DEPARTMENT OF BIOLOGICAL AND AGRICULTURAL ENGINEERING

Biological and agricultural engineers apply their knowledge of physical and biological sciences, mathematics, engineering principles and engineering design to the production and processing of food and fiber, to the preservation of environmental quality, to biological systems and processes, and to machine systems that interface with all of these. Because of their broad general engineering background, biological and agricultural engineering graduates are sought by a wide variety of employers including environmental consulting firms, equipment manufacturers, crop storage and handling industries, the cotton and forest products industries, food and feed processing industries, animal production industries, biotechnology companies, electric utility companies, chemical companies, and governmental agencies. Biological and agricultural engineers make significant contributions to meeting many basic needs of society such as maintaining food quality, quantity and safety; improving environmental quality; and enhancing the quantity and quality of our water resources.

The Biological and Agricultural Engineering Department provides quality education, research and outreach in engineering and technology for the world’s agricultural, biological, environmental and food systems. Our undergraduate programs provide a high quality education for engineering and systems management students to fulfill the needs of industries we serve and advance our reputation as a world leader in engineering and systems management education.

Biological and Agricultural Engineering is accredited by the Accreditation Board for Engineering and Technology (ABET). The Fundamentals of Engineering (FE) exam is generally your first step in the process to becoming a professional licensed engineer (P.E.). Students are able to obtain these licenses upon graduating from an ABET-accredited program.

Faculty

Agarwal, Girish S, Professor
Biological & Agricultural Eng
PHD, University of Rochester, 1969

Capareda, Sergio C, Professor
Biological & Agricultural Eng
PHD, Texas A&M University, 1990

Castell-Perez, M E, Professor
Biological & Agricultural Eng
PHD, Michigan State University, 1990

Engler, Cady R, Senior Professor
Biological & Agricultural Eng
PHD, University of Waterloo, 1980

Fernando, Sandun D, Professor
Biological & Agricultural Eng
PHD, University of Nebraska, 2003

Gomes, Carmen L, Associate Professor
Biological & Agricultural Eng
PHD, Texas A&M University, 2010

Huang, Yongheng, Associate Professor
Biological & Agricultural Eng
PHD, University of Nebraska - Lincoln, 2002

Karthikeyan, Raghupathy, Associate Professor
Biological & Agricultural Eng
PHD, Kansas State University, 2001

Kenimer, Ann L, Professor
Biological & Agricultural Eng
PHD, University of Illinois at Urbana-Champaign, 1990

King, Maria D, Assistant Professor
Biological & Agricultural Eng
PHD, Institute for Biotechnology, Berlin, Germany, 1986

Kingman, Douglas M, Instructional Associate Professor
Biological & Agricultural Eng
PHD, Purdue University, 2002

Lacey, Ronald E, Professor
Biological & Agricultural Eng
PHD, University of Kentucky, 1992

Mohanty, Binayak P, Professor
Biological & Agricultural Eng
PHD, Iowa State University, 1992

Mohtar, Rabi H, Professor
Biological & Agricultural Eng
PHD, Michigan State University, 1994

Moore, Janie M, Assistant Professor
Biological & Agricultural Eng
PHD, Purdue University, 2015

Moreira, Rosana G, Professor
Biological & Agricultural Eng
PHD, Michigan State University, 1989

Munster, Clyde L, Professor
Biological & Agricultural Eng
PHD, North Carolina State University, 1992

Nikolov, Zivko L, Professor
Biological & Agricultural Eng
PHD, Iowa State University, 1986

Riskowski, Gerald L, Professor
Biological & Agricultural Eng
PHD, Iowa State University, 1986

Searcy, Stephen W, Senior Professor
Biological & Agricultural Eng
PHD, Oklahoma State University, 1980

Singh, Vijay P, Professor
Biological & Agricultural Eng
PHD, Colorado State University, 1974

Smith, Patricia K, Professor
Biological & Agricultural Eng
PHD, North Carolina State University, 2000
Stark, Gregory L, Assistant Professor of the Practice
Biological & Agricultural Eng
MPH, University of Kentucky - Lincoln, 1986

Thomasson, John A, Professor
Biological & Agricultural Eng
PHD, University of Kentucky, 1997

**Majors**

- Bachelor of Science in Agricultural Systems Management (http://catalog.tamu.edu/undergraduate/agriculture-life-sciences/biological-agricultural-engineering/agricultural-systems-management-bs)
- Bachelor of Science in Biological and Agricultural Engineering (http://catalog.tamu.edu/undergraduate/agriculture-life-sciences/biological-agricultural-engineering/bs)

**Minors**


**Courses**

- Agricultural Systems Management (AGSM) (p. 2)
- Biological Agricultural Engineering (BAEN (p. 4))

**Agricultural Systems Management**

**AGSM 125 Introduction to Agricultural Systems Management**

Credit 1. 2 Lab Hours.
Introduction to technical management of agricultural systems using management projects presented by agricultural managers from industry; problem definition, information search, idea generation and development of management solutions.  
Prerequisite: Freshman or sophomore classification or approval of instructor; majors only.

**AGSM 201 Agricultural Energy and Power Systems**

Credits 3. 2 Lecture Hours. 2 Lab Hours.  
(AGRI 2301) Agricultural Energy and Power Systems. A study of the types of power and energy sources used in agricultural equipment and systems; management considerations for selecting, operating and maintaining internal combustion engines, electric equipment and motors, and renewables as power sources.  
Prerequisite: Freshman or sophomore classification or approval of instructor.

