3 | TEACHING PROGRAMS

Since the previous history of the Agricultural Engineering Department at the University of Illinois, which ended in 1997, there have been many changes in the curricula administered by the Department. The University changed the course numbering system, the Department name was changed to Agricultural and Biological Engineering and several official options have been changed. These changes for both the AE/ABE and TSM curricula are described below.

AGRICULTURAL ENGINEERING/AGRICULTURAL AND BIOLOGICAL ENGINEERING CURRICULUM

FROM 1997 TO 2006

The Agricultural Engineering curriculum in the College of Engineering, starting in Fall 1997, was defined in the UI Program of Study as follows:

Exhibit 3.1. Degree of Bachelor of Science in Agricultural Engineering in 1997

For the Degree of Bachelor of Science in Agricultural Engineering

Agricultural engineering is the integration of biological and physical

sciences as a foundation for engineering applications in agriculture, food systems, natural resources, the environment, and related biological systems. The goals of the program are to prepare men and women for professional careers in engineering practice or related positions in education and government.

Design experience begins in the freshman year and is integrated throughout the curriculum in the lectures, discussions, homework, and lab assignments of many of the courses dealing with engineering topics. Agricultural engineers are involved in the design of systems that include food and bioprocess engineering, off-road equipment, bioenvironmental engineering of plant and animal facilities, water quality, and systems for the use and protection of soil and water resources. Important design constraints are economics, conservation of materials and energy, safety, and environmental quality. All students complete a major design project in the senior year that draws comprehensively on the knowledge gained in the foundational courses.

Graduates are employed by industry, consulting firms, and government for research, education, and manufacturing. All graduates obtain a four-year ABET-accredited Bachelor of Science degree from the College of Engineering and, in an optional five-year program, may receive a second Bachelor of Science degree in agricultural engineering sciences from the College of Agricultural, Consumer, and Environmental Sciences. By choice of electives, a student may direct his or her program toward specialization in power and machinery, soil and water, structures and environment, or electric power and processing or to a separate food and bioprocess engineering specialization. Individual programs are checked by departmental advisers to ensure that Accreditation Board for Engineering and Technology requirements are met for any chosen specialization.

The curriculum requires 128 hours for gradation except for the specialization in food and bioprocess engineering, which requires 132 hours for graduation.

SPECIALIZATION IN POWER AND MACHINERY, SOIL AND WATER, STRUCTURES AND ENVIRONMENT, OR ELECTRIC POWER AND PROCESSING

First year

HOURS	FIRST SEMESTER
1	AG E 100-Introduction to Agricultural Engineering
4	CHEM 101-General Chemistry
0	ENG 100-Engineering Lecture
3	G E 103-Engineering Graphics and Design
5	MATH 120-Calculus and Analytic Geometry, I
4	RHET 105-Principles of Composition[1]
17	Total
HOURS	SECOND SEMESTER
4	CHEM 102-General Chemistry (Biological or Physical Version)*
3	MATH 130-Calculus and Analytic Geometry, II
2	MATH 225-Introductory Matrix Theory
4	PHYCS 111-General Physics (Mechanics)
4	Biological and natural sciences elective[2]
17	Total

*Biological version recommended.

Second year

HOURS	FIRST SEMESTER
4	AG E 221-Engineering for Agricultural and Biological Systems
3	C S 101-Introduction to Computing with Application to Engineering and Physical Science
3	MATH 242-Calculus of Several Variables
4	PHYCS 112-General Physics (Electricity and Magnetism)
2-3	T A M 150-Introduction to Statics or T A M 152-Engineeering Mechanics, I (Statics)
16-17	Total

HOURS	SECOND SEMESTER
4	AG E 222-Engineering for Bioprocessing and Bioenvironmental Systems
3	MATH 285-Differential Equations and Orthogonal Functions
2	PHYCS 113-General Physics (Fluids and Thermal Physics)
3	T A M 212-Engineering Mechanics, II (Dynamics)
3	Elective in social sciences or humanities[3, 4]
15	Total

Third year

HOURS	FIRST SEMESTER
3	Agricultural engineering technical elective[5]
3	ECE 205-Introduction to Electrical and Electronic Circuits
1	ECE 206-Introduction to Electrical and Electronic Circuits Laboratory
3	T A M 221-Elementary Mechanics of Solids
3-4	STAT 310/MATH 363-Introduction to Mathematical Statistics and Probability, I; or C E 293-Engineering Modeling Under Uncertainty; or I E 230-Analysis of Data
3	Elective in social sciences or humanities[3, 4]
16-17	Total
HOURS	SECOND SEMESTER
3	Agricultural engineering technical elective[5]
1	AG E 298-Undergraduate Seminar
3	ECON 103-Macroeconomic Principles[3]
3-4	M E 209-Thermodynamics and Heat Transfer, or M E 205-Thermodynamics, or CH E 370-Chemical Engineering Thermodynamics
3-4	T A M 235-Fluid Mechanics, or CH E 371-Fluid Mechanics and Heat Transfer, or M E 211-Introductory Gas Dynamics
3	Elective in social sciences or humanities[3, 4]
16-18	Total

Fourth year

HOURS	FIRST SEMESTER
3	Agricultural engineering technical elective[5]
3	Elective in social sciences or humanities[3, 4]
4	Technical elective[5]
3	Free elective[4]
2	AG E 299-Undergraduate Thesis
15	Total
HOURS	SECOND SEMESTER
3	Agricultural engineering technical elective[5]
3	Free elective[4]
3	Technical elective[5]
4	Biological and natural sciences elective[2]
3	Elective in social sciences or humanities [3, 4]
16	Total

1. Students may take SPCOM 111 and 112 in place of RHET 105.
2. Students must complete eight hours from biological and natural sciences approved list.
3. Each student must satisfy the social sciences and humanities requirements of the College of Engineering, including ECON 102 or 103. Students entering in fall 1994 and later must also satisfy the campus general education requirements for social sciences and humanities.
4. One elective course must satisfy the general education Composition II requirement.
5. Students must have 19 hours of technical electives; at least 12 hours must be from AG E courses and the remainder selected from the department-approved list.

Biological and Natural Sciences Electives

HOURS	
8 min	Choose from:
3	CP SC 322-Forage Crops and Pastures
3	AN SCI 202-Domestic Animal Physiology
3	AN SCI 307-Environmental Aspects of Animal Management
3	BIOL 100-Biological Sciences[1]
4	BIOL 101-Biological Sciences[1]

4	BIOL 104-Animal Biology[1]
3	CHEM 231-Elementary Organic Chemistry
2	CHEM 234-Elementary Organic Chemistry Laboratory
3	ENT 120-Introduction to Applied Entomology
4	GEOL 101-Introduction to Physical Geology
3	GEOL 250-Geology for Engineers
3	HORT 227-Indoor Plant Culture, Use, and Identification
4	HORT 345-Growth and Development of Horticultural Crops
3	MCBIO 100-Introductory Microbiology[1]
2	MCBIO 101-Introductory Experimental Microbiology
3	MCBIO 311-Food and Industrial Microbiology
2	MCBIO 312-Techniques of Applied Microbiology
4	PLBIO 100-Plant Biology[1]
4	PHYSL 103-Introduction to Human Physiology
4	SOILS 101-Introductory Soils

1. Students must take at least one of these courses.

Technical Electives

For a total of 19 hours.

Agricultural Engineering Technical Electives

HOURS	
3	AG E 236-Machine Characteristics and Mechanisms
2	AG E 271-Transport Phenomena in Food Process Design
3	AG E 277-Design of Architectural Structures[1]
3	AG E 287-Environmental Control for Plants and Animals1
3-4	AG E 311-Instrumentation and Measurement[2]
3	AG E 315-Applied Machine Vision
3	AG E 336-Engineering Design Projects for Agricultural Industries[1]
3	AG E 346-Tractors and Prime Movers
3	AG E 356-Soil and Water Conservation Structures[1]

3 AG E 357-Land Drainage[1]
3 AG E 383-Engineering Properties of Food Materials
2 AG E 385-Food and Process Engineering Design[1]
3 AG E 387-Grain Drying and Conditioning
3 AG E 389-Process Design for Corn Milling

1. Students must take at least one of these courses. Includes major design experience.
2. This course is strongly recommended.

Other Technical Electives

Choose the remainder of the 19 hours from:

4 C E 201-Engineering Surveying
3 C E 241-Environmental Quality Engineering
3 C E 255-Introduction to Hydrosystems Engineering[1]
3 C E 261-Introduction to Structural Engineering[1]
3 C E 263-Behavior and Design of Metal Structures, I
3 C E 264-Reinforced Concrete Design, I
3 C E 280-Introduction to Soil Mechanics and Foundation Engineering
3 C E 350-Surface Water Hydrology
3 C E 361-Matrix Analysis of Frame Structures
4 CHEM 323-Applied Electronics for Scientists
3 CH E 261-Introduction to Chemical Engineering
3 CH E 370-Chemical Engineering Thermodynamics
4 CH E 371-Fluid Mechanics and Heat Transfer
4 CH E 373-Mass Transfer Operations
3 G E 288-Engineering Economy and Operations Research
4 M E 231-Engineering Materials
4 M E 270-Fundamentals of Mechanical Design[1]
3 M E 285-Design for manufacturability
3 M E 307-Solar Energy Utilization
3 MFG E 210-Introduction to Manufacturing Systems
3 MFG E 350-Information Management for Manufacturing Systems

Any 200- or 300-level engineering course approved by an adviser.

1. One of these courses is strongly recommended.

SPECIALIZATION IN FOOD AND BIOPROCESS ENGINEERING

Food and bioprocess engineering is the application of engineering principles to produce, preserve, process, package, and distribute foods. Food and bioprocess engineers develop, design, and construct new machinery, processes, and plants; they develop and test new products; they preserve and distribute foods; and they manage environmental factors, waste products, and energy. Food and bioprocess engineers participate in nearly every phase of food processing. Graduates are prepared for positions in a variety of industries, including food, pharmaceutical, and biotechnology industries. Job opportunities also exist with the government, universities, and consulting firms. Career possibilities include research and development; project, process, and plant engineering, which can include design, optimization, and construction; technical sales and service; and supervision and management. Those who continue their education in graduate school will have a strong background for further study in the sciences or engineering.

First year

HOURS	FIRST SEMESTER
1	AG E 100-Introduction to Agricultural Engineering
4	CHEM 101-General Chemistry
0	ENG 100-Engineering Lecture
3	G E 103-Engineering Graphics and Design
5	MATH 120-Calculus and Analytic Geometry, I
4	RHET 105-Principles of Composition[1]
17	Total
HOURS	SECOND SEMESTER
4	CHEM 102-General Chemistry (Biological or Physical Version)
3	C S 101-Introduction to Computing with Application to Engineering and Physical Science
3	MATH 130-Calculus and Analytic Geometry, II
2	MATH 225-Introductory Matrix Theory
4	PHYCS 111-General Physics (Mechanics)
16	Total

Second year

HOURS	FIRST SEMESTER
3	CHEM 231-Elementary Organic Chemistry
3	ECON 103-Macroeconomic Principles[2]
3	MATH 242-Calculus of Several Variables
3	MCBIO 100-Introductory Microbiology
2	PHYCS 113-General Physics (Fluids and Thermal Physics)
2-3	T A M 150-Introduction to Statics or T A M 152-Engineering Mechanics, I (Statics)
16-17	Total
HOURS	SECOND SEMESTER
4	AG E 222-Engineering for Bioprocessing and Bioenvironmental Systems
3	MATH 285-Differential Equations and Orthogonal Functions
2	MCBIO 101-Introductory Experimental Microbiology
4	PHYCS 112-General Physics (Electricity and Magnetism)
3	T A M 212-Engineering Mechanics, II (Dynamics)
17	Total

Third year

HOURS	FIRST SEMESTER
3	CH E 261-Introduction to Chemical Engineering
4	F S H N 314-Food Chemistry and Nutrition, I
3	T A M 221-Elementary Mechanics of Solids
2	Technical elective3
6	Electives in social sciences or humanities[2, 4]
18	Total
HOURS	SECOND SEMESTER
1	AG E 298-Undergraduate Seminar
3	CH E 370-Chemical Engineering Thermodynamics
3	ECE 205-Introduction to Electrical and Electronic Circuits
3	MCBIO 311-Food and Industrial Microbiology
3	Free elective4

3	Elective in social sciences or humanities[2, 4]
16	Total

Fourth year

HOURS	FIRST SEMESTER
3	AG E 383-Engineering Properties of Food Materials
4	CH E 371-Fluid Mechanics and Heat Transfer
3	F S H N 361-Food Processing, I
3	Technical elective[3]
3	Elective in social sciences or humanities[2, 4]
16	Total
HOURS	SECOND SEMESTER
2	AG E 299-Undergraduate Thesis
2	AG E 385-Food and Process Engineering Design
4	CH E 373-Mass Transfer Operations
3	F S H N 362-Food Processing, II
3	Free elective4
3	Elective in social sciences or humanities[2, 4]
17	Total

1. Students may take SPCOM 111 and 112 in place of RHET 105.
2. Each student must satisfy the social sciences and humanities requirements of the College of Engineering, including ECON 102 or 103. Students entering in fall 1994 and later must also satisfy the campus general education requirements for social sciences and humanities.
3. Students select technical electives from the approved list for food and bioprocess engineering.
4. One elective course must satisfy the general education Composition II requirement.

