Department of Biological and Agricultural Engineering

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The **departmental mission** is teaching, research, and extension for solving engineering and technological management problems in agriculture, environment, biotechnology, and natural resources through an understanding of the biological and physical sciences. The department's teaching program includes degree programs in Biological and Agricultural Engineering, which are offered through the College of Engineering, and in Agricultural Systems Management, offered through the College of Agricultural and Life Sciences. The graduate program in biological and agricultural engineering is offered through the College of Graduate Studies. The educational objectives for the B.S. degree in Biological and Agricultural Engineering are:

1. Graduates can apply their technical expertise to solve engineering problems.

2. Graduates have the demonstrated ability to apply their knowledge of math, science and engineering to the technical problems they encounter, including the design of experiments and data analysis.

3. Graduates will know how to effectively use modern engineering tools to solve engineering problems.

4. Graduates will understand the design process and how it is used to develop solutions to engineering problems.

5. Graduates will have effective listening skills for gathering information to define and solve problems.

6. Graduates will have effective writing, speaking, and presentation skills for presenting technical information from engineering problem solving and design.

7. When confronted with a complex technical problem, students will organize into teams, follow the engineering design process, and produce an effective engineering solution.

8. When working in teams graduates will make effective use of all the diverse resources of the team members.

9. Graduates have sufficient knowledge of biological kinetics, biological materials, biological systems, bioprocessing, computer and automatic control systems, and natural resource systems to use this knowledge for engineering problem solving and design.

10. Graduates will understand the obligation and responsibility of professional registration and professional ethics, and will be committed to keeping their skills and expertise up-to-date

11. Graduates will understand relevant non-technical contemporary issues and the importance of these issues impacting solutions to the technical problems they encounter.

The Biological and Agricultural Engineering curriculum is accredited by the Engineering Accreditation Commission of the Accrediting Board of Engineering and Technology (EAC/ABET). Students in this program are eligible to take the Fundamentals of Engineering (FE) Examination prior to graduation and to become registered professional engineers after graduating and completing an experience requirement.

The five engineering options in the Biological and Agricultural Engineering program provide each student the opportunity to pursue a course of study suited to a particular professional engineering career goal.

Agricultural Engineering is the curriculum that bridges between two fields of applied science – engineering and agriculture. It is oriented to the design and control of equipment and systems for production, processing, and transportation of food, feed, natural raw fiber, and forest products and for the effective use of natural resources. Agricultural engineers have the education and interests that make them uniquely capable of developing engineering solutions for agricultural and biological systems.

The agricultural engineering program at the UI is designed to prepare students for a variety of interesting and rewarding careers. Many graduates are employed as design or development engineers by equipment manufacturers, irrigation companies, trade associations, engineering consulting firms, and governmental agencies. Others are self-employed in farm equipment manufacturing, consulting firms, and other engineering-related enterprises.

Biological Systems Engineering is an undergraduate curriculum designed to prepare students to solve technological problems in systems that involve plants, animals, microorganisms, and biological materials. They produce creative and effective solutions to problems in the environment, our food supply, and the interaction of living organisms in a biologically complex, interconnected and changing world. The program can be designed to prepare the student for advanced biomedical or environmental engineering studies.

A broader emphasis in biology and chemistry is made within this curriculum compared to other engineering disciplines. Depending on their electives, graduates in biological systems engineering have opportunities to work with consulting and industrial firms in design, environmental control and monitoring, non-point source pollution abatement, bioremediation, hydrology and water quality control. They may also work with food processing industries in storage, product development and quality control. Other options include governmental agencies in water resources, environmental quality, and environmental protection. This program is often used as a pre-biomedical program to prepare students for graduate studies in the biomedical profession.

Environmental Engineering focuses on the design and management of systems that use or impact natural resources. Study in this program prepares engineers to work in natural resource conservation and environmental quality enhancement. Environmental Engineers are uniquely prepared to address issues related to surface water hydrology, groundwater hydrology, sediment transport, water quality, chemical rate and transport determination, waste management, reclamation of disturbed lands, site remediation and drainage. Applications include water quality studies of lakes, rivers and groundwater, system design and management, waste treatment, management of air quality inside buildings and outside, remediation of land damaged by construction, mining, or other activity.

