

# Agricultural and Biosystems Engineering

## Agricultural and Biosystems Engineering Major

The Agricultural and Biosystems Engineering (ABEN) program prepares men and women for careers requiring application of physical, biological, and engineering sciences to develop solutions relating to: the design and production of machine systems; the production and handling of biological materials; processing of food, feed, fiber, and fuel; and the preservation of natural resources and environmental quality. A major in Agricultural and Biosystems Engineering can serve a broad range of career interests and can provide excellent career opportunities for men and women from diverse backgrounds.

The program educational objectives of this major are to educate and produce graduates who will become engineers who:

1. have the ability to use their technical knowledge and design and problem solving skills throughout their careers,
2. have the interpersonal and collaborative skills and the capacity necessary for productive careers, and
3. can use their disciplinary knowledge and educational depth and breadth to deal with changing career opportunities in agricultural and related industries.

These objectives support the department mission of developing and extending knowledge through engineering and technology that advances the productivity of agricultural production, the processing and utilization of biological materials, and the management of environmental resources.

Agricultural and biosystems engineering integrates engineering topics, engineering design, and biological sciences in a single program with two concentrations: agricultural engineering and biosystems engineering. While there is considerable overlap between the agricultural engineering (AGEN) and the biosystems engineering (BSEN) concentrations, the BSEN concentration includes a heavier emphasis on fundamental biological and chemical sciences. The AGEN concentration includes a heavier emphasis in the physical sciences. A wide range of electives in related disciplines can be used to compliment the disciplinary course work and to prepare for specific career interests. Although not required by the curriculum, students are encouraged to take advantage of Cooperative Education experiences or the opportunity of paid internships where they gain hands-on experience in engineering.

## Agricultural Engineering Option

Career opportunities for graduates in agricultural engineering are many and diverse. Graduates may work for companies and agencies that design, develop, test, and manufacture power and machine systems; handle, store, and process agricultural commodities; design environmental controls and housing systems for plant and animal production; design equipment and systems for processing, manufacturing, distribution and quality protection of food products; design systems for management of air, land and water resources; design and manage crop irrigation systems; and develop electrical and electronic applications for agricultural problems. Graduates with an agricultural engineering concentration may also pursue graduate degrees in engineering, business, or law. By selecting appropriate elective

courses, students may emphasize areas such as agricultural systems, environmental systems, biomaterials and processing systems, or an emphasis area designed by the student in consultation with an adviser.

The faculty assist with career planning and job placement of graduates. Students interested in careers involving production, delivery, management, and technical support of systems for food, agricultural, or closely related industries rather than engineering or design should consider the Agricultural Systems Management major (<http://bulletin.ndsu.edu/past-bulletin-archive/2014-15/undergraduate/colleges/agriculture-food-systems-natural-resources/agriculture-biosystems-engineering/agricultural-systems-management>) offered by the College of Agriculture, Food Systems, and Natural Resources (<http://www.ag.ndsu.edu/academics>).

## Major Requirements

### Major: Agricultural & Biosystems Engineering Option: Agricultural Engineering

**Degree Type: B.S.A.B.En**

**Required Degree Credits to Graduate: 133**

### General Education Requirements

#### First Year Experience (F):

ABEN 189	Skills for Academic Success (Students transferring in 24 or more credits do not need to take ABEN 189.)	1
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#### Communication (C):

ENGL 110	College Composition I	3
ENGL 120	College Composition II	3
One Course in Upper Level Writing. Select one of the following:		3
ENGL 321	Writing in the Technical Professions	
ENGL 324	Writing in the Sciences	
ENGL 459	Researching and Writing Grants and Proposal	
COMM 110	Fundamentals of Public Speaking	3

#### Quantitative Reasoning (R):

MATH 165	Calculus I	4
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#### Science & Technology (S):

CHEM 121	General Chemistry I	3
CHEM 122	General Chemistry II	3
PHYS 252 & 252L	University Physics II and University Physics II Laboratory	5

**Humanities & Fine Arts (A): Select from current general education list** 6

**Social & Behavioral Sciences (B): Select from current general education list** 6

**Wellness (W): Select from current general education list** 2

**Cultural Diversity (D): Select from current general education list**

**Global Perspectives (G): Select from current general education list**

Total Credits		42
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## Major Requirements - Agricultural Option