Food and Bioprocess Engineering Electives

HOURS	TECHNICAL ELECTIVES
1	AG E 284-Scale-Up of Food Processes
3-4	AG E 311-Instrumentation and Measurements
3	AG E 315-Applied Machine Vision
3	AG E 387-Grain Drying and Conditioning
3	AG E 389-Process Design for Corn Milling
3	AG E 396-Special Problems (Package Engineering)

3-4	C E 293-Engineering Modeling Under Uncertainty, I E 230-Analysis of Data, or STAT 310/MATH 363-Introduction to Mathematical Statistics and Probability, I
3	CH E 389-Chemical Process Control and Dynamics
3	G E 288-Engineering Economy and Operations Research or I E 203-Engineering Economics
.4	M E 270-Fundamentals of Mechanical Design
3	M E 261-Introduction to Instrumentation, Measurement, and Control Fundamentals
2	MCBIO 312-Techniques of Applied Microbiology

A dual program between the College of ACES and the College of Engineering was also available. It was essentially the curriculum for the College of Engineering with additional Agricultural coursework as described as follows in the Program of Study. Although several students start their program under the dual major, few finish with both degrees.

Exhibit 3.2. Dual Major in Agricultural Engineering and in Agricultural Engineering Sciences in 1997

Dual Major In Agricultural Engineering And In Agricultural Engineering Sciences

For the Degree of Bachelor of Science and the Degree of Bachelor of Science in Agriculture in Agricultural Engineering-Agriculture Science

This is a five-year program that results in a B.S. degree from the College of Engineering and a B.S. degree from the College of Agricultural, Consumer and Environmental Sciences. The 158 hour curriculum meets the requirements for both degrees.

Agricultural engineering is the integration of biological and physical sciences as a foundation for engineering applications in agriculture, food systems, natural resources, the environment, and related biological systems. Agricultural engineers are involved in the design of systems which include food and bioprocess engineering, off-road equipment, bioenvironmental engineering of plant and animal facilities, water quality and systems for the utilization and protection of soil and water resources. Important design constraints are economics, conservation of

materials and energy, safety, and environmental quality. Graduates are employed by industry, consulting firms, and government for research, education, and manufacturing. By choice of electives, a student may direct his or her program toward specialization in power and machinery, soil and water, structures and environment, electrical power and processing, or to a separate food and bioprocess engineering specialization. Individual programs are checked by departmental advisers to insure that national engineering accreditation (ABET) requirements are met for any chosen specialization.

PRESCRIBED COURSES INCLUDING CAMPUS GENERAL EDUCATION

HOURS	COMPOSITION I AND SPEECH
4-3	RHET 105-Principles of Composition or equivalent
(see college Composition I requirement)	
3	SPCOM 101-Principles of Effective Speaking
HOURS	COMPOSITION II
Select from campus approved list.	
HOURS	QUANTITATIVE REASONING
3	C S 101-Introduction to Computing with Application to Engineering
5	MATH 120-Calculus and Analytic Geometry I
3	MATH 130-Calculus and Analytic Geometry II
3	MATH 225-Introductory Matrix Theory
3	MATH 242-Calculus of Several Variables
3	MATH 285-Differential Equations & Orthogonal Functions
HOURS	NATURAL SCIENCES
4	CHEM 101-General Chemistry
4	CHEM 102-General Chemistry
4	PHYCS 111-Mechanics
4	PHYCS 112-Electricity and Magnetism
2	PHYCS 113-Fluid and Thermal Physics
HOURS	BIOLOGICAL SCIENCE
10	Ten hours of biological sciences are required from biology, entomology, microbiology, plant biology, physiology and zoology. Select at least eight of the ten

hours from the following:
BIOL 100*-Biological Sciences
BIOL 101*-Biological Sciences
BIOL 104*-Animal Biology
CPSC 322-Forage Crops and Pastures
ANSCI 202-Domestic Animal Physiology
ANSCI 307-Environmental Aspects of Animal Management
GEOL 101-Introduction to Physical Geology
GEOL 250-Geology for Engineers
HORT 227-Indoor Plant Culture
HORT 345-Growth and Development of Horticultural Crops
MCBIO 100*-Introduction to Microbiology
MCBIO 101-Introduction to Experimental Microbiology
MCBIO 311-Food and Industrial Microbiology
MCBIO 312-Techniques of Applied Microbiology
PLBIO 100*-Plant Biology or Agronomy 121
PHYSL 103-Introduction to Human Physiology
SOILS 101-Introductory Soils
CHEM 231-Elementary Organic Chemistry
CHEM 234-Elementary Organic Chemistry Lab
ENTOM 120-Introduction to Applied Entomology

* Students must take at least one of these courses.

HOURS	HUMANITIES[1] AND SOCIAL SCIENCE[1]
18	To include ACE 100-Economics of Resources, Agriculture and Food, or ECON 102-Microeconomic Principles, or ECON 103-Macroeconomic Principles.
	CULTURAL STUDIES[2]
	One western culture and one non-western/US minority culture course.

1. Students must complete ACE 100, ECON 102 or ECON 103 and 15 additional hours of social sciences or humanities courses that satisfy the requirements of approved lists for the College of Engineering, the College of Agricultural, Consumer and Environmental Sciences, and the campus general education requirement. The College of Engineering requires one six-hour sequence in social science and one six-hour

sequence in humanities from approved courses. Since these may differ, students should carefully select approved courses that meet the requirements for all of the lists.

2. Work with adviser to select courses that also satisfy the social sciences and humanities requirements.

HOURS	AG E PRESCRIBED
1	1 AG E 100-Introduction to Agricultural Engineering
4	AG E 221-Engineering for Agricultural and Biological Systems
4	AG E 222-Engineering for Bioprocess and Bioenvironmental Systems
1	AG E 298-Undergraduate Seminar
3	AG E 299-Undergraduate Thesis
HOURS	OTHER PRESCRIBED
0	ENG 100-Engineering Lecture
3	ECE 205-Introduction to Electrical & Electronic Circuits
1	ECE 206-Lab to ECE 205
3	G E 103-Engineering Graphics & Design
3-4	M E 209-Thermodynamics & Heat Transfer, or M E 205-Thermodynamics, or CH E 370-Chemical Engineering Thermodynamics
3-4	STAT 310-Statistics, or MATH 363-Intro to MATH Statistics and Probability, I, or C E 293-Engineering Modeling Under Uncertainty, or I E 230-Analysis of Data
2-3	TAM 150-Analytical Mechanics or TAM 152-Engineering Mechanics, I
3	TAM 212-Engineering Mechanics, II
3	TAM 221-Elementary Mechanics of Solids
3-4	TAM 235-Fluid Mechanics, or CH E 371-Fluid Mechanics and Heat Transfer, or M E 211-Introductory to Gas Dynamics
AGRICULTURAL SCIENCE ELECTIVES	
15	Fifteen hours of agricultural sciences with courses from at least two departments other than Agricultural Engineering and approval of advisors are required.
HOURS	TECHNICAL ELECTIVES

19 Technical electives are upper level engineering courses. Students can choose from the recommended list below or by consent of adviser.

AGRICULTURAL ENGINEERING TECHNICAL ELECTIVES

At least 12 hours from:

AG E 236-Machine Characteristics and Mechanics
AG E 271-Transport Phenomena in Food Process Design
AG E 277*-Design of Agricultural Structures
AG E 287*-Environmental Control for Plants and Animals
AG E 311#-Instrumentation and Measurements
AG E 315-Applied Machine Vision
AG E 336*-Design of Agricultural Machinery
AG E 346-Tractors and Prime Movers
AG E 356*-Soil and Water Conservation Structures
AG E 357*-Land Drainage
AG E 383-Engineering Properties of Food Materials
AG E 385*-Food and Process Engineering Design
AG E 387-Grain Drying and Conditioning
AG E 389-Process Design for Corn Milling

*Students must take at least one of these courses. Includes major design experience.

#This course is strongly recommended.

OTHER TECHNICAL ELECTIVES

Remainder of the 19 hours from:

C E 201-Engineering Surveying or C E 205
C E 241-Air and Water Quality
C E 255*-Introduction to Hydrosystems Engineering
C E 261*-Introduction to Structural Engineering
C E 262-Intermediate Structural Analysis
C E 263-Behavior and Design of Metal Structure
C E 264-Reinforced Concrete Design
C E 280-Introduction to Soil Mechanics and Foundation Engineering
C E 350-Surface Water Hydrology
CHEM 323-Applied Electronics for Scientists

CH E 261-Introduction to Chemical Engineering
CH E 370-Chemical Engineering Thermodynamics
CH E 371-Fluid Mechanics and Heat Transfer
CH E 373-Mass Transfer Operations
G E 288-Engineering Economy and Operations Research
M E 270*-Fundamentals of Mechanical Design
M E 231-Processing and Structure of Materials
M E 285-Design for Manufacturability
M E 307-Solar Energy Utilization
M E 313-Computer Controls of Mechanical Engineering Systems
MFG E 210-Introduction to Manufacturing Systems
MFG E 350-Information Management for Manufacturing Systems
or any 200 or 300 level engineering course approved by adviser

*One of these courses is strongly recommended.

HOURS	OPEN ELECTIVES
11-14	Sufficient open electives selected to total minimum curriculum requirement of 158 hours. All requirements of the combined curriculum must be completed to satisfy the requirements for both degrees.
158	Total hours required to receive a B.S. in Agricultural Engineering and a B.S. in Agricultural Sciences.

In 1999 the following changes were made in course offerings:

1. Chem 101 - General Chemistry, 4 hrs, was replaced by Chem 102 - General Chemistry 3 hrs and Chem 106 - General Chemistry Laboratory, 1 hr.
2. Chem 102 - General Chemistry, 4 hrs, was replaced by Chem 102 - General Chemistry 3 hrs and Chem 106 - General Chemistry Laboratory, 1 hr.
3. ME 209 was discontinued as a thermodynamics alternative.
4. Hort 227 was discontinued as a Biological and Natural Science Elective.
5. ME 271 - Mechanical Engineering, I, 3 hrs. was added as an Other Technical Elective.

In 2001 the following changes were made in course offerings:

1. AgE 271 - Transport Phenomena in Food Process Design, 2 hrs, was discontinued.
2. AgE 360 - Indoor Air Containment Measurement and Control, 3 hrs, was added as an Ag Technical Elective.

In the Fall of 2004 a new system of course numbering was initiated. However, as a follow-up to the previous history that ended in 1997, following is a list of AgE courses from 1997 to 2004. Following the course name and number is the instructor that developed the course and date (if new), names of other instructors of the course, and date when discontinued.

Table 3.1. Courses in Agricultural Engineering prior to 2004

AG E 100: "Introduction to Agricultural Engineering, L.E. Bode.

AG E, 199: "Undergraduate Open Seminar", Faculty.

AG E , 221: "Engineering for Agricultural and Biological Systems", J.F. Reid, P. Kalita.