Graduates in environmental engineering work with state and federal agencies, consulting firms and private companies on projects related to environmental engineering design, permitting, waste management, pollution abatement, bioremediation, and hydrology. They may also be employed by processing industries in quality control, waste management, and in projects related to other environmental issues.

Food and Bioprocess Engineering prepares students for careers within traditional food processing industries and for emerging careers in bioprocess industries including bioenergy and biofuels such as the ethanol and biodiesel industries. The program is designed to develop engineering expertise in the area of applied biotechnology in such areas as waste treatment, biomass to energy production, industrial biological processes and/or molecular biology as related to engineered applications of biotechnology. The goal is the application of the science to real-world problems through more engineering input.

Food and Bioprocess engineering involves the development of equipment and methods for efficient and environmentally sound manufacturing of food and biological commodities. Engineers in this option receive extensive training in microbiology, biochemical engineering, heat and mass transfer, storage of biological products, materials handling, and unit processes.

Graduates are prepared for work with private industry, consulting firms, state and federal agencies on projects related to bioprocess development, energy conservation, testing, evaluation and application of new food, industrial and fuel projects.

BAE has an internationally recognized program in biofuels especially biodiesel. Faculty play a significant role in biofuel development and demonstration and cooperate regularly with the University of Idaho National Institute for Advanced Transportation Technology. The Food and Bioprocessing program works cooperatively with the Food Science and Toxicology programs at both the University of Idaho and Washington State University.

Soil and Water Engineering is an undergraduate engineering program designed to prepare students to solve technological problems related to soil and water, water use, water conservation, water quality, soil conservation, irrigation and drainage, water management, and soil-plant-water relationships of practical importance to the western United States.

The Department of Biological and Agricultural Engineering is a major player in the water issues facing the state of Idaho. Faculty are involved in the Snake River Plain aquifer issues including modeling efforts directed toward the Snake River Aquifer and water use issues. They are involved with research related to water management, irrigation, and crop water response. BAE has an internationally recognized program in remote sensing related to evapotranspiration and crop water response. They have programs related to nanoparticle transport and the mobility of small particles especially the transport of constituents sorbed onto clay particles or humic acid molecules. The department conducts studies related to watershed management, and hydrologic modeling of small watersheds for erosion prediction. BAE is the home of the Idaho State Climatologist who also does research using remotely sensed surface temperature data and other phenomena related to water and energy exchange between the land surface and the atmosphere for use in weather and climate prediction.

Agricultural Systems Management emphasizes the use and management of equipment and systems based on an understanding of their design and operation. Agricultural systems management courses are designed to provide students with experience in systems technology and analysis of agricultural equipment and machinery applications, feed and food processing, agricultural electrification, soil and water management, waste management, agricultural systems, and fabrication practices for agricultural and natural resource-based enterprises.

The undergraduate degree program in agricultural systems management (B.S.A.S.M.) is designed to prepare students to apply biological, physical, mechanical, and business knowledge to the production, service, sales, application, and management of the equipment and processes used in agriculture. The curriculum stresses courses in agriculture, agricultural systems management, and basic and applied sciences. It also includes a strong background in agricultural economics, accounting, and business. It prepares students for a variety of important and rewarding career opportunities. Many graduates return to farming, while others pursue careers as farm managers or are employed in agricultural and natural resource-oriented businesses, banking firms, educational institutions, or governmental agencies. This curriculum is recognized by the American Society of Agricultural Engineers. The educational objectives in Agricultural Systems Management are:

1. The graduate can communicate in writing and orally to clientele and the public about solutions to agricultural technology and management problems.

2. The graduate has mechanical skills needed to develop, construct, alter and repair agricultural equipment systems.

3. The graduate has knowledge in business, and in physical and biological sciences for application to system and technology development to creatively solve agricultural problems.