<b>General Education Requirements</b>	40
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<b>ABEN Core Courses:</b>	
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ABEN 110	Introduction to Agricultural and Biosystems Engineering	2
ABEN 255	Computer Aided Analysis & Design	3
ABEN 263	Biological Materials Processing	3
ABEN 377	Numerical Modeling in Agricultural and Biosystems Engineering	3
ABEN 482	Instrumentation & Measurements	3
ABEN 486	Design Project I	2
ABEN 487	Design Project II	2
ABEN 491	Seminar	1
ABEN 496	Field Experience	1
ABEN 300-400 Electives: Select 9 credits from the following:		9
ABEN 358	Electric Energy Application in Agriculture	
ABEN 383	Structural Design for Biosystems	
ABEN 444	Transport Processes	
ABEN 450	Bioprocess Engineering	
ABEN 452	Bioenvironmental Systems Design	
ABEN 456	Biobased Energy	
ABEN 458	Process Engineering for Food, Biofuels and Bioproducts	
ABEN 464	Resource Conservation and Irrigation Engineering	
ABEN 473	Agricultural Power	
ABEN 478	Machinery Analysis & Design	
ABEN 479	Fluid Power Systems Design	
ABEN 484	Drainage and Wetland Engineering	
MATH Courses:		
MATH 128	Introduction to Linear Algebra	1
MATH 166	Calculus II	4
MATH 259	Multivariate Calculus	3
MATH 266	Introduction to Differential Equations	3
ME Courses:		
ME 212	Fundamentals of Visual Communication for Engineers	3
ME 221	Engineering Mechanics I	3
ME 222	Engineering Mechanics II	3
ME 223	Mechanics of Materials	3
ME 350	Thermodynamics and Heat Transfer	3
Additional Courses:		
CE 309	Fluid Mechanics	3
CE 310	Fluid Mechanics Laboratory	1
ECE 301	Electrical Engineering I	3
ENGR 402	Engineering Ethics and Social Responsibility	1
IME 440	Engineering Economy	2
IME 460	Evaluation of Engineering Data	3
or STAT 330	Introductory Statistics	
<b>Program Electives</b>	<b>The following program electives may be selected from courses listed in the Program Electives Tab</b>	
Computer Electives	Select a minimum of 3 credits from the following department website: <a href="http://www.ndsu.edu/aben/academics">www.ndsu.edu/aben/academics</a>	3

Business or Communication Elective	Choose one course from the following prefix options: BUSN, COMM, ACCT, AGECE, ECON, MGT, MIS, MRKT *	3
Chemistry/Biological Science Electives	Select a minimum of 9 credits from the following department website: <a href="http://www.ndsu.edu/aben/academics">www.ndsu.edu/aben/academics</a>	9
Technical Electives	Select a minimum of 8 credits from the Ag Option Area Tab or following department website: <a href="http://www.ndsu.edu/aben/academics">www.ndsu.edu/aben/academics</a>	8
<b>Total Credits</b>		<b>133</b>

\* The course used for this business or communication elective cannot double-count as General Education.

### SUGGESTED EMPHASIS AREA for the Agricultural Engineering

**Option:** Consult with adviser when making selections.

- **Agricultural Systems** - Select electives with emphasis on machine, power, structural, and electrical/electronic systems to solve problems involving engineering aspects of food, feed, and fiber production.
- **Environmental Systems** - Select electives with emphasis on areas that contribute to solving problems in environmental engineering, natural resources management, hydrology, irrigation, watershed management, and waste management.
- **Biomaterial Systems** - Select electives with emphasis on combining engineering, biological, and physical sciences in the application of engineering principles to handling and processing of biomaterials for food and non-food products.

### Degree Requirements and Notes

A student must complete at least 60 semester credits of professional level course work in his/her program while in residence and enrolled in the college. Students transferring into the college from programs with professional accreditation are exempt from this residency requirement but are subject to the residency requirement of NDSU.

Program Electives for ABEN:

### Agricultural Option - Program Electives

**Computer Electives: Select one course from the following:** 3

CE 212	Civil Engineering Graphic Communications
CSCI 122	Visual BASIC
CSCI 160	Computer Science I
ECE 173	Introduction to Computing
GEOG 455	Introduction to Geographic Information Systems
IME 380	CAD/CAM for Manufacturing
ME 213	Modeling of Engineering Systems

**Business or Communication Elective: Choose one course from the following prefix options:** 3

BUSN, COMM, ACCT, AGECE, ECON, MGT, MIS, MRKT (The course used for this elective cannot double-count as General Education.)
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**Chemistry/Biological Science Electives: Select 9 credits from the following:** 9

ANSC 123	Feeds and Feeding
ANSC 220	Livestock Production
BIOL 111	Concepts of Biology
BIOL 111L	Concepts of Biology Lab