AG E, 222: "Engineering for Bioprocessing and Bioenvironmental Systems", S.R. Eckhoff, P. Kalita, Y. Zhang.

AG E, 236: "Machine Characteristics and Mechanisms".

AG E, 271: "Transport Phenomena in Food Process Design", Discontinued 2001.

AG E, 277: "Design of Agricultural Structures", G.L. Riskowski, Discontinued 2003.

AG E, 282: "Food Packaging Technology" 97, Discontinued 1999.

AG E, 284: "Scale-up of Food Processes" '97, '99, Discontinued 2000.

AG E, 287: "Environmental Control for Plants and Animals", L.L. Christianson.

AG E, 293: "Off-Campus Internship", 2002, Faculty.

AG E, 295: "Undergraduate Research or Thesis", 2002, Faculty.

AG E, 296: "Honors Project", Faculty.

AG E, 298: "Undergraduate Seminar", L.L. Christianson, Discontinued 2002.

AG E, 299: "Undergraduate Thesis", Faculty, Discontinued 2002.

AG E, 311: "Instrumentation and Measurements", Q. Zhang.

AG E, 315: "Applied Machine Vision", J.F. Reid.

AG E, 320: "Kinematics and Dynamics of Mechanical Engineering".

AG E, 324: "Agricultural Engineering Project Management", 2002.

AG E, 336: "Engineering Design Projects for Agricultural Industries", D.L. Bosworth.

AG E, 399: "Seminar", 2003, Faculty.

AG E, 340: "Applied Statistical Methods".

AG E, 345: "Statistical Methods".

AG E, 346: "Tractors and Prime Movers", A.C. Hansen.

AG E, 356: "Soil and Water Conservation Structures", J.K. Mitchell, P. Kalita.

AG E, 357: "Land Drainage", R.A.C. Cooke.

AG E, 360: "Indoor Air Contaminant Measurement and Control", 1999, Y. Zhang.

AG E, 377: "Design of Agricultural and Bioenvironmental Structures", 2003.

AG E, 382: "Package Engineering", 2001.

AG E, 383: "Engineering Properties of Food Materials", K.D. Rausch.

AG E, 385: "Food and Process Engineering Design", K.D. Rausch.

AG E, 387: "Grain Drying and Conditioning", M.R. Paulsen.

AG E, 389: "Process Design for Corn Milling", S.R. Eckhoff.

AG E, 396: "Special Problems", Faculty.

AG E, 400: "Research Orientation", Graduate Faculty.

AG E, 434: "Computer Aided Kinematics" not in '01, Discontinued prior to 2001.

AG E, 436: "Dynamics of Farm Machine Elements" not in '01, Discontinued prior to 2001.

AG E, 446: "Mechatronic Systems of Off-Road Vehicles", Q. Zhang.

AG E, 490: "Seminar", Graduate Faculty.

AG E, 496: "Topics in Agricultural Engineering", Graduate Faculty.

AG E, 499: "Thesis Research", Graduate Faculty.

The extensive project of renumbering courses to match campus directives and the change of name of the Department resulted in a new list of courses in 2004. Although the Department name was changed in

2004, the engineering curriculum remained Agricultural Engineering. The request to change the curriculum name to Agricultural and Biological Engineering was initiated in 2006 and approved for the 2009 program year. Following are the courses available from 2004 to present in Agricultural and Biological Engineering with the entries containing:

a) Course Number
b) Previous course number in parenthesis
c) Course title
d) Date course was started, if new
e) Faculty member who revised the course for the new system
f) Faculty who have taught the course
g) Date course discontinued

FROM 2006 TO 2010

The result of these changes was a Program of Study until 2010 as follows:

Exhibit 3.3. The Degree of Bachelor of Science in Agricultural and Biological Engineering, 2006 to 2010

For the Degree of Bachelor of Science in Agricultural and Biological Engineering

Agricultural and biological engineering is the application of mathematics, physical and biological science, and engineering to agriculture, food systems, energy, natural resources, the environment, and related biological systems. This program has special emphasis on environmental protection and the biological interface of plants, animals, soils, and microorganisms with the design and performance of environments, machines, mechanisms, processes, and structures.

Areas of Study

The agricultural and biological engineering program provides four standard Areas of Study.

Table 3.2. Courses in ABE from 2004

ABE	100	(100)	Intro Agric & Biological Engrg	L.E. Bode, A.C. Hansen, M. Danao, A. Green, R.S. Gates.
ABE	199	(199)	Undergraduate Open Seminar	Faculty.
ABE	221	(221)	Agric & Biological Engrg I	P. Kalita, T.E. Grift.
ABE	222	(222)	Agric & Biological Engrg II	Y. Zhang, S.R. Eckhoff, L.F. Rodriguez.
ABE	293	(293)	Off-Campus Internships	Discontinued 2007.
ABE	295	(295)	Independent Study	Discontinued 2007.
ABE	361	(236)	Off-Road Machine Design	A.C. Hansen, L. Tian.
ABE	374	(287)	Environ Control for Buildings	X. Wang, A. Green.
ABE	396	(296)	Honors Independent Study	Faculty.
ABE	397		Independent Study	Faculty.
ABE	398		Special Topics	Faculty.
ABE	420	(320)	Kinem & Dynamics of Mech Syst	Faculty of MIE.
ABE	425	(311)	Engr Measurement Systems	Q. Zhang, T.E. Grift.
ABE	426	(315)	Applied Machine Vision	T.E. Grift, discontinued 2009.
ABE	430	(324)	Project Management	L.E. Christianson, S.C. Zahos, L. Schideman.
ABE	436		Renewable Energy Systems	2007, X. Wang.
ABE	440	(340)	Applied Statistical Methods I	NRES Faculty.

ABE	445	(395)	Statistical Methods	AnSci Faculty.
ABE	446		Biological Nanoengineering	2009, K. Bhalerao.
ABE	455		Erosion and Sediment Control	2007, M.C. Hirschi.
ABE	456	(356)	Land & Water Resources Engrg	P. Kalita.
ABE	457		NPS Pollution Processes	2009, P. Kalita.
ABE	458		NPS Pollution Modelling	2009, R.A.C. Cooke.
ABE	459	(357)	Drainage and Water Management	R.A.C.Cooke.
ABE	463		Electrohydraulic Systems	2008, Q. Zhang, T.E. Grift.
ABE	466	(346)	Engineering Off-Road Vehicles	A.C. Hansen.
ABE	469	(336)	Industry-Linked Design Project	A.C. Hansen, S.C. Zahos, L. Schideman.
ABE	476	(360)	Indoor Air Quality Engineering	Y. Zhang.
ABE	479		Light Frame Structure Design	X. Wang, Discontinued 2008.
ABE	482	(382)	Package Engineering	S. Morris.
ABE	483	(383)	Engrg Properties of Food Matls	K.D. Rausch.
ABE	485	(385)	Food & Process Engrg Design	K.D. Rausch.
ABE	487	(387)	Grain Drying and Conditioning	M.R. Paulsen.
ABE	488		Bioprocessing Grains for Fuels	2006,V. Singh.
ABE	489	(389)	Corn Milling Process Design	S.R. Eckhoff.

ABE	497		Independent Study	2007, Faculty.
ABE	498	(396)	Special Topics	Faculty.
ABE	501	(400)	Graduate Research I	L.E. Bode, Y. Zhang.
ABE	502	(490)	Graduate Research II	S.R. Eckhoff.
ABE	594		Graduate Seminar	2006, M.R. Paulsen, L.E. Bode, P. Kalita, Y. Zhang, S.R. Eckhoff.
ABE	561	(446)	Off-Road Vehicle Mechatronics	Q. Zhang.
ABE	597	(496)	Independent Study	Graduate Faculty.
ABE	598		Special Topics	2008, Graduate Faculty.
ABE	599	(499)	Thesis Research	Graduate Faculty.

Specializations

- Bioenvironmental Engineering: the application of engineering principles to design, manufacture, and test systems that provide the desired environmental conditions for animals, human housing, crop storage structures, greenhouses, and other biological systems. Bioenvironmental engineers design equipment for heating, ventilating, air-conditioning, air-quality control, and develop systems to handle and treat biowaste.
- Off-Road Equipment Engineering: the application of engineering knowledge and skill to design, manufacture, and test equipment for the agricultural, construction, forestry, and mining industries. Off-road equipment engineers develop precision machine systems that rely on advanced information and sensing technologies and a high level of automation and control.
- Soil and Water Resource Engineering: the application of engineering principles and practices to design and develop systems for natural resources and environmental protection and utilization. Soil and water engineers design systems to control soil erosion and flooding, and develop ways to handle stormwater and control the movement of sediment into water systems.

Concentration

- Food and Bioprocess Engineering: the application of engineering principles to produce, process and package foods and bioproducts. Food and bioprocess engineers design, develop, and construct new processes, machines, and plants; they develop and test new products; and they manage environmental factors, waste products, and energy conservation.

Overview of Curricular Requirements

The curriculum requires 128 hours for graduation, except for the Concentration in Food and Bioprocess Engineering, which requires 132 hours. The curriculum is organized as follows.

Orientation and Professional Development

These courses introduce the opportunities and resources your college,

department, and curriculum can offer you as you work to achieve your career goals. They also provide the skills to work effectively and successfully in the engineering profession.

Hours	Requirements
1	ABE 100-Agric & Biological Engrg[1]
0	ENG 100-Engineering Orientation[1]
1	Total

1. External transfer students take ENG 300-Engrg Transfer Orientation instead.

Foundational Mathematics and Science

These courses stress the basic mathematical and scientific principles upon which the engineering discipline is based.

Hours	Requirements
3	CHEM 102-General Chemistry I
1	CHEM 103-General Chemistry Lab I
3	CHEM 104-General Chemistry II
1	CHEM 105-General Chemistry Lab II
4	MATH 221-Calculus I[1]
2	MATH 225-Introductory Matrix Theory
3	MATH 231-Calculus II
4	MATH 241-Calculus III
3	MATH 285-Intro Differential Equations
4	PHYS 211-University Physics: Mechanics
4	PHYS 212-University Physics: Elec & Mag
2	PHYS 213-Univ Physics: Thermal Physics
34	Total

1. MATH 220-Calculus may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

Agricultural and Biological Engineering Technical Core

These courses stress fundamental concepts and basic laboratory techniques that comprise the common intellectual understanding of agricultural and biological engineering and the background for the technical courses and electives in each student's specialization or concentration.

For all Specializations and the Concentration

Hours	Requirements
4	ABE 222-Agric & Biological Engrg II
2	ABE 430-Project Management
4	ABE 469-Industry-Linked Design Project
3	CS 101-Intro Computing: Engrg & Sci
3	ECE 205-Elec & Electronic Circuits
3	GE 101-Engineering Graphics & Design
2	TAM 210-Introduction to Statics or TAM 211-Statics1
3	TAM 212-Introductory Dynamics
3	TAM 251-Introductory Solid Mechanics
27	Subtotal for all specializations and the concentration. See additional technical core requirements below.

1. The extra hour of credit for this course may be used to help meet free elective requirements.

For the Specializations in Bioenvironmental Engineering, Off-Road Equipment Engineering, or Soil and Water Resource Engineering

Hours	Requirements
4	ABE 221-Agric & Biological Engrg I
3	CEE 202-Engineering Risk & Uncertainty or IE 300-Analysis of Data or ABE 440-Applied Statistical Methods I[1] or STAT 400-Statistics and Probability I[1]
1	ECE 206-Elec & Electronic Circuits Lab
3	ME 300-Thermodynamics or CHBE 321-Thermodynamics[1]
4	TAM 335-Introductory Fluid Mechanics or CHBE 421-Momentum and Heat Transfer or ME 310-Introductory Gas Dynamics
15	Subtotal
42	Total for the Specializations in Bioenvironmental Engineering, Off-Road Equipment Engineering, or Soil and Water Resource Engineering

1. The extra hour of credit for this course may be used to help meet free elective requirements.

For the Concentration in Food and Bioprocess Engineering

Hours	Requirements
3	ABE 483-Engrg Properties of Food Matls
3	CHBE 221-Principles of CHE
4	CHBE 321-Thermodynamics
4	CHBE 421-Momentum and Heat Transfer
4	CHBE 422-Mass Transfer Operations
3	CHEM 232-Elementary Organic Chemistry I
3	FSHN 414-Food Chemistry
3	FSHN 461-Food Processing I
3	FSHN 462-Food Processing II
3	FSHN 471-Food & Industrial Microbiology
3	MCB 100-Introductory Microbiology
2	MCB 101-Intro Microbiology Laboratory
38	Subtotal
65	Total for the Concentration in Food and Bioprocess Engineering

Technical Electives

This elective course work must be completed to fulfill each Specialization or Concentration. The subjects build upon the agricultural and biological engineering technical core.

