture and Life Sciences and the College of Engineering and combines the fields of engineering, biology, chemistry, and agriculture. The Biological Engineering program is accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org>. BE graduates are qualified to become registered professional engineers by passing the appropriate examinations and upon completing the engineering experience requirements. Specific curriculum requirements are available online.

BAE faculty, in concert with program constituencies, has developed the following undergraduate program objectives. Within the first five years following graduation, NC State's Biological Engineering graduates will:

- Excel in their careers by applying their engineering knowledge, critical-thinking skills, systematic approach to problem solving, and innovation to improve biological and agricultural systems;
- Work effectively both independently and as part of professional teams and demonstrate leadership potential in project management;
- Display professionalism, ethics, equity, and inclusivity in the practice of engineering to safeguard life, health, and public welfare;
- Communicate effectively in a professional environment; and
- Be engaged in life-long learning and professional development.

Plan Requirements

First Year

| Fall Semester | | Hours |
|---------------|--|-----------|
| CH 101 | Chemistry - A Molecular Science ¹ | 3 |
| CH 102 | General Chemistry Laboratory ¹ | 1 |
| E 101 | Introduction to Engineering & Problem Solving ² | 1 |
| E 115 | Introduction to Computing Environments | 1 |
| ENG 101 | Academic Writing and Research ² | 4 |
| MA 141 | Calculus I ¹ | 4 |
| Hours | | 14 |

Spring Semester

| | | |
|------------------------------|--|---|
| Select one of the following: | | 4 |
| CH 201 & CH 202 | Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory | |
| CH 220 & CH 222 | Introductory Organic Chemistry and Organic Chemistry I Lab | |
| CH 221 & CH 222 | Organic Chemistry I and Organic Chemistry I Lab | |
| MA 241 | Calculus II ¹ | 4 |

| | | |
|-----------------|---|---|
| PY 205 & PY 206 | Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory ¹ | 4 |
|-----------------|---|---|

| | | |
|------------------------------|---|-----------|
| Select one of the following: | | 3 |
| ARE 201 | Introduction to Agricultural & Resource Economics | |
| ARE 201A | Introduction to Agricultural & Resource Economics | |
| EC 201 | Principles of Microeconomics | |
| EC 205 | Fundamentals of Economics | |
| Hours | | 15 |

Second Year

Fall Semester

| | | |
|--------------------|--|-----------|
| BAE 200 | Computer Methods in Biological Engineering | 2 |
| CE 214 or MAE 206 | Engineering Mechanics-Statics ² or Engineering Statics | 3 |
| MA 242 | Calculus III | 4 |
| PY 208 & PY 209 | Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory | 4 |
| BIO 181 or BIO 183 | Introductory Biology: Ecology, Evolution, and Biodiversity or Introductory Biology: Cellular and Molecular Biology | 4 |
| Hours | | 17 |

Spring Semester

| | | |
|--------------|---|-----------|
| BAE 203 | Introduction to AutoCAD Civil 3D for Environmental & Ecological Engineers | 2 |
| BAE 204 | Introduction to Environmental and Ecological Engineering | 2 |
| MAE 208 | Engineering Dynamics ² | 3 |
| MA 341 | Applied Differential Equations I | 3 |
| MAE 201 | Engineering Thermodynamics I | 3 |
| SSC 200 | Soil Science | 3 |
| Hours | | 16 |

Third Year

Fall Semester

| | | |
|--------------|---|-----------|
| BAE 325 | Introductory Geomatics | 3 |
| BAE 302 | Transport Phenomena | 3 |
| BAE 371 | Fundamentals of Hydrology for Engineers | 3 |
| CE 282 | Hydraulics ² | 3 |
| BAE 305 | Biological Engineering Circuits | 4 |
| Hours | | 16 |

