Agricultural and Biosystems Engineering

Department Information

- **Department Location:**
  Agricultural and Biosystems Engineering
- **Department Phone:**
  701-231-7261
- **Department Email:**
  ndsu.asm@ndsu.edu
- **Department Web Site:**
  www.ndsu.edu/aben/ (http://www.ndsu.edu/aben/)
- **Credential Offered:**
  B.S.A.B.En.
- **Plan Of Study Sample:**
  catalog.ndsu.edu/programs-study/undergraduate/agricultural-biosystems-engineering/ (http://catalog.ndsu.edu/programs-study/undergraduate/agricultural-biosystems-engineering/)

Major Requirements

Major: Agricultural & Biosystems Engineering
Option: Agricultural

Degree Type: B.S.A.B.En
Minimum Degree Credits to Graduate: 133

University Degree Requirements

1. Satisfactory completion of all requirements of the curriculum in which one is enrolled.
2. Earn a minimum total of 120 credits in approved coursework. Some academic programs exceed this minimum.
3. Satisfactory completion of the general education requirements as specified by the university.
4. A minimum institutional GPA of 2.00 based on work taken at NDSU.
5. At least 36 credits presented for graduation must be in courses numbered 300 or higher.
6. Transfer Students: Must earn a minimum of 60 credits from a baccalaureate-degree granting or professional institution.
   a. Of these 60, at least 36 must be NDSU resident credits as defined in #7.
   b. Within the 36 resident credits, a minimum of 15 must be in courses numbered 300 or higher and 15 credits in the major field of study.
7. At least 36 credits must be NDSU resident credits. Resident credits include credits registered and paid for at NDSU.

For complete information, please refer to the Degree and Graduation Requirements (http://catalog.ndsu.edu/past-bulletin-archive/2021-22/academic-policies/undergraduate-policies/degree-and-graduation/) section of this Bulletin.

University General Education Requirements

Code	Title	Credits
Communication (C)		**12**
ENGL 110	College Composition I	
ENGL 120	College Composition II	
COMM 110	Fundamentals of Public Speaking	
Upper Division Writing †		
Quantitative Reasoning (R) †		**3**
Science and Technology (S) †		**10**
Humanities and Fine Arts (A) †		**6**
Social and Behavioral Sciences (B) †		**6**
Wellness (W) †		**2**
Cultural Diversity (D) *†		
Global Perspectives (G) *†		
Total Credits		**39**

* May be satisfied by completing courses in another General Education category.

† General education courses may be used to satisfy requirements for both general education and the major, minor, and program emphases, where applicable. Students should carefully review major requirements to determine if specific courses can also satisfy these general education categories.

- A list of university approved general education courses and administrative policies are available here (http://catalog.ndsu.edu/past-bulletin-archive/2021-22/academic-policies/undergraduate-policies/general-education/#genedcoursestext).

Major Requirements - Agricultural Option

Code	Title	Credits
ABEN Core Courses:		
ABEN 110	Introduction to Agricultural and Biosystems Engineering	3
ABEN 255	Computer Aided Analysis & Design	3
ABEN 263	Biological Materials Processing	3
ABEN 377	Numerical Modeling in Agricultural and Biosystems Engineering	3
ABEN 391	Seminar	1
ABEN 482	Instrumentation & Measurements	3
ABEN 486	Design Project I	2
ABEN 487	Design Project II	2
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 128	Introduction to Linear Algebra	1
MATH 165	Calculus I (May satisfy general education category R)	4
MATH 166	Calculus II	4
MATH 259	Multivariate Calculus	3
MATH 266	Introduction to Differential Equations	3
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
CE 309	Fluid Mechanics	3
or ME 352	Fluid Dynamics	
CHEM 121	General Chemistry I (May satisfy general education category S)	3
CHEM 122	General Chemistry II (May satisfy general education category S)	3
ECE 301	Electrical Engineering I	3
Select one from the following:		3
ENGL 321	Writing in the Technical Professions	
ENGL 324	Writing in the Sciences	
ENGL 459	Researching and Writing Grants and Proposal	
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	
PHYS 252	University Physics II	5
& 252L	and University Physics II Laboratory (May satisfy general education category S)	
Program Electives:		**23**
Select the following program electives in each category from courses listed in the corresponding Program Electives Tab. Minimum credit in each category below will apply. A minimum of 9 Adv. Bioscience credits (at least 3 credits non-ABEN) are required as part of these 23 program electives.		
Computer Electives	Select a minimum of 3 credits from the Program Electives Tab.	
Business or Communication Elective	Select a minimum of 3 credits from the following prefix options: BUSN, COMM, ACCT, AGEC, ECON, MGT, MIS, MRKT [2]	
Chemistry/Biological Science Electives	Select a minimum of 9 credits from the Program Electives Tab.	
Technical Electives	Select a minimum of 8 credits from the Program Electives Tab.	
Total Credits		**109**