For the Specializations in Bioenvironmental Engineering, Off-Road Equipment Engineering, or Soil and Water Resource Engineering

Hours	Requirements
7	Biological and natural sciences electives chosen from a departmentally approved list of Biological and Natural Sciences Electives
16	Technical electives in one or more of the three Specializations chosen in consultation with an advisor. At least 8 hours must be Agricultural and Biological Engineering Technical Electives and the remainder approved Other Technical Electives.
23	Total

For the Concentration in Food and Bioprocess Engineering

Hours	Requirements
4	Technical electives chosen from a departmentally approved list of Food and Bioprocess Engineering Electives

Social Sciences and Humanities

The social sciences and humanities courses, as approved by the College of Engineering, ensure that students have exposure in breadth and depth to areas of intellectual activity that are essential to the general education of any college graduate.

Hours	Requirements
3	ECON 103-Macroeconomic Principles[1]
15	Electives in social sciences and humanities approved by the College of Engineering and satisfying the campus general education requirements for social sciences and humanities, including cultural studies western and non-western.
18	Total

1. ECON 102 or ACE 100 may be substituted by petition.

Composition

These courses teach fundamentals of expository writing.

Hours	Requirements
4	RHET 105-Principles of Composition Advanced Composition. May be satisfied by completing a course with the Advanced Composition designation in either the social sciences and humanities or the free elective categories.
4	Total

Free Electives

These unrestricted electives, subject to certain exceptions as noted at the College of Engineering advising Web site, give the student the opportunity to explore any intellectual area of unique interest. This freedom plays a critical role in helping students to define research spe-

cialties or to complete minors.

Hours	Requirements
6	Free electives. Additional unrestricted course work, subject to certain exceptions as noted at the College of Engineering advising Web site, so that there are at least 128 credit hours earned toward the degree, except for the Concentration in Food and Bioprocess Engineering, which requires132 hours.

Suggested Sequence

The schedule that follows is illustrative, showing the typical sequence in which courses would be taken by a student with no college course credit already earned and who intends to graduate in four years. Each individual's case may vary, but the position of required named courses is generally indicative of the order in which they should be taken. The first year of the Suggested Sequence is the same for all agricultural and biological engineering students. The second through fourth years vary with the Specialization or Concentration chosen. Refer to the appropriate sequence continuation below.

First year

Hours	First Semester
1	ABE 100-Intro Agric & Biological Engrg
3	CHEM 102-General Chemistry I
1	CHEM 103-General Chemistry Lab I
0	ENG 100-Engineering Orientation
3-4	GE 101-Engineering Graphics & Design or RHET 105-Principles of Composition[1]
4	MATH 221-Calculus I[2]
3	Elective in social sciences or humanities[3,4]
15-16	Total
Hours	Second Semester
3	CHEM 104-General Chemistry II★
1	CHEM 105-General Chemistry Lab II★
2	MATH 225-Introductory Matrix Theory
3	MATH 231-Calculus II
4	PHYS 211-University Physics: Mechanics

4-3	RHET 105-Principles of Composition or GE 101-Engineering Graphics & Design[1]
17-16	Total

*Biological version recommended.

Specializations in Bioenvironmental Engineering, Off-Road Equipment Engineering, or Soil and Water Resource Engineering

Second year

Hours	First Semester
4	ABE 221-Agric & Biological Engrg I
3	CS 101-Intro Computing: Engrg & Sci
4	MATH 241-Calculus III
4	PHYS 212-University Physics: Elec & Mag
2	TAM 210-Introduction to Statics or TAM 211-Statics[5]
17	Total
Hours	**Second Semester**
4	ABE 222-Agric & Biological Engrg II
3	MATH 285-Intro Differential Equations
2	PHYS 213-Univ Physics: Thermal Physics
3	TAM 212-Introductory Dynamics
4	Biological and natural sciences elective[6]
16	Total

Third year

Hours	First Semester
2	Agricultural and biological engineering technical elective[7]
3	ECE 205-Elec & Electronic Circuits
1	ECE 206-Elec & Electronic Circuits Lab
3	TAM 251-Introductory Solid Mechanics
3	CEE 202-Engineering Risk & Uncertainty or IE 300-Analysis of Data or ABE 440-Applied Statistical Methods I[5] or STAT 400-Statistics and Probability I[5]

3	Elective in social sciences or humanities[3,4]
15	Total
Hours	Second Semester
3	Agricultural and biological engineering technical elective[7]
3	ECON 103-Macroeconomic Principles[3]
3	ME 300-Thermodynamics
4	TAM 335-Introductory Fluid Mechanics or CHBE 421-Momentum and Heat Transfer or ME 310-Introductory Gas Dynamics
3	Elective in social sciences or humanities[3,4]
16	Total

Fourth year

Hours	
First Semester	
2	ABE 430-Project Management
3	Agricultural and biological engineering technical elective[7]
3	Elective in social sciences or humanities[3,4]
4	Technical elective[7]
3	Free elective[4]
15	Total
Hours	Second Semester
4	ABE 469-Industry-Linked Design Project
3	Free elective4
4	Technical elective[7]
3	Biological and natural sciences elective[6]
3	Elective in social sciences or humanities[3,4]
17	Total

Concentration in Food and Bioprocess Engineering

Second year

Hours	First Semester
3	CHEM 232-Elementary Organic Chemistry I

3	CS 101-Intro Computing: Engrg & Sci
4	MATH 241-Calculus III
3	MCB 100-Introductory Microbiology
2	PHYS 213-Univ Physics: Thermal Physics
2	TAM 210-Introduction to Statics or TAM 211-Statics[5]
17	Total
Hours	Second Semester
4	ABE 222-Agric & Biological Engrg II
3	MATH 285-Intro Differential Equations
2	MCB 101-Intro Microbiology Laboratory
4	PHYS 212-University Physics: Elec & Mag
3	TAM 212-Introductory Dynamics
16	Total

Third year

Hours	First Semester
3	CHBE 221-Principles of CHE
3	FSHN 414-Food Chemistry
3	TAM 251-Introductory Solid Mechanics
3	ECON 103-Macroeconomic Principles[3]
3	Electives in social sciences or humanities[3,4]
2	Technical elective[8]
17	Total
Hours	Second Semester
4	CHBE 321-Thermodynamics
3	ECE 205-Elec & Electronic Circuits
3	FSHN 471-Food & Industrial Microbiology
3	Free elective[4]
3	Elective in social sciences or humanities[3,4]
16	Total

Fourth year

Hours	First Semester
2	ABE 430-Project Management
3	ABE 483-Engrg Properties of Food Matls
4	CHBE 421-Momentum and Heat Transfer

3	FSHN 461-Food Processing I
2	Technical elective[8]
3	Elective in social sciences or humanities[3,4]
17	Total
Hours	Second Semester
4	ABE 469-Industry-Linked Design Project
4	CHBE 422-Mass Transfer Operations
3	FSHN 462-Food Processing II
3	Free elective[4]
3	Elective in social sciences or humanities[3,4]
17	Total

1. RHET 105 may be taken in the first or second semester of the first year as authorized. The alternative is GE 101. Students may take SPCM 111 and 112 in place of RHET 105.
2. MATH 220-Calculus may be substituted with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.
3. Each student must satisfy the 18-hour social sciences and humanities requirements of the College of Engineering, including ECON 103 (or either ECON 102 or ACE 100 by permission), and the campus general education requirements for social sciences and humanities.
4. One elective course must satisfy the General Education Advanced Composition requirement.
5. The extra hour of credit for this course may be used to help meet free elective requirements.
6. Students in the Specializations of Bioenvironmental Engineering, Off-Road Equipment Engineering, and Soil and Water Resource Engineering must complete seven hours from the approved list of Biological and Natural Sciences Electives.
7. Students in the Specializations of Bioenvironmental Engineering, Off-Road Equipment Engineering, and Soil and Water Resource Engineering must have 16 hours of technical electives chosen in consultation with an advisor. At least 8 hours must be from the approved list of Agricultural and Biological Engineering Technical Electives and the remainder selected from the approved list of Other Technical Electives.
8. Students in the Food and Bioprocess Engineering Concentration must select 4 hours of technical electives from the approved list of Food and Bioprocess Engineering Electives

As described previously, there is a dual degree program available which is described by the following Program of Study.

Exhibit 3.4. Dual Major in Agricultural and Biological Engineering Sciences, 2006 to 2010

Dual Major in Agricultural and Biological Engineering Sciences

Students who successfully complete this five-year academic program receive the Bachelor of Science with a major in Agricultural and Biological Engineering from the College of Engineering as well as Agricultural and Biological Engineering Sciences from the College of ACES. Students first enroll in the College of ACES and then transfer to the College of Engineering after two years. The suggested program of study that follows fulfills graduation requirements for both the College of Engineering and the College of ACES. Graduates are employed by industry, consulting firms, and government for research, education, and manufacturing. Departmental advisors ensure that national engineering accreditation (ABET) requirements are met by advisees.

Prescribed Courses Including Campus General Education

Hours	Composition I and Speech
4	RHET 105 - Principles of Composition or equivalent (see college Composition I requirement)
3	CMN 101 - Public Speaking
Hours	Advanced Composition One elective course must satisfy the Advanced Composition requirement.
Hours	Cultural Studies One Western culture and one non-Western/US minority culture course must be completed as part of the Social and Behavioral Sciences and/or Humanities and the Arts General Education coursework
Hours	Foreign Language: Coursework at or above the third level is required for graduation.
Hours	Quantitative Reasoning I
4	MATH 221 - Calculus I
Hours	Quantitative Reasoning II

3	MATH 231 - Calculus II
Hours	Natural Sciences and Technology
3	CHEM 102 - General Chemistry I
1	CHEM 103 - General Chemistry Lab I
3	CHEM 104 - General Chemistry II
1	CHEM 105 - General Chemistry Lab II
4	PHYS 211 - Univ Physics Mechanics
4	PHYS 212 - Univ Physics Elec and Mag
2	PHYS 213 - Univ Physics, Thermal Physics
Hours	General Education Coursework
6	Six hours of Social and Behavioral Science courses that must include ACE 100 or ECON 102 or ECON 103 and that satisfy the campus general education requirements.
6	Six hours of Humanities and the Arts courses that satisfy the campus general education requirements.
6	Six hours of either Social and Behavioral Science or Humanities and the Arts courses that satisfy the requirements of approved lists for the College of Engineering and the campus general education requirements.
Hours	Biological Sciences Coursework
10	Ten hours of biological sciences are required from biology, entomology, microbiology, plant biology, physiology, and zoology. Select at least seven of the ten hours from the following: ANSC 362 - Princ of Animal Physiology ANSCI 467 - Applied Animal Ecology CHEM 232 - Elementary Organic Chemistry I CHEM 233 - Elementary Organic Chemistry Lab I CPSC 112 - Introduction to Crop Sciences CPSC 270 - Applied Entomology CPSC 414 - Forage Crops and Pasture Eco GEOL 101 - Introductory Physical Geology GEOL 250 - Geology for Engineers IB 101-Biological Sciences or 103*-Introduction to Plant Biology or 104*-Animal Biology MCB 100* - Introductory Microbiology

	MCB 101* - Intro Microbiology Laboratory
	MCB 103-Intro to Human Physiology
	MCB 312 - Applied Microbiology Methods
	MCB 434 - Food & Industrial Microbiology
	NRES 201 - Introductory Soils

* Students must take at least one of these courses.

