

## Biosystems Engineering

Accredited by the Engineering Accreditation Commission of ABET,  
 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 – telephone (410) 347-7700.

### University Requirements (23)

Writing, Rhetoric and American Cultures (WRA)  
 Integrative Studies in Humanities (IAH)  
 Integrative Studies in Social Sciences (ISS)  
 Bioscience (one of the following):  
 BS 111, MMG 201, PLB 105

### College Requirements (29)

CEM 141 General Chemistry 4  
 CSE 131 Technical Computing and Problem Solving 3  
 MTH 132 Calculus I 3  
 MTH 133 Calculus II 4  
 MTH 234 Multivariable Calculus 4  
 MTH 235 Differential Equations 3  
<sup>1</sup>PHY 183 Physics for Scientists and Engineers I 4  
<sup>1</sup>PHY 184 Physics for Scientists and Engineers II 4

### Major Requirements (58)

BE 130 Engineering Design Fundamentals for Biological Systems 2  
 BE 230 Engineering Analysis of Biological Systems 3  
 BE 332 Engineering Properties of Biological Materials 3  
 BE 333 Biosystems Engineering Laboratory 1  
 BE 350 Heat and Mass Transfer in Biosystems 3  
 BE 351 Environmental Thermodynamics 3  
 BE 431 Bio-resource Optimization 3  
 BE 485 Biosystems Design Techniques 3  
 BE 487 Biosystems Design Project (W) 3  
 BS 110 Organisms and Populations 4  
 CE 221 Statics 3  
 CE 321 Introduction to Fluid Mechanics 4  
 CEM 143 Survey of Organic Chemistry 4  
 CEM 161 Chemistry Laboratory I 1  
 ECE 345 Electronic Instrumentation and Systems 3  
 STT 351 Probability and Statistics for Engineering 3

### Select two of the following courses:

BE 456 Electric Power and Control 3  
<sup>2</sup>BE 477 Food Engineering: Fluids 3  
<sup>2</sup>BE 478 Food Engineering: Solids 3  
<sup>3</sup>BE 481 Land and Water Conservation Engineering 3  
<sup>3</sup>BE 482 Non-point Source Pollution Control 3

### Engineering Electives

Complete at least 6 credits in courses selected from a list of approved technical electives available from the Department, Website or Academic Advisor.

<sup>1</sup>If PHY 231 is taken in place of PHY 183, PHY 233B must also be completed. If PHY 232 is taken in place of PHY 184, PHY 234B must also be completed.

<sup>2</sup>Strongly recommended for Food Engineering Cognate.

<sup>3</sup>Strongly recommended for Ecosystems Engineering Cognate.

### Cognates (12)

4 A cognate consists of carefully selected courses that support a career objective involving the application of engineering skills to challenges  
 8 with critical biological components. The cognate allows for breadth of  
 8 interest and depth of learning for a given student. The cognate must  
 3 include at least one **biological science course** beyond the university requirements, at least one **quantitative/technical course**, and must include **300- and 400- level courses** to achieve depth in a particular area. Engineering electives cannot simultaneously satisfy the cognate requirement. Courses that are used to satisfy the engineering electives requirement and the cognate requirement must be chosen to form a career objective and be approved by the student's academic adviser.

A student has three choices for completing the cognate:

- Complete one of the two cognates developed by the department (described below):
  - Food Engineering (Food Processing Safety)
  - Ecosystems Engineering (Natural Resources and Environmental)
- Complete a college/university recognized option or Specialization, such as:
  - Biomedical Engineering
    - Biotechnology
- Complete a custom-designed cognate, consistent with the BE program objectives. These must be approved in advance by the academic adviser. Examples are:
  - Agricultural Engineering
  - Aquacultural Engineering

### a) Food Engineering Cognate

Food engineers develop new and innovative processing and preservation techniques to increase value and ensure the safety of manufactured food products. They study the physics, chemistry, and biology of food materials, in order to apply that knowledge to new and innovative engineering designs. Graduates in this area typically are employed by food manufacturing companies, food equipment companies, pharmaceutical companies, or regulatory agencies (e.g., FDA).

### Select at least 1 of the following biological science courses or approved alternatives:

6 MMG 201 Fundamentals of Microbiology 3  
 FSC 440 Food Microbiology 3

### Select at least 3 of the following or approved alternatives:

FSC 211 Principles of Food Science 3  
 FSC 401 Food Chemistry 3  
 FSC 421 Food Laws and Regulations 3  
 FSC 430 Food Processing: Fruits & Vegetables 3  
 FSC 431 Food Processing: Cereals 3  
 FSC 432 Food Processing: Dairy Foods 3  
 FSC 433 Food Processing: Muscle Foods 3  
 FW/FSC 275 Seafood Systems Management 3  
 HRT 403 Handling and Storage of Horticulture Crops 3

### **b) Ecosystems Engineering Cognate**

Ecosystems engineers take a proactive, systems approach to protecting our environment and conserving our natural resources. They apply geographic information systems (GIS) for watershed modeling, design constructed wetlands to manage water quality, develop on-site wastewater treatment systems, and generally apply their engineering skills to problems that involve complex plant and/or animal systems. Graduates in this area typically are employed by environmental consulting firms or regulatory agencies (e.g., Michigan Department of Environmental Quality or the U.S. Natural Resource Conservation Services).