[2] 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 for the Accelerated M.S. Program in Agricultural and Biosystems Engineering

Students pursuing an accelerated master's degree in ABEN must complete the following requirements:

- 30 credits after the B.S is required. However, a maximum of 15 graduate credits earned during the combined/accelerated degree program may also be counted toward the graduate degree.
- 20-24 credits are from didactic course work, while 6-10 credits are typically devoted for a master's thesis based on research
- A minimum of 6 credits of NDSU ABEN courses numbered 601-689 and 700-789 is required.
- ABEN Graduate Seminar (ABEN 790).

Major Requirements

Major: Agricultural & Biosystems Engineering
Option: Biosystems

Degree Type: B.S.A.B.En
Minimum Degree Credits to Graduate: 133

University Degree Requirements

1. Satisfactory completion of all requirements of the curriculum in which one is enrolled.
2. Earn a minimum total of 120 credits in approved coursework. Some academic programs exceed this minimum.
3. Satisfactory completion of the general education requirements as specified by the university.
4. A minimum institutional GPA of 2.00 based on work taken at NDSU.
5. At least 36 credits presented for graduation must be in courses numbered 300 or higher.
6. Transfer Students: Must earn a minimum of 60 credits from a baccalaureate-degree granting or professional institution.
   a. Of these 60, at least 36 must be NDSU resident credits as defined in #7.
   b. Within the 36 resident credits, a minimum of 15 must be in courses numbered 300 or higher and 15 credits in the major field of study.
7. At least 36 credits must be NDSU resident credits. Resident credits include credits registered and paid for at NDSU.

For complete information, please refer to the Degree and Graduation Requirements (http://catalog.ndsu.edu/past-bulletin-archive/2021-22/academic-policies/undergraduate-policies/degree-and-graduation/) section of this Bulletin.

University General Education Requirements

Code	Title	Credits
Communication (C)		**12**
ENGL 110	College Composition I	
ENGL 120	College Composition II	
COMM 110	Fundamentals of Public Speaking	
Upper Division Writing †		
Quantitative Reasoning (R) †		**3**
Science and Technology (S) †		**10**
Humanities and Fine Arts (A) †		**6**
Social and Behavioral Sciences (B) †		**6**
Wellness (W) †		**2**
Cultural Diversity (D) *†		
Global Perspectives (G) *†		
Total Credits		**39**

* May be satisfied by completing courses in another General Education category.

† General education courses may be used to satisfy requirements for both general education and the major, minor, and program emphases, where applicable. Students should carefully review major requirements to determine if specific courses can also satisfy these general education categories.

- A list of university approved general education courses and administrative policies are available here (http://catalog.ndsu.edu/past-bulletin-archive/2021-22/academic-policies/undergraduate-policies/general-education/#genedcoursestext).