Hours	Agricultural Engineering Required
1	ABE 100 - Intro to Agr Engineering
4	ABE 221 - Agr & Bio Engineering I
4	ABE 222 - Agr & Bio Engineering II
2	ABE 430-- Project Management
4	ABE 469 - Industry-Linked Design Project
3	CS 101- Intro to Computing, Eng & Sci
0	ENG 100 - Engineering Lecture
3	ECE 205 - Intro Elec & Electr Circuits
1	ECE 206 - Intro Elec & Electr Ckts Lab
3	GE 101 - Engineering Graphics & Design
3-4	ME 300 - Thermodynamics or CHBE 321 - Thermodynamics
2	MATH 225 - Introductory Matrix Theory
4	MATH 241 - Calculus III
3	MATH 285 - Intro Differential Equations
3-4	ABE 440-Applied Statistical Methods I, or STAT 400 - Statistics and Probability I, or CEE 202 - Engineering Risk & Uncertainty, or IE 300 - Analysis of Data
2-3	TAM 210 - Intro to Statics or TAM 211 - Statics
3	TAM 212 - Introductory Dynamics
3	TAM 251 - Introductory Solid Mechanics
4	TAM 335 - Introductory Fluid Mechanics, or CHBE 421 - Momentum and Heat Transfer, or ME 310 - Introductory Gas Dynamics

Hours	Agricultural Sciences Coursework
15	Fifteen hours of agricultural sciences with courses from at least two departments other than Agricultural and Biological Engineering and approval of advisers are required.

Hours	Technical Coursework
16	A total of 16 hours of technical electives are required.

At least 8 hours must be from the following list of Agricultural and Biological Engineering Technical Electives and at least eight hours selected from the list of "Other Technical Electives" in the next section.

Agricultural Engineering Technical Electives

At least 12 hours from:
ABE 361 - Princ of Off-road Machines
ABE 374 - Env Control for Bio Buildings
ABE 397-Independent Study
ABE 420-Kinem & Dynamics of Mech Syst
ABE 425# - Eng Measurement Systems
ABE 426 - Applied Machine Vision
ABE 436-Renewable Energy Systems
ABE 455-Erosion and Sediment Control
ABE 456 - Land and Water Resources Eng
ABE 459 - Drainage and Water Management
ABE 463-Electrohydraulic Systems
ABE 466 - Engineering Off-Road Vehicles
ABE 476 - Indoor Air Quality Engineering
ABE 479* - Design of Agr & Bio Structures
ABE 482 - Package Engineering
ABE 483 - Eng Properties of Food Mat
ABE 485 - Food and Process Eng Design
ABE 487 - Grain Drying and Conditioning
ABE 488 - Bioprocessing Grains for Fuels
ABE 489 - Process Des for Corn Milling
ABE 497-Independent Study

Hours Other Technical Electives

Choose at least eight hours from:
CEE 311- Engineering Surveying or CEE 312- Route Surveying
CEE 330- Environmental Engineering
CEE 350- Water Resources Engineering
CEE 360- Structural Engineering
CEE 380- Geotechnical Engineering
CEE 450- Surface Hydrology

CEE 460- Steel Structures, I
CEE 461- Reinforces Concrete Design, I
CHBE 221- Principles of CHE
CHBE 421- Momentum and Heat Transfer
CHBE 422- Mass Transfer Operations
GE 330- OR Methods for Profit & Value Eng
ME330- Engineering Materials
ME 350- Design for Manufacturability
ME 370- Mechanical Design, I
ME 461- Computer Ctrl of Mechanl Sys
MFGE 310- Intro to MFG Systems
MFGE 450- Info Mgmt for MFG Systems
PHYS 214 - Univ Physics, Quantum Physics
TAM 324-Behavior of Materials
or any 300 or 400 level engineering course approved by advisor

Hours Open Electives

Sufficient open electives selected to total minimum curriculum requirement of 158 hours. All requirements of the combined curriculum must be completed to satisfy the requirements for both degrees.

158 Total hours required to receive a B.S. in Agricultural Engineering and a B.S. in Agricultural Sciences.

FROM 2010

During the 2010-2011 academic year, the curriculum was again revised to discontinue the concentration in Food and Bioprocess Engineering and establish a new concentration in Agricultural Engineering and a new concentration in Biological Engineering. The Agricultural and Biological Engineering major is maintained at 128 hours (with the exception of students electing the Food and Bioprocess Engineering Concentration, which required 132 hours) but students will be required to choose one of two distinct concentration paths for their degree. Specific changes included:

1. Concentration in Agricultural Engineering: This concentration focuses on the practice of engineering primarily in the agricultural domain of the field of agricultural and biological engineering (ABE) with students required to select a coherent set of courses in

consultation with their advisor that constitutes a specialization in this domain such as off-road equipment engineering, soil and water resources engineering, and renewable energy systems. The concentration consists of 14 hours of required core technical courses and 23 hours of technical electives.

2. Concentration in Biological Engineering: This concentration focuses on the practice of engineering in the realm of living systems in agriculture, food, energy, the environment, and related biological systems. This extends beyond the singular area of study currently available as the Food and Bioprocess Engineering Concentration with students again required to select coherent sets of courses that constitute specializations in this domain such as bioenvironmental engineering (for example greenhouse and livestock building design), ecological engineering, food and bioprocess engineering, and nanoscale biological engineering. The concentration consists of 16 hours of required core technical courses and 21 hours of technical electives.

The details of these changes follows:

Exhibit 3.5. The Degree of Bachelor of Science in Agricultural and Biological Engineering in 2010

For the Degree of Bachelor of Science in Agricultural and Biological Engineering

Agricultural and biological engineering is the application of mathematics, physical and biological science, and engineering to agriculture, food systems, energy, the environment, and related biological systems. This ABET-accredited degree program has special emphasis on environmental protection and the biological interface of plants, animals, soils, and microorganisms with the design and performance of environments, machines, mechanisms, processes, and structures.

Concentrations

The agricultural and biological engineering program provides two concentrations: Agricultural Engineering and Biological Engineering. Each concentration has specific areas of specialization related to career

interest.

Agricultural Engineering Concentration

The B.S. Degree in Agricultural and Biological Engineering provides a concentration in Agricultural Engineering. This concentration includes the integration of physical and biological sciences as a foundation for engineering applications in agriculture, food systems, energy, the environment, and related biological systems. Students pursuing this concentration are involved in the design of systems for renewable energy, off-road equipment, water quality, and the utilization and protection of soil and water resources. Important design constraints are economics, conservation of materials and energy, safety, and environmental quality. Within this concentration, students are required to select a set of coherent courses that constitutes a specialization in their area of career interest either from the following list or a customized area chosen in consultation with an advisor:

Renewable Energy Systems
Off-Road Equipment Engineering
Soil and Water Resources Engineering

Biological Engineering Concentration

The B.S. Degree in Agricultural and Biological Engineering also provides a concentration in Biological Engineering. This concentration integrates biology and engineering to provide solutions to problems related to living systems in agriculture, food, energy, the environment, and related biological systems. . Engineered biological systems in these domains vary widely in scale. At the molecular level, nanometer-scale devices consist of a few biomolecules inside individual cells. At the other extreme, regionally-scaled complex ecosystems depend upon multiple species of interacting living organisms. Such systems are becoming increasingly important in areas such as bioenergy, bioprocessing, nanotechnology, biosensing, bio-informatics, and bioenvironment. Within this concentration, students are required to select a set of coherent courses that constitutes a specialization in their area of career interest either from the following list or a customized area chosen in consultation with an advisor:

Bioenvironmental Engineering

Ecological Engineering
Food and Bioprocess Engineering
Nanoscale Biological Engineering

Overview of Curricular Requirements

The curriculum requires 128 hours for graduation. The curriculum is organized as follows.

Orientation and Professional Development

These courses introduce the opportunities and resources that your college, department, and curriculum can offer you as you work to achieve your career goals. They also provide the skills to work effectively and successfully in the engineering profession.

Hours	Requirements
1	ABE 100-Agric & Biological Engrg[1]
0	ENG 100-Engineering Orientation[1]
1	Total

1. External transfer students take ENG 300-Engrg Transfer Orientation instead.

Foundational Mathematics and Science

These courses stress the basic mathematical and scientific principles upon which the engineering discipline is based.

Hours	Requirements
3	CHEM 102-General Chemistry I
1	CHEM 103-General Chemistry Lab I
3	CHEM 104-General Chemistry II
1	CHEM 105-General Chemistry Lab II
4	MATH 221-Calculus I1
2	MATH 225-Introductory Matrix Theory
3	MATH 231-Calculus II
4	MATH 241-Calculus III
3	MATH 285-Intro Differential Equations
4	PHYS 211-University Physics: Mechanics
4	PHYS 212-University Physics: Elec & Mag
2	PHYS 213-Univ Physics: Thermal Physics

34	Total

1. MATH 220-Calculus may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

Agricultural and Biological Engineering Technical Core

These courses stress fundamental concepts and basic laboratory techniques that comprise the common intellectual understanding of agricultural and biological engineering and the background for the technical courses and electives in each student's concentration.

For Both Concentrations

Hours	Requirements
4	ABE 221-Agric & Biological Engrg I
4	ABE 222-Agric & Biological Engrg II
2	ABE 430-Project Management
4	ABE 469-Industry-Linked Design Project
3	CS 101-Intro Computing: Engrg & Sci
3	ECE 205-Elec & Electronic Circuits
3	GE 101-Engineering Graphics & Design
2	TAM 210-Introduction to Statics or TAM 211-Statics1
3	TAM 212-Introductory Dynamics
28	Subtotal for both concentrations. See additional technical core requirements below.

1. The extra hour of credit for this course may be used to help meet free elective requirements.

For the Agricultural Engineering Concentration

Hours	Requirements
3	CEE 202-Engineering Risk & Uncertainty or IE 300-Analysis of Data or ABE 440-Applied Statistical Methods I[1] or STAT 400-Statistics and Probability I[1]
1	ECE 206-Elec & Electronic Circuits Lab
3	ME 300-Thermodynamics

3	TAM 251-Introductory Solid Mechanics
4	TAM 335-Introductory Fluid Mechanics or CHBE 421-Momentum and Heat Transfer or ME 310-Introductory Gas Dynamics
14	Subtotal
42	Total for the Agricultural Engineering Concentration

1. The extra hour of credit for this course may be used to help meet free elective requirements.

For the Biological Engineering Concentration

Hours	Requirements
2	ABE 141-Biological Principles in Engrg
3	ABE 341-Heat/Mass Transfer & Momentum
4	CHBE 321-Thermodynamics
3	CHEM 232-Elementary Organic Chemistry I
4	MCB 150-Molec & Cellular Basis of Life
16	Subtotal
44	Total for the Biological Engineering Concentration

Technical Electives

This elective course work must be completed to fulfill each Concentration. The subjects build upon the agricultural and biological engineering technical core.

For the Agricultural Engineering Concentration

Hours	Requirements
7	Biological and natural sciences electives chosen from a departmentally approved list of Biological and Natural Sciences Electives - Group A
16	Technical electives chosen in consultation with an advisor. At least 8 hours must be Agricultural and Biological Engineering Technical Electives - Group A, and the remainder approved Other Technical Electives - Group A.
23	Total

For the Biological Engineering Concentration

Hours	Requirements
6	Biological and natural sciences electives chosen from a departmentally approved list of Biological and Natural Sciences Electives - Group B
15	Technical electives chosen in consultation with an advisor. At least 8 hours must be Agricultural and Biological Engineering Technical Electives - Group B, and the remainder approved Other Technical Electives - Group B.
21	Total

Social Sciences and Humanities

The social sciences and humanities courses, as approved by the College of Engineering, ensure that students have exposure in breadth and depth to areas of intellectual activity that are essential to the general education of any college graduate.

Hours	Requirements
3	ECON 103-Macroeconomic Principles[1]
15	Electives in social sciences and humanities approved by the College of Engineering and satisfying the campus general education requirements for social sciences and humanities, including cultural studies western and non-western.
18	Total

1. ECON 102 or ACE 100 may be substituted by advisor approval.

Composition

These courses teach fundamentals of expository writing.