4. The graduate has computer skills that can be used in the analysis and development of agricultural systems.

5. The graduate has mathematical skills to quantify physical and biological processes in agriculture.

6. The graduate has a social science and humanities background to provide sensitivity for the concerns of society and appreciate different points of view.

The four specialty options in the Agricultural Systems Management curricula provide each student the opportunity to select a course of study suited to a particular career goal.

The Agricultural Information Systems option is designed to prepare students to apply biological, physical, and business knowledge to the computing and management problems in agricultural production, service, marketing, and other rural activities. The curriculum stresses courses in computer applications, applied computing techniques, agricultural economics, accounting, and business. It also includes a strong background in agriculture, agricultural systems, and basic and applied sciences. Students are prepared for a variety of important and rewarding careers. Examples include commercial agricultural firms, agricultural and natural resource-oriented businesses, banking firms, educational institutions, or government agencies. Some graduates of this option may return to farms and ranches as farm managers.

The Water and Waste Management Systems option is designed to prepare students with the necessary background in the biological, physical, and business knowledge required for work in the area of water and waste management. This would include water system management, irrigation management, water conveyance, management of agricultural and processing waste streams, odor control, and other agricultural environmental issues. The curriculum provides a strong background in agricultural systems management, business and economics, with additional work in water quality, water and waste operation management, and basic and applied sciences. Students are prepared for a variety of careers in agricultural and environmental related fields. Examples include commercial agricultural operations; agricultural and natural resource-oriented businesses; water master; manager for an irrigation district or canal companies; educational institutions; local, state and federal agencies. Some graduates of this option may return to private business or farm operation.

The Agricultural Production Management option is a traditional program in agricultural systems management it provides students with a background in systems technology, agricultural equipment, engines and power units, agricultural electrification, agricultural processing, and soil and water principles based on understanding of basic and applied sciences such as chemistry, biology and physics. Students may choose from a variety of business, economics and agriculturally based courses for their technical electives to prepare them for work directly with agricultural industries or to work as farm managers or operators. Students from this option are prepared to operate an agriculturally related business or to work directly in production agriculture.

The Agricultural Machine Systems option allows students to build on the agricultural machinery and equipment portion of the general curriculum with more emphasis in technical courses related to equipment operation and testing. The curriculum provides a strong background in mathematics, basic sciences, agriculture and agricultural systems management courses but then allows a student to specialize in courses related to precision agriculture, agricultural safety and health, engineering materials, fundamental thermal and fluid principles which are necessary for a more complete understanding of machine systems. Students from this option are prepared to work directly in agricultural equipment related business such as to serve as a technical representative. They also might manage equipment systems or participate in sales or testing of agricultural or agriculturally related equipment.

The agricultural systems management courses are also available to nonmajors interested in obtaining an understanding of the technology used in modern agricultural production systems. A minor in agricultural systems management can be used to support degree programs in other departments.

Graduate study is offered in biological and agricultural engineering with specialization in irrigation, water and chemical management, hydrology, soil and water conservation, subsurface water and chemical transport modeling, and climate modeling; alternative fuels and lubricants; harvesting and handling food and bioproduct processing of agricultural crops; off-road vehicle development, instrumentation and control; equipment design and development; and bioremediation and organic waste management and treatment. The M.S. and Ph.D. degrees are primarily research degrees. Prospective students should have the equivalent of a B.S. degree in engineering and must have a working knowledge of computers including mainframe and microcomputers, structured programming, and electronic spreadsheets.

Assessment of departmental objectives is accomplished by monitoring performance of students on the Fundamentals of Engineering examination and by student interviews. All graduates are interviewed at the time of graduation by the department to evaluate concerns, opportunities, and effectiveness of its educational programs. The assessment statistics can be obtained from the departmental office.

Courses

See Part 6 for courses in Agricultural Systems Management (ASM) and Biological and Agricultural Engineering (BAE).

Undergraduate Curricular Requirements

AGRICULTURAL SYSTEMS MANAGEMENT (B.S.A.S.M.)