BIOL 124	Environmental Science
BIOL 124L	Environmental Science Laboratory
BIOL 150	General Biology I
BIOL 150L	General Biology I Laboratory
BIOL 151	General Biology II
BIOL 151L	General Biology II Laboratory
CFS 210	Introduction to Food Science and Technology
CFS 370	Food Processing I
CFS 450	Cereal Technology
CHEM 121L	General Chemistry I Laboratory
CHEM 122L	General Chemistry II Laboratory
CHEM 240	Survey of Organic Chemistry
ENT 210	Insects, Humans and the Environment
MICR 202	Introductory Microbiology
MICR 202L	Introductory Microbiology Lab
PLSC 110	World Food Crops
PLSC 225	Principles of Crop Production
PLSC 315	Genetics
PLSC 320	Principles of Forage Production
PLSC 323	Principles of Weed Science
PLSC 335	Seed Technology & Production
RNG 225	Natural Resource & Agro-Ecosystems
SOIL 210	Introduction to Soil Science
SOIL 217	Introduction to Meteorology & Climatology
SOIL 410	Soils and Land Use
SOIL 480	Soils and Pollution

**Technical Electives: Select elective courses from the following department website [www.ndsu.edu/asm/](http://www.ndsu.edu/asm/). May choose from the ABEN section, Chemistry/Biological Science electives or the Engineering electives listed below:** 8

ASM 323	Post-Harvest Technology
ASM 373	Tractors & Power Units
ASM 374	Power Units Laboratory
ASM 378	Machinery Principles and Management
ASM 429	Hydraulic Power Principles and Applications
ASM 454	Principles and Application of Precision Agriculture
CE 204	Surveying
CE 343	Structural Engineering and Analysis
CE 370	Introduction to Environmental Engineering
CE 371	Environmental Engineering Laboratory
CE 404	Reinforced Concrete
CE 408	Water Resources and Supply
CE 410	Water and Wastewater Engineering
CE 421	Open Channel Flow
CE 451	Advanced Surveying
CE 472	Solid Waste Management
CE 473	Air Pollution
CE 477	Applied Hydrology
CE 478	Water Quality Management
CE 479	Advanced Water and Wastewater Treatment
CE 483	Contracts and Specifications
ECE 275	Digital Design
ECE 303	Electrical Engineering II

ECE 376	Embedded Systems
IME 330	Manufacturing Processes
GEOG 456	Advanced Geographic Information Systems
IME 335	Welding Technology
IME 380	CAD/CAM for Manufacturing
IME 430	Process Engineering
IME 431	Production Engineering
IME 450	Systems Engineering and Management
IME 455	Management of People Systems
IME 456	Program and Project Management
IME 461	Quality Assurance and Control
ME 331	Materials Science and Engineering
ME 341	Mechanics of Machinery
ME 353	Thermodynamics II
ME 421	Theory of Vibrations
ME 442	Machine Design I
ME 454	Heat and Mass Transfer
ME 471	Experimental Stress Analysis
ME 473	Engineering with Polymeric Materials
ME 474	Mechanics of Composite Materials
ME 475	Automatic Controls
ME 487	Internal Combustion Engines
RNG 326	Modeling of Range and Agro-Ecosystems
STAT 461	Applied Regression Models
STAT 462	Introduction to Experimental Design

Total Credits 23

**SUGGESTED EMPHASIS AREA for the Agricultural & Biosystems Engineering Option:** Consult with adviser when making selections.

- **Agricultural Systems** - Select electives with emphasis on machine, power, structural, and electrical/electronic systems to solve problems involving engineering aspects of food, feed, and fiber production.
- **Environmental Systems** - Select electives with emphasis on areas that contribute to solving problems in environmental engineering, natural resources management, hydrology, irrigation, watershed management, and waste management.
- **Biomaterials Systems** - Select electives with emphasis on combining engineering, biological, and physical sciences in the application of engineering principles to handling and processing of biomaterials for food and non-food products.