Hours	Requirements
4	RHET 105-Principles of Composition
Advanced Composition.	May be satisfied by completing a course with the Advanced Composition designation in either the social sciences and humanities or the free elective categories.
4	Total

Free Electives

These unrestricted electives, subject to certain exceptions as noted at the College of Engineering advising Web site, give the student the opportunity to explore any intellectual area of unique interest. This freedom plays a critical role in helping students to define research specialties or to complete minors.

Hours	Requirements
6	Free electives. Additional unrestricted course work, subject to certain exceptions as noted at the College of Engineering advising Web site, so that there are at least 128 credit hours earned toward the degree.

SENIOR DESIGN COURSE

The Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering & Technology (ABET) requires a capstone design course to be part of any accredited engineering program. The course will utilize the previous engineering education and will demonstrate the student has the design skills appropriate for the professional practice of engineering.

The original capstone design course for the Off-Road Equipment majors (AgE 336) was established 60 years ago by George Pickard who had industry experience with Massey-Harris. He was followed by Dwight Kampe who had worked with Ford Farm Equipment group. Don Hunt who had industry experience with Oliver Farm Equipment led 336 from 1965 until 1985. Richard Coddington was hired from Deere & Co. after extensive design, research and evaluation experiences. He brought his extensive experience and industry contacts to further develop the senior design course. Carroll Goering, who had worked with International Harvester, handled 336 the year that Coddington was on sabbatical leave. In 1995, Coddington was promoted to become the Placement Director for the College of Engineering. He was replaced by Douglas Bosworth, a Past President of the American Society of Agricultural & Biological Engineers and served on the EAC. He came to the University of Illinois after 35 years with Deere & Co. In 2005, Steve Zahos who had 32 years of experience with Union Carbide, Universal Companies, Envirecycle and in consulting attained the leadership of the course and brought new insights to the design

experience.

The key elements of this course have been that all of the instructors have worked in industry, the students work in a team environment and the student projects have all involved "real life" problems from industry sponsors. Key sponsors of student projects include: Deere & Co., Caterpillar, Case-New Holland, Hydro-Gear, Alamo Group and Waterborne Engineering. The student teams are assigned design projects that are "needed" by the industry sponsor and they work with a mentor engineer from that organization. A list of the industry-sponsored projects is given in the appendix. The projects are designed so the teams can conduct research, design, build and evaluate the project to assure that it meets the needs of the industry customer. The goal is to have the student teams experience the entire product development process. The course work also involves developing knowledge and skills in the "real world" to enhance their potential for success as engineers. The feedback from the students that have taken this course is that it is the most valuable course they took in college since it prepared them for success in the workplace. Another measure of the success is that besides ABE students, the team members have included Technical Systems Management, Mechanical Engineering and Engineering Mechanics majors.

This course has evolved over the past 60 years to meet the needs of the students and potential customers while utilizing the tools, technology and processes utilized in American industry. The results are that over 1/3 of the projects are ultimately adopted by the industry sponsor and the exposure of the team members have resulted in many career opportunities with the sponsor.

The latest evolution in 2007 was to move from an Off Road Equipment course to a Senior Capstone Design (ABE 469) for all of the options in ABE. This change is a natural move since the product development processes are similar for most industries. The Senior Design course has been a model for other university programs and has provided solid engineering experiences for graduates of the program.

Prior to 2007 Capstone Design was accomplished in other concentrations within senior level courses. In AGE 356, Soil and Water Conservation Structures, and ABE 456, Land and Water Resources Engineering, taught by Kent Mitchell and Prasanta Kalita (both of whom had experience in SW design and construction), students were required to design a major project either individually or, usually, in teams. The

project designs included small dams, terrace systems, or other complex systems requiring full use of their knowledge of hydrology, hydraulics, hydraulic structures, soil mechanics, soil science, soil erosion, construction methods, cost and benefit economics, etc. In AGE 357, Land Drainage, and ABE 459, Drainage and Water Management, taught by Richard Cooke (who also had design and construction experience), similar projects were required concerned with the design of drainage or irrigation systems. In some cases the student teams were also involved in construction and emplacement.

For the food and bioprocessing concentration, ABE 385 (renumbered to 485) was taught by Kent Rausch (product development engineering expertise at American Maize and extension experience at Kansas State working with small food processors). ABE 485 worked in teams with food processing companies to develop solutions for chronic processing problems. Companies that collaborated included Quaker Oats (Danville, IL) and General Mills (Minneapolis, MN). Design projects usually involved working with an on site engineer as well as a plant tour. Projects included developing monitoring equipment for measuring food thickness, design and layout of a extruded snack food process, and development of specialty equipment for breakfast cereal production.

AGRICULTURAL AND BIOLOGICAL ENGINEERING GRADUATE PROGRAMS

The MS and PhD programs were essentially unchanged until 2008. Before that, requirements were general statements about total and thesis hours required; a few specific requirements were a responsibility of the Department to transmit to the faculty of the Department.

Beginning in 2008 more specific requirements are stated in the Programs of Study. A description of the ABE graduate programs follows. Graduate courses information was presented in the previous two course listings tables (Tables 1 & 2).

Exhibit 3.6. Department of Agricultural and Biological Engineering Graduate Degree Programs from 2008

The Department of Agricultural and Biological Engineering offers a graduate degree program which is at the forefront of the application of engineering principles to solve problems of agricultural production, utilization, environmental control, and biological systems and to improve the quality of life. Students may concentrate study in one of the faculty research interest areas listed below. Supporting course work includes: mathematics; computer science; statistics; engineering mechanics; chemical, civil, electrical, and mechanical engineering; animal science; crop sciences; food science; and other appropriate fields. Opportunity also exists for specializing in computational science and engineering within the department's graduate program via the Computational Science and Engineering (CSE) Option. The Medical Scholars Program permits highly qualified students to integrate the study of medicine with study for a graduate degree in a second discipline, including Agricultural and Biological Engineering.

Degree Requirements

*For additional details and requirements refer to the department's Graduate Handbook and the Graduate College Handbook.

Master of Science

Required Courses	Thesis Option-Required Hours	Non-thesis Option-Required Hours
1 course in Instrumentation and measurement	3-5	3-5
1 course in statistical design and analysis	3-5	3-5
1 MATH course beyond Differential Equations	3-4	3-4
Formal 500 level course in area of specialization (3 hours min)	3-5	3-5
ABE 594 enrollment (0 hrs) every semester	0	0
ABE 501and 502	2	2
Research and Project Hours (min-max applied toward degree):	4 max	
Thesis Hours Required (min-max applied toward degree):	8	n/a
Total Hours	33	36
Minimum 500-level Hours Required Overall:	12	12
Other Requirements:*		A written report is required The non-thesis option is only allowed with departmental approval at or before initiation of graduate study, and a final report is required.
Minimum GPA:	3.0	3.0

Doctor of Philosophy

Required Courses	Required Hours
1 course in Instrumentation and measurement	3-5
1 course in statistical design and analysis	3-5
1 MATH course beyond Differential Equations	3-4
1 formal 500 level course in area of specialization (3 hours min)	3-5
ABE 594 enrollment every semester	0
ABE 501and 502 (unless taken during MS)	0-2
Thesis Hours Required (min-max applied toward degree):	32 max
Total Hours	64
Other Requirements:*	Teaching experience is required.
Minimum GPA:	3.0
Masters Degree Required for Admission to PhD?	Yes
Qualifying Exam Required	No
Preliminary Exam Required	Yes
Final Exam or Dissertation Defense Required	Yes
Dissertation Deposit Required	Yes

Medical Scholars Program

Students in the Medical Scholars program must meet the specific requirements for both the medical and graduate degrees. On average, students take eight years to complete both degrees. The first year of the combined program is typically spent meeting requirements of the Agricultural and Biological Engineering graduate degree.

Graduate Teaching Experience

Experience in teaching is considered a vital part of the graduate program and is required as part of the academic work of all Ph.D. candidates in this program.

TECHNICAL SYSTEMS MANAGEMENT

BS DEGREE IN TSM

The Technical Systems Management (TSM) curriculum in 1997 was defined in the UI Program of Study as follows:

Exhibit 3.7. Major in Technical Systems Management in 1997

Major in Technical Systems Management

For the degree of Bachelor of Science in Technical Systems Management

This major is designed to prepare students as problem solvers for systems involving the application, management, and/or marketing of agricultural engineering technologies. Students are instructed in engineering and business principles in preparation for professional careers as entrepreneurs, marketing representatives, project managers, or plant managers working with service organizations, manufacturers, corporate farms, retail dealers, power suppliers, contractors and management companies at every stage from production through processing and distribution.

Students pursuing this major can select between three options: production systems; mechanization, marketing and technical systems; and environmental systems.

Prescribed Courses Including Campus General Education

HOURS	COMPOSITION I AND SPEECH
4	Rhet 105 - Principles of Composition or equivalent
3	SPCOM 101 - Principles of Effective Speaking

HOURS	COMPOSITION II
3	Select one from: B&T W 250 - Principles of Business Writing B&T W 253 - Business and Administrative Communication B&T W 272 - Report Writing

HOURS	QUANTITATIVE REASONING
4	Math 134 - Calculus for Social Sciences I, or equivalent
3	STAT 100 - Statistics, or ACE 261 - Statistics for Agricultural and Consumer Economics or ECON 172 - Economic Statistics, I or PSYCH 233 - Descriptive Statistics

HOURS	NATURAL SCIENCES
4	CHEM 101 - General Chemistry
5	PHYCS 101 - General Physics (Mechanics, Heat and Sound)
4-5	One course selected from: BIOL 101 - Biological Sciences or BIOL 104 - Animal Biology MCBIO 100 - Introductory Microbiology and MCBIO 101 - Introductory Experimental Microbiology
3-4	Once course selected from: ATMOS 100 - Introduction to Meteorology GEOG 102 - Weather and Climate or GEOG 103 - Earths Physical Systems GEOL 101 - Introduction to Physical Geology or GEOL 105 - Geology of Energy Resources or GEOL 107 - General Geology, I EEE 105 - Environmental Biology

HOURS	HUMANITIES
6	Select from campus approved list

HOURS	SOCIAL SCIENCES
	From at least two departments to include:
4	ACE 100 - Economics of Resources, Agriculture, and Food
3	ECON 103 - Macroeconomic Principles
2	Social science elective. Select from campus approved list.

CULTURAL STUDIES[1]

Two courses; one western culture and one non-western/US minority culture course

1. Work with advisor to select courses that also satisfy the social sciences and humanities requirements.

HOURS	ACES PRESCRIBED
2	ACES 100 - Contemporary Issues in Agricultural, Consumer and Environmental Sciences

HOURS	OTHER PRESCRIBED
3	ACE 161 - Microcomputer Applications or equivalent
3	ACCY 200 - Fundamentals of Accounting or ACCY 201 - Principles of Accounting I
4	CPSC 121 - Principles of Field Crop Sciences
4	Soils 101 - Introductory Soils
3	TSM 100 - Technical Systems in Agriculture
1	TSM 299 - Technical Systems Management Seminar

HOURS	TSM ELECTIVES
18	TSM elective courses. A total of 18 hours selected from the following courses. A minimum of six hours must be at the 300 level.
	TSM 199 - Undergraduate Seminar
	TSM 200 - Construction Technology
	TSM 202 - Welding Processes, Metallurgy and Materials

TSM 203 - Electric Wiring, Motors, and Controls
TSM 221 - Farm Power and Machinery Management
TSM 250 - Agricultural Mechanization Internship
TSM 252 - Mechanics of Soil and Water Conservation
TSM 271 - Engineering Applications in Residential Housing
TSM 272 - Farm Buildings
TSM 281 - Grain Drying, Handling, and Storage
TSM 300 - Special Problems
TSM 331 - Farm Machinery Technology
TSM 333 - Agricultural Chemical Applications Systems
TSM 341 - Engine and Tractor Power
TSM 372 - Livestock Waste Management
TSM 381 - Electrical and Microcomputer Controls for Agriculture

HOURS	OPTION ELECTIVES
15	Option elective courses. See specific requirements for each option listed below. A minimum of six hours must be at the 300 level.

