

# Biological Engineering (BS): Ecological 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 <sup>1</sup>	3
CH 102	General Chemistry Laboratory <sup>1</sup>	1
E 101	Introduction to Engineering & Problem Solving <sup>2</sup>	1
E 115	Introduction to Computing Environments	1
ENG 101	Academic Writing and Research <sup>2</sup>	4
MA 141	Calculus I <sup>1</sup>	4
<b>Hours</b>		<b>14</b>

### Spring Semester

CH 221	Organic Chemistry I	3
CH 222	Organic Chemistry I Lab	1
MA 241	Calculus II <sup>1</sup>	4
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory <sup>1</sup>	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 <sup>2</sup> 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	Introductory Biology: Ecology, Evolution, and Biodiversity	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 <sup>2</sup>	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 302	Transport Phenomena	3
BAE 305	Biological Engineering Circuits	4
BAE 371	Fundamentals of Hydrology for Engineers	3
CE 282	Hydraulics <sup>2</sup>	3
PB 360	Ecology	3

**Hours 16**

#### Spring Semester

BAE 376	Watershed Assessment and Water Quality Protection	3
BAE 401	Sensors and Controls	3
CE 225 or MAE 214	Mechanics of Solids <sup>2</sup> or Solid Mechanics	3
ST 370	Probability and Statistics for Engineers	3

**Hours 12**

### Fourth Year

#### Fall Semester

BAE 325	Introductory Geomatics	3
BAE 451	Engineering Design I	2
BAE 473	Introduction to Hydrologic and Water Quality Modeling	3
BAE 474	Principles and Applications of Ecological Engineering	3

ENG 331 or ENG 333	Communication for Engineering and Technology or Communication for Science and Research	3
Ethics Elective (p. 2)		3
<b>Hours</b>		<b>17</b>
<b>Spring Semester</b>		
BAE 452	Engineering Design II	2
Engineering Elective (p. 2)		3
<b>Hours</b>		<b>5</b>
<b>Total Hours</b>		<b>112</b>

<sup>1</sup> A grade of C or higher is required.

<sup>2</sup> A grade of C- or higher is required.

Code	Title	Hours	Counts towards
<b>GEP Courses</b>			
	GEP Humanities ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/</a> )	6	
	GEP Social Sciences ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/</a> )	3	
	GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )	2	
	GEP Additional Breadth ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> ) (Humanities/Social Sciences/Visual and Performing Arts)	3	
	GEP Interdisciplinary Perspectives ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/</a> )	2	
	GEP U.S. Diversity ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-us-diversity/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-us-diversity/</a> ) (verify requirement)		
	GEP Global Knowledge ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/</a> ) (verify requirement)		
	Foreign Language Proficiency ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/foreign-language-proficiency/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/foreign-language-proficiency/</a> ) (verify requirement)		
<b>Total Hours</b>		<b>16</b>	

## Ethics Elective

Code	Title	Hours	Counts towards
IDS 201	Environmental Ethics	3	
PHI 325	Bio-Medical Ethics	3	
STS 302	Contemporary Science, Technology and Human Values	3	
STS 304	Ethical Dimensions of Progress	3	
STS 322	Technological Catastrophes	3	
STS 323	World Population and Food Prospects	3	
STS 325	Bio-Medical Ethics	3	

## Engineering Elective

Code	Title	Hours	Counts towards
BAE 322	Introduction to Food Process Engineering	3	
BAE 361	Analytical Methods in Engineering Design	3	
BAE 478	Agricultural Waste Management	3	
BAE 481	Structures & Environment	3	
BAE 574	DRAINMOD: Theory and Application	3	
BAE 578	Agricultural Waste Management	3	
BAE 581	Open Channel Hydraulics for Natural Systems	3	

## Semester Sequence

This is a sample.

<b>First Year</b>		
<b>Fall Semester</b>		<b>Hours</b>
CH 101	Chemistry - A Molecular Science <sup>1</sup>	3
CH 102	General Chemistry Laboratory <sup>1</sup>	1
E 101	Introduction to Engineering & Problem Solving <sup>1</sup>	1
E 115	Introduction to Computing Environments	1
ENG 101	Academic Writing and Research <sup>1</sup>	4

MA 141	Calculus I <sup>1</sup>	4
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )		1

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**Hours** **15**

**Spring Semester**

CH 221	Organic Chemistry I	3
CH 222	Organic Chemistry I Lab	1
MA 241	Calculus II <sup>1</sup>	4
PY 205	Physics for Engineers and Scientists I	3
PY 206	Physics for Engineers and Scientists I Laboratory	1
EC 205	Fundamentals of Economics	3

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**Hours** **15**

**Second Year**
**Fall Semester**

BAE 200	Computer Methods in Biological Engineering	2
MAE 206 or CE 214	Engineering Statics <sup>2</sup> 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	Introductory Biology: Ecology, Evolution, and Biodiversity	4

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**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 <sup>2</sup>	3
MA 341	Applied Differential Equations I	3
MAE 201	Engineering Thermodynamics I	3
SSC 200	Soil Science	3

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**Hours** **16**

**Third Year**
**Fall Semester**

BAE 302	Transport Phenomena	3
BAE 305	Biological Engineering Circuits	4
BAE 371	Fundamentals of Hydrology for Engineers	3
CE 282	Hydraulics <sup>2</sup>	3
PB 360	Ecology	3

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**Hours** **16**

**Spring Semester**

BAE 376	Watershed Assessment and Water Quality Protection	3
ST 370	Probability and Statistics for Engineers	3
MAE 214 or CE 225	Solid Mechanics <sup>2</sup> or Mechanics of Solids	3
BAE 401	Sensors and Controls	3

GEP Humanities ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/</a> )	3
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**Hours** **15**

**Fourth Year**
**Fall Semester**

BAE 451	Engineering Design I	2
BAE 325	Introductory Geomatics	3
BAE 473	Introduction to Hydrologic and Water Quality Modeling	3
BAE 474	Principles and Applications of Ecological Engineering	3
ENG 331 or ENG 333	Communication for Engineering and Technology or Communication for Science and Research	3
Ethics Elective (p. 1)		3

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**Hours** **17**

**Spring Semester**

BAE 452	Engineering Design II	2
Engineering Elective (p. 2)		3
GEP Social Sciences ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/</a> )		3
GEP Additional Breadth ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
GEP Humanities ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/</a> )		3
GEP Interdisciplinary Perspectives ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/</a> )		2
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )		1

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**Hours** **17**

**Total Hours** **128**

<sup>1</sup> A grade of C or higher is required.

<sup>2</sup> 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.