Major Requirements - Biosystems Option

Code	Title	Credits
ABEN Core Requirements:		
ABEN 110	Introduction to Agricultural and Biosystems Engineering	3
ABEN 255	Computer Aided Analysis & Design	3
ABEN 263	Biological Materials Processing	3
ABEN 391	Seminar	1
ABEN 444	Transport Processes	3
ABEN 482	Instrumentation & Measurements	3
ABEN 486	Design Project I	2
ABEN 487	Design Project II	2
ABEN 496	Field Experience	1
ABEN 300-400 Electives: Select 9 credits from the following:		9
ABEN 358	Electric Energy Application in Agriculture	
ABEN 377	Numerical Modeling in Agricultural and Biosystems Engineering	
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/ME 479	Fluid Power Systems Design	
ABEN 484	Drainage and Wetland Engineering	
MATH 128	Introduction to Linear Algebra	1
MATH 165	Calculus I (May satisfy general education category R)	4
MATH 166	Calculus II	4
MATH 259	Multivariate Calculus	3
MATH 266	Introduction to Differential Equations	3

ME 221	Engineering Mechanics I	3
ME 222	Engineering Mechanics II	3
ME 350	Thermodynamics and Heat Transfer	3
BIOL 150	General Biology I	3
CHEM 121 & 121L	General Chemistry I and General Chemistry I Laboratory (May satisfy general education category S)	4
CHEM 122 & 122L	General Chemistry II and General Chemistry II Laboratory (May satisfy general education category S)	4
CHEM 240	Survey of Organic Chemistry	3
CE 309	Fluid Mechanics	3
Select one from the following:		3
ENGL 321	Writing in the Technical Professions	
ENGL 324	Writing in the Sciences	
ENGL 459	Researching and Writing Grants and Proposal	
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	
PHYS 252 & 252L	University Physics II and University Physics II Laboratory (May satisfy general education category S)	5
Program Electives:		**24**
Select the following program electives in each category from courses listed in the corresponding Program Electives Tab. Minimum credit in each category below will apply. A minimum of 9 Adv. Bioscience credits (at least 3 credits non-ABEN) are required as part of these 24 program electives.		
Engineering Electives	Select a minimum of 9 credits from the Program Electives Tab.	
Chemistry/Biological Science Electives	Select a minimum of 6 credits from the Program Electives Tab.	
Technical Electives	Select a minimum of 6 elective courses from the Program Electives Tab.	
Computer Elective	Select a minimum of 3 credits from the Program Electives Tab.	
Total Credits		**109**

Program Electives for the Agricultural and Biosystems Engineering - Agricultural Option

Code	Title	Credits
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 105	Fundamentals of Geographic Information Systems	
GEOG 455	Introduction to Geographic Information Systems	
IME 380	CAD/CAM for Manufacturing	
ME 213	Modeling of Engineering Systems	

Code	Title	Credits
Business or Communication Electives: Choose one of the following courses or a course from the following prefix options:		**3**
BUSN, COMM, ACCT, AGEC, ECON, MGT, MIS, MRKT (The course used for this elective cannot double-count as General Education)		
ACCT 102	Fundamentals of Accounting	
ACCT 200	Elements of Accounting I	
AGEC 242	Introduction to Agricultural Management	
AGEC 244	Agricultural Marketing	
AGEC 246	Introduction to Agricultural Finance	
COMM 212	Interpersonal Communication	
COMM 216	Intercultural Communication	

COMM 260	Introduction to Web Design
ECON 201	Principles of Microeconomics
ECON 202	Principles of Macroeconomics

Code	Title	Credits
Chemistry/Biological/Environmental Science Electives: Select 9 credits from the following:		**9**
ASM 264	Natural Resource Management Systems	
ANSC 220	Livestock Production	
BIOL 100L	Non-Majors Biology Lab	
BIOL 111	Concepts of Biology	
BIOL 124	Environmental Science	
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	
MICR 350	General Microbiology	
MICR 350L	General Microbiology Lab	
NRM 322	Environmental Law and Policy	
PLSC 110	World Food Crops	
PLSC 215	Weed Identification	
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	

Code	Title	Credits
Technical Electives: May choose from the ABEN section, Chemistry/Biological Science electives, Computer electives, or the Engineering electives listed below:		**8**
ABEN 496 - Ag Tech Expo (1 add'l cr.) may be used as a Technical Elective. ABEN 496 - Field Exp./Internship, 1 cr., may be used as an ABEN Elective or as a Technical Elective. A maximum of two credits of ABEN 496 FE/Internship may be counted towards degree requirements.		
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 310	Fluid Mechanics Laboratory	
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 473	
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
GEOG 455	Introduction to Geographic Information Systems
GEOG 456	Advanced Geographic Information Systems
IME 330	Manufacturing Processes
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 456	Program and Project Management
IME 461	Quality Assurance and Control
ME 331	Materials Science and Engineering
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
STAT 461	Applied Regression Models
STAT 462	Introduction to Experimental Design
Total Credits	**8**

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.
- 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.
- Advance Biosciences Electives - 9 credits required. Double Count with electives above. A minimum of 3 credits must be from non-ABEN prefix courses in the Advanced Biosciences tab.