HOURS	OPEN ELECTIVES
18-21	Additional free elective courses selected to meet the required 126 hours for graduation
126	Total credit hours required for the B.S. degree

Mechanization, Marketing, and Technology Management Systems Option

Mechanization, marketing and technology management systems is designed for students interested in the management, marketing, and/or application of technical systems in agriculture. The focus of this option is to prepare individuals as technically competent professional for all aspects of the agricultural and food industries.

HOURS	OPTION ELECTIVES
15*	AGCOM 270 - Agricultural Sales Communications AGCOM 280 - Leadership Development ACE 222 - Marketing Commodity and Food Products

ACE 231 - Food and Agribusiness Management or BA 210 - Management and Organizational Behavior
ACE 233 - Agribusiness Market Planning
ACE 243 - Agricultural Finance
ACE 356 - Agricultural Policies and Programs
B ADM 200 - Legal Environment of Business
B ADM 202 - Principles of Marketing
B ADM 247 - Introduction to Management (no credit if had B ADM 210)
B ADM 261 - Summary of Business Law
B ADM 274 - Operations of Research
B ADM 314 - Production
B ADM 315 - Management in Manufacturing
B ADM 320 - Marketing Research
B ADM 321 - Individual Behavior in Organizations
B&T W 271 - Persuasive Writing
FIN 254 - Introduction to Business Finance Management
FIN 264 - Fundamentals of Real Estate

*Six hours of course work must be at the 300 level.

Production Systems Option

Production Systems is designed for those students interested in learning about and working within the production enterprise. Students in this option learn marketing, management, and application of the technical systems relative to a production agriculture enterprise.

HOURS	OPTION ELECTIVES
15*	Choose from the following:
	ACE 203 - Rural Taxation
	ACE 222 - Marketing of Commodity and Food Products
	ACE 232 - Management of Farm Enterprises
	ACE 243 - Agricultural Finance
	ACE 303 - Agricultural Law
	ACE 320 - Economics of Commodity Marketing
	ACE 332 - Decision-Making in the Agricultural Firm
	ACE 334 - Professional Farm Management

ACE 348 - Rural Real Estate Appraisal
CPSC 318 - Crop Growth and Production
CPSC 321 - Biological Control of Insect Pests
CPSC 322 - Forage Crops and Pastures
CPSC 326 - Weeds and Their Control
SOILS 303 - Soil Fertility and Fertilizers
SOILS 304 - Soil Conservation and Management
ANSCI 221 - Animal Nutrition
ANSCI 283 - Beef Cattle and Swine Production
ANSCI - Any Animal Production Class
HORT 242 - Commercial Vegetable Production

*Six hours of course work must be at the 300 level.

Environmental Systems Option

Environmental Systems is designed for those students interested in environmental systems as they relate to the agricultural and food industries. The focus of this option is the study of technical systems and their management as they relate to the interface between the physical and biological science components of agriculture.

HOURS	OPTION ELECTIVES
15*	Choose from the following:
	ACE 210 - Economics of the Environment
	ACE 306 - Environmental Law
	ACE 310 - Intermediate Natural Resource Economics
	ACE 319 - Regional Environmental Management Simulation
	ANSCI 307 - Environmental Aspects of Animal Management
	B ADM 210 - Management and Organizational Behavior
	C E 241 - Air and Water Quality
	C E 341 - Regional Environmental Management Simulation
	E S 236 - Tomorrow's Environments
	FOR 319 - Environment and Plant Ecosystems
	SOILS 303 - Soil Fertility and Fertilizers
	SOILS 304 - Soils Conservation and Management

*Six hours of course work must be at the 300 level.

In the Fall of 2004 a new system of course numbering was initiated. However, as a follow-up to the previous history that ended in 1997, following is a list of TSM courses from 1997 to 2004. Each entry contains the course name and number, the instructor who developed the course and date (if it is a new course) names of other instructors of the course and date when discontinued.

Table 3.3. Courses in TSM prior to 2004

TSM	100	Technical Systems in Agriculture	P. Buriak
TSM	111	Humanity in the Food Web	P. Buriak, M.C. Hirshi, Westgren
TSM	199	Undergraduate Open Seminar	Faculty
TSM	200	Materials and Construction Systems	P. Buriak, P Benson
TSM	202	Metallurgy, Materials, and Welding Processes	P. Buriak, P Benson
TSM	203	Electric Wiring, Motors, and Controls Systems	P. Buriak, P Benson
TSM	221	Power and Machinery Management	J. F. Reid, T.E. Grift
TSM	240	Fluid Power Technology, 2001	Q. Zhang
TSM	250	Technical Systems Management Internship	Discontinued 2003, P Buriak
TSM	252	Soil and Water Management Systems	M.C. Hirschi, P. Kalita
TSM	271	Residential Housing Design	G.L. Riskowski, T. Funk, M.J. Robert
TSM	272	Structural and Environmental Systems	G.L. Riskowski
TSM	281	Grain Drying, Handling, and Storage Systems	M.R. Paulsen
TSM	293	Off-Campus Internship, 2003	
TSM	295	Independent Study	
TSM	296	Undergraduate Honors Research or Thesis, 2003	
TSM	299	Professional Seminar	Discontinued 2004, L.L. Christianson
TSM	300	Undergraduate Research or Theses	R.A. Aherin, P. Buriak

TSM	324	Agricultural Engineering Project Management, 2003	L.L. Christianson
TSM	331	Farm Machinery Management	Discontinued 2001, J.C. Siemens
TSM	333	Chemical Applications Systems	L.E. Bode, L. Tian
TSM	341	Engine and Tractor Power	C.E. Goering, A.C. Hansen
TSM	372	Livestock Waste Management	Discontinued 2003, T. Funk
TSM	381	Electrical and Microcomputer Control Systems	M.R. Paulsen
TSM	399	Seminar	

An extensive project of renumbering courses to match campus directives resulted in a new list of courses in 2004. Following are the courses available from 2004 to the present in TSM with entries containing:

a) course number
b) previous course number in parenthesis
c) course title
d) date course was started if new
e) faculty member who revised the course for the new system
f) faculty who have taught courses
g) date course discontinued

Table 3.4. Courses in TSM from 2004

TSM	100	(100)	Technical Systems in Agr.	P. Buriak, J.G. Harper, L.F. Rodriguez
TSM	199	(199)	Undergraduate Open Seminar	Faculty
TSM	232	(200)	Materials and Construction Sys	P. Buriak, J.G. Harper
TSM	233	(202)	Metallurgy & Welding Processes	J.G. Harper
TSM	234	(203)	Wiring, Motors and Control Sys	J.G. Harper
TSM	262	(221)	Off-Road Equipment Management	T.E. Grift, A.C. Hansen
TSM	293	(293)	Off-Campus Internship	Faculty
TSM	295	(295)	Undergrad Research or Thesis	Faculty
TSM	311	(111)	Humanity in the Food Web	P. Buriak, Westgren, M.C. Hirschi, L. Schideman, A. Green, M. Danao, R.S. Gates, L.F. Rodriguez, K. Bhalerao
TSM	352	(252)	Land and Water Mgt Systems	M.C. Hirschi, R.A.C. Cooke
TSM	363	(240)	Fluid Power Systems	Q. Zhang, T.E. Grift
TSM	371	(271)	Residential Housing Design	L.L. Christianson, M.J. Robert, R.S. Gates
TSM	372	(272)	Environ Control & HVAN Systems	X. Wang
TSM	381	(281)	Grain Drying :& Storage Systems	M.R. Paulsen, S.R. Eckhoff
TSM	396	(296)	UG Honors Research or Thesis	Faculty
TSM	421		Ag Safety-Injury Prevention, 2007	R.A.Aherin, R.E. Petrea

TSM	422		Ag Health-Illnesses Prevention, 2007	R.E. Petrea, R.A. Aherin
TSM	425		Managing Ag Safety Risk, 2007	R.A. Aherin, R.E. Petrea
TSM	430	(324)	Project Management	L.L. Christianson, S.C. Zahos, L. Schideman
TSM	435	(381)	Elec Computer Ctrl Sys	M.R. Paulsen, K. Bhalerao
TSM	436		Renewable Energy Systems, 2007	X. Wang
TSM	455	(381)	Erosion and Sediment Control, 2007	M.C. Hirschi
TSM	464	(341)	Engine and Tractor Power	A.C. Hansen
TSM	465	(333)	Chemical Application Systems	L. Tian
TSM	486		Grain Bioprocessing Coproducts, 2009	K.D. Rausch, V. Singh
TSM	496	(300)	Independent Study	Faculty
TSM	499	(399)	Seminar	Faculty
TSM	501		Graduate Research I	
TSM	502		Graduate Research II	
TSM	594		Graduate Seminar	
TSM	596		Independent Study	
TSM	598		Special Topics	
TSM	599		Thesis Research	

The final result of these course changes in 2004 was a Program of Study as follows:

Exhibit 3.8. Major in Technical Systems Management from 2006

MAJOR IN TECHNICAL SYSTEMS MANAGEMENT

For the Degree of Bachelor of Science with a Major in Technical Systems Management

This major in Technical Systems Management is designed to prepare students as problem solvers for systems involving the application, management, and/or marketing of agricultural engineering technologies. Students are instructed in engineering and business principles in preparation as technically competent business persons for professional careers as entrepreneurs, marketing representatives, or plant managers working with service organizations, manufacturers, corporate farms, retail dealers, power suppliers, contractors, or management companies from production through processing and distribution.

Students can specialize in Mechanization, Marketing, and Technical Systems; Production Systems; or Environmental Systems by selection of specific electives.

Prescribed Courses Including Campus General Education

Hours	Composition I and Speech
4	RHET 105 - Principles of Composition or equivalent (see college Composition I requirement) AND
3	CMN 101 - Public Speaking
	OR
3	CMN 111 - Oral and Written Communication I AND
3	CMN 112 - Oral and Written Communication II

Hours	Advanced Composition
3-4	Select from campus approved list.

Hours	Cultural Studies: Two courses; one Western culture and one non-Western/US minority culture course.

Hours	Foreign Language: Coursework at or above the third level is required for graduation.
Hours	Quantitative Reasoning I
4	MATH 234 - Calculus for Business I, or equivalent
Hours	Quantitative Reasoning II
3-4	Introductory statistics. See department for approved list.
Hours	Natural Sciences and Technology
4	CHEM 102 - General Chemistry I, and CHEM 103 - General Chemistry Lab I
5	PHYS 101 - College Physics Mech & Heat
4-5	PHYS 102 - College Physics, E & M & Modern, or CHEM 104 - General Chemistry II and CHEM 105 - General Chemistry Lab II
3-5	Biological sciences (see campus approved list)
Hours	Humanities and the Arts
6	Select from campus approved list.
Hours	Social and Behavioral Sciences
4	ACE 100 - Agr Cons and Resource Econ
3	ECON 103 - Macroeconomic Principles
3-4	Social and behavioral sciences elective. Select from campus approved list.
Hours	ACES Prescribed
2	ACES 101 - Contemporary Issues in ACES
Hours	TSM Required
3	ACE 161 - Microcomputer Applications or equivalent
3	ACCY 200 - Fundamentals of Accounting or ACCY 201 - Accounting and Accountancy, I
4	CPSC 112 - Introduction to Crop Science
4	NRES 201 - Introductory Soils
3	TSM 100 - Technical Systems in Agr
2	TSM 430 - Project Management

18	TSM elective courses. A total of 18 hours selected from the following courses. A minimum of six hours must be selected from TSM 295 or 396, or at the 300- or 400-level. TSM 199 - Undergraduate Open Seminar TSM 232 - Materials and Construction Sys TSM 233 - Metallurgy, & Welding Processes TSM 234 - Wiring, Motors, and Controls Sys TSM 262 - Off-Road Equipment Management TSM 295 - Undergrad Research or Thesis TSM 352 - Land & Water Mgt Systems TSM 363 - Fluid Power Systems TSM 371 - Residential Housing Design TSM 372 - Structures and Env Systems TSM 381 - Grain Drying, & Storage Systems TSM 396-UG Honors Research Or Thesis TSM 435 - Elec Microcomputer Ctrl Sys TSM 464 - Engine and Tractor Power TSM 465 - Chemical Applications Systems TSM 496 - Independent Study TSM 499--Seminar