Designed to prepare students for careers in agriculture and agriculturally related businesses that require a knowledge of engineering methods. Emphasis is placed on the practical application of technology to agriculture. This curriculum is administered by the Department of Biological and Agricultural Engineering.

Required course work includes the university requirements (see regulation J-3) and:

Acct 201 Introduction to Financial Accounting and Acct 202 Introduction to Managerial Accounting; or Acct 205 Fundamentals of Accounting (4-6 cr)
AgEc 278 Farm and Agribusiness Management (3 cr)
ASM 112 Introduction to Agricultural Systems Management (3 cr)
ASM 200 Seminar (1 cr)
ASM 202 Agricultural Shop Practices (2 cr)
ASM 240 Computer Applications in Biological Systems (3 cr)
ASM 305 Agricultural Machinery Systems (3 cr)
ASM 315 Irrigation Systems and Water Management (3 cr)
ASM 331 Electric Power Systems for Agriculture (3 cr)
ASM 409 Agricultural Tractors and Power Units (3 cr)
ASM 433 Agricultural Processing Systems (3 cr)
BAE 478 Biological and Agricultural Engineering Design I (2 cr)
BAE 479 Biological and Agricultural Engineering Design II (2 cr)
BAE 491 Seminar (1 cr)
Biol 102 Biology and Society or Biol 115 Cells and the Evolution of Life (4 cr)
BLaw 265 Legal Environment of Business (3 cr)
Chem 101 Introduction to Chemistry I or Chem 111 Principles of Chemistry I (4 cr)
Comm 101 Fundamentals of Public Speaking (2 cr)
Econ 201 Principles of Economics (3 cr)
Econ 202 Principles of Economics (3 cr)
Eng 317 Technical Writing or Engl 313 Business Writing (3 cr)
Engl 102 College Writing and Rhetoric (3 cr)
Phys 100 Fundamentals of Physics, Phys 111 General Physics I, or Phys 211 Engineering Physics I (4 cr)
PlSc 102 The Science of Plants in Agriculture (3 cr)
PTTE 367 Teaching and Learning Computer Aided Drafting/Design (3 cr)
Soil 205 The Soil Ecosystem (3 cr)
Soil 206 The Soil Ecosystem Lab (1 cr)
Stat 251 Statistical Methods (3 cr)

Select one of the following options

A. Agricultural Information Systems Option

BAE 143 Engineering Problem Solving (2 cr)
Bus 250 Introductory Systems Development (3 cr)
CS 112 Introduction to Problem Solving & Programming (3 cr)
CS 120 Computer Science I (4 cr)
Geog 385 GIS Primer (3 cr)
Math 160 Survey of Calculus or Math 170 Analytical Geometry and Calculus (4 cr)
PTTE 428 Teaching and Learning Computer Operating Systems for Technology (3 cr)
Agriculture Electives (See list in Dept. Office) (9 cr)
Advisor approved electives to total 128 for the degree (See list in Dept. Office)

B. Water and Waste Management Systems Option

ASM 430 Water & Wastewater Operations Management (3 cr)
BAE 351 Hydrology (3 cr)
BAE 356 Hydrologic Measurement Techniques (1 cr)
EnvS 446 Drinking Water & Human Health (3 cr)
Math 160 Survey of Calculus or Math 170 Analytical Geometry and Calculus (4 cr)
Agriculture Electives (See list in Dept. Office) (9 cr)
Advisor approved electives to total 128 for the degree (See list in Dept. Office)

C. Agricultural Production Management Option

ASM 304 Agricultural Fluid Power (2 cr)
ForP 230 Forest Harvesting Field Measurement or CE 218 Elementary Surveying (2 cr)
Math 143 Pre-calculus Algebra and Analytic Geometry or Math 160 Survey of Calculus (3-4 cr)
Agricultural Economics Elective (3 cr)
Structures Elective (See list in Dept. Office) (3 cr)
Agriculture and Technical Electives (See list in Dept. Office) (14 cr)
Life Science Electives (See list in Dept. Office) (3 cr)
Business Electives (See list in Dept. Office) (3 cr)
Upper Division (300 level or higher) AgEc or Bus elective (3 cr)
Advisor approved electives to total 128 for the degree (See list in Dept. Office)