**Select at least 1 of the following biological science courses approved alternatives:**

MMG 201	Fundamentals of Microbiology	3
MMG 425	Microbial Ecology	3
PLB 203	Biology of Plants	3
ZOL 355	Ecology	3

**Select at least 3 of the following or approved alternatives:**

ATM 431	Irrigation, Drainage & Erosion Control Systems	3
CSS 210	Fundamentals of Soil Science	3
CSS 360	Soil Biology	3
CSS 380	Crop Physiology	3
CSS 440	Soil Biophysics	3
CSS 455	Pollutants in the Soil Environment	3
CSS 470	Soil Resources	3
EEP 255	Ecological Economics	3
EEP 320	Environmental Economics	3
FOR 220	Forests and the Global Environment	3
FOR 404	Forest and Agricultural Ecology	3
FW 207	Great Lakes: Biology and Management	3
FW 364	Ecological Problem Solving	3
FW 410	Upland Ecosystem Management	3
FW 412	Wetland Ecology and Management	3
FW 443	Restoration Ecology	3
FW 472	Limnology	3
GEO 402	Agricultural Climatology	3
GLG 411	Hydrogeology	4
GLG 421	Environmental Geochemistry	4
ME 180	Engineering Graphic Communications	3
ESA 430	Law and Resources	3
ESA 460	Natural Resource Economics	3

### **c) Biomedical Engineering Specialization**

Biosystems engineers identify and solve problems at the interface of engineering and biology. In the biomedical area, Biosystems engineering students have opportunities for undergraduate research in areas such as microbial modeling and biosensors for rapid detection of pathogens. In this application area, Biosystems engineers find employment with pharmaceutical/healthcare companies, medical supply companies, and federal agencies, as well as continuing their studies in medical, veterinary, and graduate school.

BS 111	Cells and Molecules	3
PSL 250	Introductory Physiology	4

**Plus 9 credits from the following list:**

BME 401	Quantitative Human Biology	3 (spring only)
BME 490	Independent Study	1-4 (fall, spring or summer)
BME 491	Selected Topics	1-4 (fall, spring or summer)
ME 494	Biofluid Mechanics and Heat Transfer	3 (fall only)
ME 495	Tissue Mechanics	3 (spring only)
ME 497	Biomechanical Design	3 (spring only)
MSE 425	Biomaterials and Biocompatibility	3 (spring only)

**Other Electives (Variable)**

**Total Credits Required for Degree 128**

The requirements listed above apply to students admitted to the program beginning Fall 2007. The Department of Biosystems and Agricultural Engineering (BAE) constantly reviews program requirements and reserves the right to make changes as necessary. Consequently, each student is strongly encouraged to consult with his/her adviser to obtain assistance in planning an appropriate schedule of courses. Students who have questions about Biosystems Engineering should contact Elaine Johnson-Hahn (517) 355-6616 ext 1.

## Biosystems Engineering Sample Program

Freshman Year				Sophomore Year			
Fall	Credits	Spring	Credits	Fall	Credits	Spring	Credits
BE 130	2	Bioscience	3	CSE 131	3	BE 230	3
CEM 141	4	ISS 2XX	4	BS 110	4	CE 221	3
CEM 161	1	MTH 133	4	Cognate	3	CEM 143	4
MTH 132	3	PHY 183	4	MTH 234	4	IAH 20X	4
WRA 1XX	4			PHY 184	4	MTH 235	3
<b>Total</b>	<b>14</b>	<b>Total</b>	<b>15</b>	<b>Total</b>	<b>18</b>	<b>Total</b>	<b>17</b>

  

Junior Year				Senior Year			
Fall	Credits	Spring	Credits	Fall	Credits	Spring	Credits
BE 332	3	BE 350	3	BE 431	3	BE 487	3
BE 333	1	Cognate	3	BE 485	3	BE Elective	3
BE 351	3	Elective	3	BE Elective	3	Cognate	3
CE 321	4	ISS 3XX	4	Cognate	3	Elective	3
ECE 345	3	STT 351	3	Engr Elective	3	Engr Elective	3
IAH XXX	4						
<b>Total</b>	<b>18</b>	<b>Total</b>	<b>16</b>	<b>Total</b>	<b>15</b>	<b>Total</b>	<b>15</b>

### PROGRAM EDUCATIONAL OBJECTIVES

The overall purpose of the MSU biosystems engineering undergraduate program is to prepare graduates who will integrate and apply principles of engineering and biology to a wide variety of socially important problems. To achieve that purpose, the primary objectives of the biosystems engineering program are to prepare graduates to:

- identify and solve problems at the interface of biology and engineering, using modern engineering techniques and the systems approach, and
- analyze, design, and control components, systems, and processes that involve critical biological components.

Additionally, the biosystems engineering program is designed to help graduates succeed in diverse careers by developing a professional foundation that includes vision, adaptability, a practical mindset, effective communication skills, the ability to work in cross-disciplinary teams, an appreciation for global, economic, and societal issues, and a commitment to continuing professional growth and ethical conduct.

(Approved by the Biosystems Engineering faculty, student group, and Industry Advisory Board, April 2004)