Code	Title	Credits
AGRICULTURAL SYSTEMS		
ABEN 358	Electric Energy Application in Agriculture	
ABEN 444	Transport Processes	
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
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 343	Structural Engineering and Analysis
CE 404	Reinforced Concrete
ECE 275	Digital Design
ECE 303	Electrical Engineering II
ECE 376	Embedded Systems
GEOG 455	Introduction to Geographic Information Systems
GEOG 456	Advanced Geographic Information Systems
IME 330	Manufacturing Processes
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 456	Program and Project Management
IME 461	Quality Assurance and Control
ME 331	Materials Science and Engineering
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
ENVIRONMENTAL SYSTEMS	
ABEN 358	Electric Energy Application in Agriculture
ABEN 444	Transport Processes
ABEN 452	Bioenvironmental Systems Design
ABEN 456	Biobased Energy
ABEN 464	Resource Conservation and Irrigation Engineering
ABEN 479	Fluid Power Systems Design
ABEN 484	Drainage and Wetland Engineering
ASM 454	Principles and Application of Precision Agriculture
CE 204	Surveying
CE 370	Introduction to Environmental Engineering
CE 371	Environmental Engineering Laboratory
CE 408	Water Resources and Supply
CE 410	Water and Wastewater Engineering
CE 421	Open Channel Flow

CE 473	
CE 477	Applied Hydrology
CE 478	Water Quality Management
CE 479	Advanced Water and Wastewater Treatment
CE 483	Contracts and Specifications
CHEM 240	Survey of Organic Chemistry
CHEM 341	Organic Chemistry I
CHEM 341L	Organic Chemistry I Laboratory
ECE 303	Electrical Engineering II
ME 454	Heat and Mass Transfer
MICR 350	General Microbiology
SOIL 210	Introduction to Soil Science
SOIL 410	Soils and Land Use
BIOMATERIAL SYSTEMS	
ABEN 358	Electric Energy Application in Agriculture
ABEN 444	Transport Processes
ABEN 452	Bioenvironmental Systems Design
ABEN 456	Biobased Energy
ABEN 458	Process Engineering for Food, Biofuels and Bioproducts
ABEN 479	Fluid Power Systems Design
ABEN 479	Fluid Power Systems Design
ABEN 484	Drainage and Wetland Engineering
BIOC 460	Foundations of Biochemistry and Molecular Biology I
BIOC 460L	Foundations of Biochemistry I Laboratory
CFS 210	Introduction to Food Science and Technology
CFS 430	Food Unit Operations
CFS 450	Cereal Technology
CFS 470	Food Processing II
CFS 471	Food Processing Laboratory
CHEM 240	Survey of Organic Chemistry
CHEM 341	Organic Chemistry I
CHEM 341L	Organic Chemistry I Laboratory
CHEM 342	Organic Chemistry II
ECE 303	Electrical Engineering II
IME 450	Systems Engineering and Management
IME 460	Evaluation of Engineering Data
IME 461	Quality Assurance and Control
ME 331	Materials Science and Engineering
ME 442	Machine Design I
ME 454	Heat and Mass Transfer
MICR 350	General Microbiology

Code	Title	Credits
Advanced Biosciences Electives - 9 credits required. Students may double count with other program electives. A minimum of 3 credits must be from non-ABEN prefix courses in the Advanced Biosciences tab.		
ABEN Courses (Eligible for Adv. Biosci.)		
ABEN 444	Transport Processes	
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 484	Drainage and Wetland Engineering	
SOIL Courses		