D. Agricultural Machine Systems Option

ASM 210 Small Engines (3 cr)
ASM 304 Fluid Power Systems (2 cr)
ASM 412 Agricultural Safety and Health (2 cr)
Geog 385 GIS Primer (3 cr)
Math 170 Analytical Geometry and Calculus (4 cr)
ME 123 Introduction to Mechanical Design (3 cr)
ME 261 Engineering Materials (3 cr)
Phys 111 General Physics I (4 cr)
PTTE 481 Computer Numerical Control Manufacturing (4 cr)
Agriculture Electives (See list in Dept. Office) (6 cr)
Advisor approved electives to total 128 for the degree (See list in Dept. Office)

BIOLOGICAL AND AGRICULTURAL ENGINEERING (B.S.B.A.E.)

Required course work includes the university requirements (see regulation J-3) and:

BAE 142 Engineering for Living Systems (2 cr)
BAE 143 Engineering Problem Solving or CS 112 Introduction to Problem Solving and Programming (3 cr)
BAE 355 Fundamentals of Hydrologic Engineering (3 cr)
BAE 441 Instrumentation and Measurements (3 cr)
BAE 462 Electric Power and Controls (3 cr)
BAE 478 Engineering Design I (2 cr)
BAE 479 Engineering Design II (2 cr)
BAE 491 Senior Seminar (1 cr)
Chem 111 Principles of Chemistry I (4 cr)
Chem 112 Principles of Chemistry II (5 cr)
Engl 102 College Writing and Rhetoric (3 cr)
Engr 105 Engineering Graphics (2 cr)
Engr 210 Engineering Statics (3 cr)
Engr 240 Introduction to Electrical Circuits (3 cr)
Engr 320 Engineering Thermodynamics and Heat Transfer (3 cr)
Engr 335 Engineering Fluid Mechanics (3 cr)
Engr 350 Engineering Mechanics of Material (3 cr)
Engr 360 Engineering Economy (3 cr)
Math 170 Analytic Geometry and Calculus I (4 cr)
Math 175 Analytic Geometry and Calculus II (4 cr)
Math 275 Analytic Geometry and Calculus III (3 cr)
Math 310 Ordinary Differential Equations (3 cr)
Phys 211 Engineering Physics I (4 cr)
Phys 212 Engineering Physics II (4 cr)
Soil 205 The Soil Ecosystem (3 cr)
Stat 301 Probability and Statistics (3 cr)
Communications Elective (2 cr)

And one of the following options:

A. Agricultural Engineering Option

BAE 242 Agricultural Engineering Analysis and Design (2 cr)
BAE 352 Soil and Water Engineering or CE 322/323 Hydraulics and Lab (3-4 cr)
BAE 372 Agricultural Power and Machines (3 cr)
BAE 459 Irrigation System Design (3 cr)
BAE 461 Bioprocess Engineering (3 cr)
CE 211 Engineering Measurements (3 cr)
CE 342 Theory of Structures (3 cr)
Engr 220 Engineering Dynamics (3 cr)
Biological Science Electives (3 cr)

Technical Electives (8 cr)
Electives to total 128 cr for the degree

B. Biological Systems Engineering Option

BAE 242 Agricultural Engineering Analysis and Design (2 cr)
BAE 461 Bioprocess Engineering (3 cr)
Biol 115 Cells and the Evolution of Life (4 cr)
Chem 277 Organic Chemistry I (3 cr)
Chem 278 Organic Chemistry I: Lab (1 cr)
MMBB 250, 255 General Microbiology and Lab (5 cr)
MMBB 380 Introductory Biochemistry (4 cr)
Biological Science Electives (3 cr)
Technical Electives (9 cr)
Electives to total 128 cr for the degree