Spring Semester

| | | |
|------------------------------|---|---|
| BAE 401 | Sensors and Controls | 3 |
| BAE 472 | Irrigation and Drainage | 3 |
| CE 225 or MAE 214 | Mechanics of Solids ² or Solid Mechanics | 3 |
| ST 370 | Probability and Statistics for Engineers | 3 |
| Select one of the following: | | 3 |
| AEC 360 | Ecology | |
| PB 321 | Introduction to Whole Plant Physiology | |
| PB 360 | Ecology | |

| | | |
|------------------------------|---|------------|
| SSC 332 | Environmental Soil Microbiology | |
| Hours | | 15 |
| Fourth Year | | |
| Fall Semester | | |
| BAE 478 | Agricultural Waste Management | 3 |
| BAE 451 | Engineering Design I | 2 |
| Select one of the following: | | 3 |
| BAE 473 | Introduction to Hydrologic and Water Quality Modeling | |
| BAE 481 | Structures & Environment | |
| BAE 573 | Introduction to Hydrologic and Water Quality Modeling | |
| SSC 473 | Introduction to Hydrologic and Water Quality Modeling | |
| SSC 573 | Introduction to Hydrologic and Water Quality Modeling | |
| Select one of the following: | | 3 |
| IDS 201 | Environmental Ethics | |
| STS 301 | Science and Civilization | |
| STS 304 | Ethical Dimensions of Progress | |
| ENG 331 or ENG 333 | Communication for Engineering and Technology or Communication for Science and Research | 3 |
| Hours | | 14 |
| Spring Semester | | |
| BAE 452 | Engineering Design II | 2 |
| Select one of the following: | | 3 |
| BAE 322 | Introduction to Food Process Engineering | |
| BAE 361 | Analytical Methods in Engineering Design | |
| BAE 481 | Structures & Environment | |
| Hours | | 5 |
| Total Hours | | 112 |

¹ A grade of C or higher is required.

² A grade of C- or higher is required.

| Code | Title | Hours | Counts towards |
|---|-------|-------|----------------|
| GEP Courses | | | |
| GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/) | | 6 | |
| GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/) | | 3 | |
| GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/) | | 2 | |

GEP US Diversity, Equity, and Inclusion (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-usdei/>) 3

GEP Interdisciplinary Perspectives (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/>) 2

GEP Global Knowledge (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/>) (verify requirement)

Foreign Language Proficiency (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/foreign-language-proficiency/>) (verify requirement)

Total Hours 16

Semester Sequence

This is a sample.

First Year

| Fall Semester | Hours |
|---|-------|
| CH 101 Chemistry - A Molecular Science ¹ | 3 |
| CH 102 General Chemistry Laboratory ¹ | 1 |
| E 101 Introduction to Engineering & Problem Solving ¹ | 1 |
| E 115 Introduction to Computing Environments | 1 |
| ENG 101 Academic Writing and Research ¹ | 4 |
| MA 141 Calculus I ¹ | 4 |
| GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/) | 1 |

Hours 15

Spring Semester

| | | |
|--|--|---|
| Select one of the following: | | 4 |
| CH 221 & CH 222 Organic Chemistry I and Organic Chemistry I Lab | | |
| CH 220 & CH 222 Introductory Organic Chemistry and Organic Chemistry I Lab | | |
| CH 221 & CH 222 Organic Chemistry I and Organic Chemistry I Lab | | |
| MA 241 Calculus II ¹ | | 4 |
| PY 205 Physics for Engineers and Scientists I ¹ | | 3 |
| PY 206 Physics for Engineers and Scientists I Laboratory | | 1 |

Select one of the following: 3

| | |
|---|--|
| EC 201 Principles of Microeconomics | |
| EC 205 Fundamentals of Economics | |
| ARE 201 Introduction to Agricultural & Resource Economics | |

Hours 15

Second Year
Fall Semester

| | | |
|-----------------------|---|-----------|
| BAE 200 | Computer Methods in Biological Engineering | 2 |
| MAE 206 or CE 214 | Engineering Statics ¹ or Engineering Mechanics-Statics | 3 |
| MA 242 | Calculus III | 4 |
| PY 208 | Physics for Engineers and Scientists II | 3 |
| PY 209 | Physics for Engineers and Scientists II Laboratory | 1 |
| BIO 181 or BIO 183 | Introductory Biology: Ecology, Evolution, and Biodiversity or Introductory Biology: Cellular and Molecular Biology | 4 |
| Hours | | 17 |