### Agricultural Systems

ABEN 358	Electric Energy Application in Agriculture	3
ABEN 383	Structural Design for Biosystems	3
ABEN 444	Transport Processes	3
ABEN 452	Bioenvironmental Systems Design	3
ABEN 456	Biobased Energy	3
ABEN 458	Process Engineering for Food, Biofuels and Bioproducts	3
ABEN 464	Resource Conservation and Irrigation Engineering	4
ABEN 473	Agricultural Power	3
ABEN 478	Machinery Analysis & Design	3
ABEN/ME 479	Fluid Power Systems Design	3
ASM 323	Post-Harvest Technology	3

ASM 373	Tractors & Power Units	3
ASM 374	Power Units Laboratory	1
ASM 378	Machinery Principles and Management	3
ASM 429	Hydraulic Power Principles and Applications	3
ASM 454	Principles and Application of Precision Agriculture	3
CE 343	Structural Engineering and Analysis	4
CE 404	Reinforced Concrete	3
ECE 275	Digital Design	3
ECE 303	Electrical Engineering II	3
ECE 376	Embedded Systems	4
GEOG 455	Introduction to Geographic Information Systems	4
GEOG 456	Advanced Geographic Information Systems	3
IME 330	Manufacturing Processes	3
IME 335	Welding Technology	3
IME 380	CAD/CAM for Manufacturing	3
IME 430	Process Engineering	3
IME 431	Production Engineering	3
IME 450	Systems Engineering and Management	3
IME 455	Management of People Systems	2
IME 456	Program and Project Management	3
IME 461	Quality Assurance and Control	3
ME 331	Materials Science and Engineering	4
ME 341	Mechanics of Machinery	3
ME 353	Thermodynamics II	3
ME 421	Theory of Vibrations	3
ME 442	Machine Design I	3
ME 454	Heat and Mass Transfer	3
ME 471	Experimental Stress Analysis	3
ME 473	Engineering with Polymeric Materials	3
ME 474	Mechanics of Composite Materials	3
ME 475	Automatic Controls	3
ME 487	Internal Combustion Engines	3

## Environmental Systems

ABEN 358	Electric Energy Application in Agriculture	3
ABEN 444	Transport Processes	3
ABEN 450	Bioprocess Engineering	3
ABEN 452	Bioenvironmental Systems Design	3
ABEN 456	Biobased Energy	3
ABEN 464	Resource Conservation and Irrigation Engineering	4
ABEN 479	Fluid Power Systems Design	3
ABEN 484	Drainage and Wetland Engineering	3
ASM 454	Principles and Application of Precision Agriculture	3
CE 204	Surveying	4
CE 370	Introduction to Environmental Engineering	3
CE 371	Environmental Engineering Laboratory	1
CE 408	Water Resources and Supply	3
CE 410	Water and Wastewater Engineering	3
CE 421	Open Channel Flow	3
CE 451	Advanced Surveying	2
CE 472	Solid Waste Management	3
CE 473	Air Pollution	3

CE 477	Applied Hydrology	3
CE 478	Water Quality Management	3
CE 479	Advanced Water and Wastewater Treatment	3
CE 483	Contracts and Specifications	3
CHEM 240	Survey of Organic Chemistry	3
CHEM 341	Organic Chemistry I	3
CHEM 341L	Organic Chemistry I Laboratory	1
ECE 303	Electrical Engineering II	3
ME 454	Heat and Mass Transfer	3
MICR 350	General Microbiology	3
RNG 326	Modeling of Range and Agro-Ecosystems	3
SOIL 210	Introduction to Soil Science	3
SOIL 410	Soils and Land Use	3
SOIL 480	Soils and Pollution	3

## Biomaterials Systems

ABEN 358	Electric Energy Application in Agriculture	3
ABEN 444	Transport Processes	3
ABEN 450	Bioprocess Engineering	3
ABEN 452	Bioenvironmental Systems Design	3
ABEN 456	Biobased Energy	3
ABEN 458	Process Engineering for Food, Biofuels and Bioproducts	3
ABEN 479	Fluid Power Systems Design	3
ABEN 484	Drainage and Wetland Engineering	3
BIOC 460	Foundations of Biochemistry and Molecular Biology I	3
BIOC 460L	Foundations of Biochemistry I Laboratory	1
CFS 210	Introduction to Food Science and Technology	2
CFS 430	Food Unit Operations	2
CFS 450	Cereal Technology	3
CFS 470	Food Processing II	3
CFS 471	Food Processing Laboratory	1
CHEM 240	Survey of Organic Chemistry	3
CHEM 341	Organic Chemistry I	3
CHEM 341L	Organic Chemistry I Laboratory	1
CHEM 342	Organic Chemistry II	3
ECE 303	Electrical Engineering II	3
IME 450	Systems Engineering and Management	3
IME 460	Evaluation of Engineering Data	3
IME 461	Quality Assurance and Control	3-4
ME 331	Materials Science and Engineering	4
ME 442	Machine Design I	3
ME 454	Heat and Mass Transfer	3
MICR 350	General Microbiology	3