C. Environmental Engineering Option

BAE 432 Bioreactor Theory and Design for Waste Treatment (3 cr)
BAE 433 Bioremediation (3 cr)
BAE 452 Environmental Water Quality (3 cr)
BAE 461 Bioprocess Engineering (3 cr)
Biol 115 Cells and the Evolution of Life (4 cr)
ChE 223 Material and Energy Balances (3 cr)
Chem 277 Organic Chemistry I (3 cr)
Chem 278 Organic Chemistry I: Lab (1 cr)
CE 330 Fundamentals of Environmental Engineering (3 cr)
MMBB 250, 255 General Microbiology and Lab (5 cr)
MMBB 380 Introductory Biochemistry (4 cr)
Electives to total 128 cr for the degree

D. Food and Bioprocess Engineering Option

BAE 242 Agricultural Engineering Analysis and Design (2 cr)
BAE 461 Bioprocess Engineering (3 cr)
Biol 115 Cells and the Evolution of Life (4 cr)
Chem 277 Organic Chemistry I (3 cr)
Chem 278 Organic Chemistry I: Lab (1 cr)
FST 303 Food Processing (3 cr)
MMBB 250, 255 General Microbiology and Lab (5 cr)
MMBB 380 Introductory Biochemistry (4 cr)
Technical Electives (3 cr)
Food Engineering Electives (3 cr)
Food Science Electives (3 cr)
Electives to total 128 cr for the degree

E. Soil and Water Engineering Option

BAE 242 Agricultural Engineering Analysis and Design (2 cr)
BAE 352 Soil and Water Engineering (3 cr)
BAE 451 Engineering Hydrology (3 cr)
BAE 452 Environmental Water Quality (3 cr)
BAE 458 Open Channel Hydraulics (3 cr)
BAE 459 Irrigation System Design (3 cr)
CE 211 Engineering Measurements (3 cr)
Technical Electives (8 cr)
Soil and/or Water Engineering Electives (3 cr)
Biological Science Electives (3 cr)
Electives to total 128 cr for the degree

A grade of C or better is required in each of the following courses before registration is permitted in upper-division engineering courses: BAE 143, BAE 242, Chem 111, Engr 210, Math 275, and Phys 211.

To graduate in this program, a grade of C or better is required in each of the following courses: BAE 143, BAE 242, Chem 111, Engr 210, Math 275, and Phys 211.

Students are required to submit a course plan and a statement of how the humanistic and social course requirements complement the technical content of the curriculum and are consistent with the program and institution objectives.

Academic Minor Requirements

AGRICULTURAL SYSTEMS MANAGEMENT MINOR

ASM 202 Agricultural Shop Practices (2 cr)
At least four credits from the following skill courses:
- ASM 107 Beginning Welding (2 cr)
- PTTE 367 Teaching and Learning Computer Aided Drafting/Design (2 cr)
- ASM 210 Small Engines (2 cr)

At least twelve credits from the following application courses:
- ASM 304 Agricultural Fluid Power Systems (2 cr)
- ASM 305 Agricultural Machinery Systems (3 cr)
- ASM 315 Irrigation Systems and Water Management (3 cr)
- ASM 409 Agricultural Tractors and Power Units (3 cr)
- ASM 412 Agricultural Safety and Health (2 cr)
- ASM 430 Water and Wastewater Management (3 cr)

The minimum number of credits in agricultural systems management courses for the minor is 19.

Graduate Degree Programs

Candidates must fulfill the requirements of the College of Graduate Studies and of the Department of Biological and Agricultural Engineering. See the College of Graduate Studies section of Part 4 for the general requirements applicable to each degree.

Master of Science. General M.S. requirements apply. Study and research programs are available in all of the areas listed above.

Master of Engineering. General M.Engr. requirements apply.

Doctor of Philosophy. Admission to this program is based on the student's interest being compatible with faculty interest, funds, and facilities. Admission is given only after a thorough review of the student's academic background, research interests, and potential. Individual programs normally consist of three years' work beyond the bachelor's degree. The department does not have a mandatory foreign language requirement. Students are required, however, to broaden their education in an area outside the normal engineering and science curricula. This can be done by taking courses in the humanities and social sciences, demonstrating an in-depth proficiency in a foreign language, or participating in an equivalent broadening educational experience.