SOIL 322	Soil Fertility and Fertilizers
SOIL 351	Soil Ecology
SOIL 410	Soils and Land Use
SOIL 444	Soil Genesis and Survey
SOIL 465	Soil And Plant Analysis
PLSC Courses	
PLSC 320	Principles of Forage Production
PLSC 335	Seed Technology & Production
PLSC 350	Sugarbeet Production
PLSC 411	Genomics
PLSC 431	Intermediate Genetics
Additional Course Options	
BIOL 364	General Ecology
ANSC 357	Animal Genetics
RNG 452	Managing Natural and Rangeland Resources using GIS

Code	Title	Credits
Engineering Electives: Select 9 credits from the following:		**9**
CE 310	Fluid Mechanics Laboratory	
CE 370	Introduction to Environmental Engineering	
CE 371	Environmental Engineering Laboratory	
ECE 301	Electrical Engineering I	
ME 223	Mechanics of Materials	
ME 331	Materials Science and Engineering	
Chemistry/Biological Science Electives: Select 6 credits from the following:		**6**
ANSC 357	Animal Genetics	
ANSC 463	Physiology of Reproduction	
BIOC 260	Elements of Biochemistry	
BIOC 461	Foundations of Biochemistry and Molecular Biology II	
BIOC 473	Methods of Biochemical Research	
BIOC 474	Methods of Recombinant DNA Technology	
BIOL 150L	General Biology I Laboratory	
BIOL 151	General Biology II	
BIOL 151L	General Biology II Laboratory	
BIOL 220	Human Anatomy and Physiology I	
BIOL 315	Genetics	
BIOL 315L	Genetics Laboratory	
BIOL 364	General Ecology	
CFS 210	Introduction to Food Science and Technology	
CFS 370	Food Processing I	
CFS 450	Cereal Technology	
CHEM 341	Organic Chemistry I	
CHEM 341L	Organic Chemistry I Laboratory	
CHEM 342	Organic Chemistry II	
CHEM 342L	Organic Chemistry II Laboratory	
MICR 202	Introductory Microbiology	
MICR 202L	Introductory Microbiology Lab	
MICR 350	General Microbiology	
MICR 350L	General Microbiology Lab	
MICR 352	General Microbiology II	
MICR 352L	General Microbiology Lab II	
MICR 452	Microbial Ecology	
Technical Electives: Select 6 credits from ABEN Electives, Engineering Electives, Chem/Bio Electives, or Computer Electives.		**6**

ABEN 496 - Ag Tech Expo (1 add'l cr.) may be used as a Technical Elective. ABEN 496 - Field Exp./Internship, 1 cr., may be used as an ABEN Elective or as a Technical Elective. A maximum of two credits of ABEN 496 FE/Internship may be counted towards degree requirements.

Computer Elective: Select 3 credits 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 212	Fundamentals of Visual Communication for Engineers	
ME 213	Modeling of Engineering Systems	
Total Credits		**24**

Code	Title	Credits
Advanced Biosciences Electives - 9 credits required. Students may double count with other program electives. A minimum of 3 credits must be from non-ABEN prefix courses in the Advanced Biosciences tab.		
ABEN Courses (Eligible for Adv. Biosci.)		
ABEN 444	Transport Processes	
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 484	Drainage and Wetland Engineering	
Engineering Electives (Eligible for Adv. Biosci.)		
CE 370	Introduction to Environmental Engineering	
CE 371	Environmental Engineering Laboratory	
CHEM/BIO Electives (Eligible for Adv. Biosci.)		
ANSC 357	Animal Genetics	
BIOC 260	Elements of Biochemistry	
BIOC 473	Methods of Biochemical Research	
BIOC 474	Methods of Recombinant DNA Technology	
BIOL 364	General Ecology	
CHEM 240	Survey of Organic Chemistry	
CHEM 341	Organic Chemistry I	
CHEM 341L	Organic Chemistry I Laboratory	
CHEM 342	Organic Chemistry II	
CHEM 342L	Organic Chemistry II Laboratory	
MICR 350	General Microbiology	
MICR 350L	General Microbiology Lab	
MICR 352	General Microbiology II	
MICR 352L	General Microbiology Lab II	
MICR 452	Microbial Ecology	