Hours	Specialization Electives
15	Choose from the following: ACE 210 - Environmental Economics ACE 222 - Agricultural Marketing ACE 231 - Food and Agribusiness Mgt ACE 232 - Management of Farm Enterprises ACE 303 - Rural Taxation ACE 310 - Natural Resource Economics ACE 320 - Commodity Marketing ACE 332 - Farm Management ACE 340 - Agricultural Finance ACE 403 - Agricultural Law ACE 406 - Environmental Law ACE 428 - Commodity Futures and Options ACE 448 - Rural Real Estate Appraisal ACE 456 - Agr and Food Policies

AGCM 370 - Ag Sales Communications
AGCM 380 - Leadership Development
ANSC 213 - Beef and Swine Management
ANSC 321 - Animal Nutrition
ANSC 467 - Applied Animal Ecology
BADM 300 - Legal Environment of Business
BADM 301 - Summary of Business Law
BADM 310 - Mgt and Organizational Behavior
BADM 311 - Individual Behavior in Orgs
BADM 320 - Principles of Marketing
BADM 322 - Marketing Research
BADM 374 - Management Decision Models
BADM 375 - Business Process Management
BADM 376 - Enterprise Proc Integr & Dymm
BADM 445 - Small Business Consulting
BADM 446 - Entrepreneurship Sm Bus Form
BTW 271 - Persuasive Writing
CEE 330 - Environmental Engineering
CPSC 226 - Introduction to Weed Science
CPSC 414 - Forage Crops and Pastures Eco
CPSC 418 - Crop Growth and Management
CPSC 477 - Biol Control on Insect Pests
ENVS 336 - Tomorrow's Environment
FIN 221 - Corporate Finance
FIN 341 - Fundamentals of Real Estate
HORT 364 - Vegetable Crop Production
NRES 419 - Env and Plant Ecosystems
NRES 474 - Soil and Water Conservation
NRES 488 - Soil Fertility and Fertilizers

Hours	Open Electives
17-23	Additional free elective courses selected to meet the required 126 hours for graduation.
126	Total credit hours required for the B.S. degree.

Minor in Technical Systems Management

Note: This minor has prerequisites of a minimum of 60 hours with a 2.5 GPA; completion of Math 234 or equivalent; Physics 101 or equivalent; Chemistry 102 and 103 or equivalent; and Physics 102 or Chemistry 104 and 105 or equivalent.

Hours	Minor Required
3	TSM 100--Technical Systems in Agr
15	Fifteen Hours, at least six of which must be at the 400 level
	TSM 232 - Materials and Construction Sys
	TSM 233 - Metallurgy, & Welding Processes
	TSM 234 - Wiring, Motors, and Controls Sys
	TSM 262 - Off-Road Equipment Management
	TSM 352 - Land and Water Mgt Systems
	TSM 363 - Fluid Power Systems
	TSM 371 - Residential Housing Design
	TSM 372 - Structures and Env Systems
	TSM 381 - Grain Drying, & Storage Systems
	TSM 435 - Elec Microcomputer Ctrl Sys
	TSM 464 - Engine and Tractor Power
	TSM 465 - Chemical Applications Systems
	TSM 496 - Independent Study
18	Total Hours Required

A minor in Agricultural Safety and Health was recently approved for inclusion in the TSM program and is described as follows:

Exhibit 3.9. Agricultural Safety and Health Minor Programs

Agricultural Safety and Health Minor Programs and Requirements

The minor in Agricultural Safety and Health is designed to provide students with a strong understanding of the occupational safety and health issues facing production agriculture. The program will familiarize students with the primary injury control methodologies of behavioral persuasion, engineering design, and regulation or enforcement and their related strengths and weaknesses of effecting injury and occupational illness rates among agricultural populations. They will also

develop a strong understanding of safety risk management. A minor in agricultural safety and health would benefit most students who intend to pursue any type of agricultural or rural health profession. There are no prerequisites for the minor.

Requirements: A minimum of 18 hours must be completed for this minor.

Hours	Required Courses for Agricultural Safety and Health Minor
3	TSM 421 - Ag Safety-Injury Prevention
3	TSM 422 - Ag Health-Illness Prevention
3	TSM 425 - Managing Ag Safety Risk
	A minimum of 3 credit hours is required from the following courses:
1-4	TSM 293 or ABE 293 - Off-Campus Internship
1-4	TSM 295 or ABE 396 - Undergraduate Research Thesis
1-4	TSM 496 or ABE 295 - Independent Study
	A minimum of 6 credit hours selected from:
3	CHLH 101 - Introduction to Public Health
3	CHLH 244 - Health Statistics
3	CHLH 274 - Introduction to Epidemiology
4	CHLH 304 - Foundations of Health Behavior
3-4	CHLH 469 - Environmental Health
4	CHLH 474 - Principles of Epidemiology
4	CHLH 540 - Health Behavior-Theory
3	EOHS 400 - Principles of Environmental Health Sciences (UIC Web)
2	EOHS 421 - Fundamentals of Industrial Hygiene (UIC Web)
3	FSHN 480 - Basic Toxicology
3	HDFS 105 - Intro to Human Development
4	HRE 415 - Diversity in the Workplace
4	HRE 585 - Program Evaluation
3-4	IE 440 - Occupational Biomechanics
3	IE 442 - Safety Engineering
3-4	KIN 262 - Motor Develop, Growth & Form
3-4	KIN 454 - Growth & Physical Development
4	PSYC 100 - Intro Psych

4	PSYC 103 - Intro Experimental Psych
4	PSYC 358 - Human Factors
3-4	PSYC 456 - Hum Perf and Eng Psych

Prerequisites for the minor: Any student who has completed at least 30 credit hours of course work with a minimum GPA of 2.5 or consent from program director may apply for the minor. There are no other specific prerequisites.

MS DEGREE IN TSM

A Master of Science Degree with a Major in Technical Systems Management and an Optional Graduate Concentration in the Professional Science Master's Program was initiated during the 2010-2011 academic year as follows:

Exhibit 3.10. Master of Science in Technical Systems Management

The Master of Science in Technical Systems Management (TSM) serves students seeking a post-graduate degree as an enhanced preparation for a career in agricultural and biological technical systems management. It will provide exposure to faculty and industry research in agricultural, construction and environmental systems, equipment and food industries, or environmental protection and safety.

Additionally, a non-thesis Master of Science (M.S.) degree program with a major in Technical Systems Management is offered through the University of Illinois' Professional Science Masters (PSM) initiative.

Degree Requirements

For the TSM M.S., required courses for all graduate programs include TSM 501 and TSM 502, one course in statistics, one course in research methods including experimental design and one 500 level course (in the elective list) are required.

Master of Science, Technical Systems Management

The completion of 33 hours (25 h formal course and 8 h research) and the preparation and defense of a thesis involving an analytical or experimental investigation (which satisfies 8 hours of credit) are required

of M.S. candidates in both degree programs unless a waiver of thesis is granted. At least 12 hours for the M.S. degree must be in 500-level courses and 8 hours must be in the program rubric. Candidates who are permitted to pursue a non-thesis degree must complete a minimum of 36 hours. Non-thesis TSM graduate students pursuing the Professional Science Masters (PSM) option are required to complete the PSM concentration courses (ten additional credit hours, totaling 42 credit hours). Students may concentrate study in one of the areas of research specialization listed below. Supporting coursework options include: mathematics; computer science; statistics; engineering mechanics; civil and environmental engineering; electrical and computer engineering; mechanical engineering; industrial engineering; general engineering; natural resources and environmental sciences; agricultural communication; agricultural education; food science and human nutrition; animal sciences; agricultural and consumer economics; business management; finance; labor and industrial relations; crop sciences and other appropriate fields.

Curriculum for the M.S. Degree with a Major in Technical Systems Management (TSM).

The M.S. degree with a Major in Technical Systems Management has the following course work that must be completed by all students to fulfill the degree requirements with a minimum of 12 credit hours required at the 500-level:

Core Requirements

TSM 501 Graduate Research I
TSM 502 Graduate Research II
TSM 594 Graduate Seminar
One course in statistics
One course in research methods

Technical Systems Management M.S. Degree Electives: (minimum 3 credit hours are required)

TSM 421 Ag. Safety-Injury Prevention
TSM 422 Ag. Health-Illness Prevention
TSM 425 Applying Safety Interventions
TSM 435 Electronic Microcomputer Control Systems

TSM 436 Renewable Energy Systems
TSM 455 Erosion and Sediment Control
TSM 464 Engine and Tractor Power
TSM 465 Chemical Application Systems
TSM 486 Grain Bioprocessing Coproducts
NRES 510 Adv Natural Resource Economics
TE 461 Technology Entrepreneurship
TE 560 Managing Advanced Technol I
TE 561 Managing Advanced Technol II
UP 546 Land Use Policy and Planning

Curriculum for the M.S. Degree with a Major in Technical Systems Management and Concentration in Professional Science Masters (PSM).

The M.S. degree with a Major in Technical Systems Management and Concentration in PSM curriculum has the following three categories of coursework that must be completed by all students to fulfill the degree requirements:

1. Core Requirements:

TSM 501 Graduate Research I
TSM 502 Graduate Research II
TSM 594 Graduate Seminar
One course in statistics
One course in research methods

2. Technical Systems Management M.S. Degree Electives: (minimum 3 credit hours are required)

TSM 421 Ag. Safety-Injury Prevention
TSM 422 Ag. Health-Illness Prevention
TSM 425 Applying Safety Interventions
TSM 435 Electronic Microcomputer Control Systems
TSM 436 Renewable Energy Systems
TSM 455 Erosion and Sediment Control
TSM 464 Engine and Tractor Power

TSM 465 Chemical Application Systems
TSM 486 Grain Bioprocessing Coproducts
NRES 510 Adv Natural Resource Economics
TE 461 Technology Entrepreneurship
TE 560 Managing Advanced Technol I
TE 561 Managing Advanced Technol II
UP 546 Land Use Policy and Planning

3. PSM Concentration Requirements - 10 hours of coursework required for all students in the program that provides business fundamentals, as part of the proposed campus-wide PSM initiative.

Key Features of the PSM Concentration to be Coupled with the Proposed M.S. Major in Technical Systems Management Required Courses

There are three components of the PSM concentration:
1. Business curriculum (courses listed in table below)
2. Industry seminar series (PSM 501, 502, and 503)
3. Internship (PSM 555)
Business Curriculum (10 hours)
The business curriculum is a sequence of eight courses jointly delivered by the School of Labor and Employment Relations (LER) and the College of Business. These courses, common across all PSM programs, are intended to provide PSM students with core business knowledge and skills. The business curriculum totals 10 semester credit hours in an intensive, focused delivery. The requirements are summarized below.

Term / Semester	Course	Title	Instructional Unit	Credit Hours
1 - Fall	PSM 510	Managerial Accounting	Business	1
1 - Fall	PSM 511	Financial Management	Business	1
1 - Fall	PSM 512	People and Technology at Work	LER	2
2 - Spring	PSM 520	Technology Management	Business	1
2 - Spring	PSM 521	Strategic Decision Making	Business	1
2 - Spring	PSM 522	Human Resource Management for Scientists and Engineers	LER	2
3 - Fall	PSM 530	Entrepreneurship	Business	1
3 - Fall	PSM 531	Marketing	Business	
	1			

Industry Seminar Series (0 hours)

The industry seminars provide opportunities for intellectual and social engagement for students across Illinois PSM programs. The seminars extend the professional preparation provided in the business curriculum. A key element of the seminar is invited guest lecturers in significant science-related leadership roles from business, industry, and governmental organizations. All PSM students will enroll in a common seminar each semester, blending students from multiple disciplines to explore issues in common. PSM students will enroll in the seminar each semester in which they are enrolled in the cohort program (PSM 501, 502 and 503, respectively), excluding summer.

Internship (0 hours)

The internship is judged a necessary component of a professional graduate degree program whose goal is to produce graduates proficient in their science area of study with the knowledge, skills, and abilities to apply their proficiency to managerial and leadership challenges of business, government, and not-for-profits. In consultation with the program coordinator, students find internship companies and positions that match their individual career objectives and meet the learning goals of the program. The student bears the principal responsibility for securing the internship.