Spring Semester

| | | |
|--------------|---|-----------|
| BAE 203 | Introduction to AutoCAD Civil 3D for Environmental & Ecological Engineers | 2 |
| BAE 204 | Introduction to Environmental and Ecological Engineering | 2 |
| MAE 208 | Engineering Dynamics ¹ | 3 |
| MA 341 | Applied Differential Equations I | 3 |
| MAE 201 | Engineering Thermodynamics I | 3 |
| SSC 200 | Soil Science | 3 |
| Hours | | 16 |

Third Year
Fall Semester

| | | |
|--------------|---|-----------|
| BAE 325 | Introductory Geomatics | 3 |
| BAE 302 | Transport Phenomena | 3 |
| BAE 371 | Fundamentals of Hydrology for Engineers | 3 |
| CE 282 | Hydraulics ¹ | 3 |
| BAE 305 | Biological Engineering Circuits | 4 |
| Hours | | 16 |

Spring Semester

| | | |
|----------------------------------|--|-----------|
| BAE 401 | Sensors and Controls | 3 |
| BAE 472 | Irrigation and Drainage | 3 |
| MAE 214 or CE 225 | Solid Mechanics ¹ or Mechanics of Solids | 3 |
| ST 370 | Probability and Statistics for Engineers | 3 |
| Advanced Biology Elective (p. 1) | | 3 |
| Hours | | 15 |

Fourth Year
Fall Semester

| | | |
|--|---|-----------|
| BAE 451 | Engineering Design I | 2 |
| BAE 478 | Agricultural Waste Management | 3 |
| Engineering Elective | | 3 |
| Ethics (p. 1) | | 3 |
| GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/) | | 3 |
| ENG 331 or ENG 333 | Communication for Engineering and Technology or Communication for Science and Research | 3 |
| Hours | | 17 |

Spring Semester

| | | |
|--|-----------------------|------------|
| BAE 452 | Engineering Design II | 2 |
| BAE Elective (p. 1) | | 3 |
| GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/) | | 3 |
| GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/) | | 2 |
| GEP US Diversity, Equity, and Inclusion (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-usdei/) | | 3 |
| GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/) | | 3 |
| GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/) | | 1 |
| Hours | | 17 |
| Total Hours | | 128 |

¹ A grade of C- or higher is required.

Career Opportunities

BE students learn to solve a wide variety of engineering problems and will have opportunities for specialization through selection of a specific concentration. Scientific and engineering principles are applied: to conserve and manage air, energy, soil and water resources; to manage, protect and restore natural ecosystems; to understand and utilize biological, chemical and physical processes for the production and conversion of biomass to bio energy; to analyze, understand and utilize mechanical properties of biological materials; to design and develop machinery systems for all phases of agricultural and food production; to design and evaluate structures and environmental control systems for housing animals, plant growth, and biological product storage; to develop improved systems for processing and marketing food and agricultural products; and to design sensor-based instrumentation and control systems for biological and agricultural applications.

Graduates of the BE curriculum receive a Bachelor's of Engineering in Biological Engineering, qualifying them for positions in design, development, and research in industry, government and public institutions. The curriculum also prepares students for post-graduate work leading to advanced degrees. Typical positions filled by recent BE graduates include: stream and wetlands restoration project manager; product design; development and testing engineer; plant engineering and management; engineering analysis and inspection for federal and state agencies; engineering consultant and research engineer. Entry-level salary ranges for BE graduates are similar to those of Civil, Industrial, and Mechanical Engineering graduates.

The BAET curriculum provides graduates opportunities in technical analysis, application and evaluation of agricultural production systems and environmental systems. The curriculum's flexibility enables students to specialize technologically in agriculture, the environment, or business management. Careers include technical jobs in production agriculture, environmental systems, agribusiness sales and service, and agricultural extension.