**AGSM 284 Internship**

Credits 0. 0 Lecture Hours. 0 Lab Hours. 0 Other Hours.  
No Credit. Practical experience working in a professional agricultural systems management setting. May be taken three times.  
Prerequisite: Freshman or sophomore classification; approval of the instructor.

**AGSM 285 Directed Studies**

Credits 0 to 4. 0 to 4 Other Hours.  
Selected problems in any phase of agricultural systems management; credit and specific content dependent upon background, interest, ability and needs of student enrolled; individual consultations and reports required.  
Prerequisites: Freshman or sophomore classification; approval of department head.

**AGSM 289 Special Topics in...**

Credits 1 to 4. 1 to 4 Lecture Hours.
Selected topics in an identified area of agricultural systems management. May be repeated for credit.  
Prerequisite: Approval of instructor.

**AGSM 291 Research**

Credits 0 to 3. 0 to 3 Other Hours.  
Research conducted under the direction of faculty member in agricultural systems management.  
Prerequisites: Freshman or sophomore classification and approval of instructor.

**AGSM 301 Systems Analysis in Agriculture**

Credits 3. 3 Lecture Hours.  
Operations research and systems theory applied to management problems in food and agricultural industries; linear programming, queuing theory, simulation and critical path method; provides the knowledge and computer skills to better manage resources for the evolving agricultural industries.  
Prerequisites: Grade of C or better in MATH 140 or MATH 141 and MATH 142 or MATH 151.

**AGSM 310 Agricultural Machinery Management**

Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Selection of a matched complement of power units and machines for farming operations; consider constraints such as crops, season, weather, personnel and capital; apply systems techniques such as linear programming, optimization, queuing theory and inventory models; utilize available software programs and learn to develop electronic spreadsheets and other customized software.  
Prerequisites: AGSM 201; grade of C or better in AGSM 301 or concurrent enrollment.

**AGSM 315/NFSC 315 Food Process Engineering Technology**

Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Elementary mechanics, physical and thermal properties of food and processing materials, heat transfer, mass and energy balances, psychrometrics (properties of air), insulation.  
Prerequisites: Grade of C or better in PHYS 201 or PHYS 218, or approval of instructor.  
Cross Listing: NFSC 315/AGSM 315.

**AGSM 325 Agri-Industrial Applications of Electricity**

Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Elements of electric current generation and transmission, applications of electric heating, lighting and power, wiring, motors, energy rates, meter reading, safety rules and regulations.  
Prerequisite: AGSM 201; AGSM majors or minors only.

**AGSM 335 Water and Soil Management**

Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Elementary principles of surface and ground water supply, flood control, water distribution systems and irrigation systems; principles of drainage, soil conservation and erosion control; elementary surveying, chaining, leveling and mapping applied to agricultural and natural resource needs; illustrated by practical examples of terracing and farm pond design.  
Prerequisite: Grade of C or better in MATH 140 or MATH 141; grade of C or better in CHEM 101 and CHEM 111; or approval of instructor.
AGSM 337 Technology for Environmental and Natural Resource Engineering
Credits 3. 3 Lecture Hours.
For the nonengineering student in the environmental and management sciences; concentrates on the application of technology for solving local environmental problems while considering global issues; reduction of water, air and hazardous waste pollutants; legislative issues and modeling.
Prerequisites: Grade of C or better in MATH 140 or MATH 141 and MATH 142 or AGSM 301.

AGSM 355 Energy and Conversion Systems
Credits 3. 3 Lecture Hours.
Basic physical conversion principles of energy use, including historical and future patterns; conservation measures, alternative energy sources, and the environment impact of U.S. and world energy use.
Prerequisites: Junior or senior classification; non-majors only.

AGSM 360 Occupational Safety Management
Credits 3. 3 Lecture Hours. 0 Lab Hours.
Safety considerations in the work environment, including safety mandates, safety mission, personal and business liability, fire, chemical, dust, machine noise, personal protective devices; design and implementation of safety programs.
Prerequisite: Junior or senior classification.

AGSM 403 Processing and Storage of Agricultural Products
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Factors influencing the nature of biological materials and the preservation of quality throughout the harvesting, handling and processing system; a systems approach to cereal grains includes principles of drying, quality deterioration, storage, conveying and handling; processing of fiber crops.
Prerequisites: AGSM 310 and AGSM 315/NFSC 315; or approval of instructor.

AGSM 417/NFSC 417 Food Process Engineering Technology II
Credits 3. 3 Lecture Hours.
Applications of basic engineering concepts to understand common unit operations in the food (and related) industry.
Prerequisites: AGSM 315/NFSC 315 or NFSC 315/AGSM 315.
Cross Listing: NFSC 417/AGSM 417.

AGSM 435 Irrigation Principles and Management
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Principles of irrigation and management for efficient use of water; soil-water-plant relationships; methods of application; power and labor requirements; automated systems and components.
Prerequisites: Grade of C or better in MATH 140 or MATH 141; grade of C or better in CHEM 101 and CHEM 111.

AGSM 439 Management of Agricultural Systems I
Credits 3. 3 Lecture Hours.
Application of agricultural systems management principles in solving realistic problems faced by agribusiness managers; project selection from problems posed by biological and agricultural industrial consultants; project feasibility study and outline; management and application philosophy; teamwork and communication, economics; product liability and reliability; standards and codes; goal setting and time management.
Prerequisites: Grade of C or better in AGSM 301; ENGL 210, AGSM 310, and AGSM 325; AGSM 335, AGSM 337 and AGSM 403 or concurrent enrollment; must be taken prior to AGSM 440; AGSM majors only.

AGSM 440 Management of Agricultural Systems II
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Management of agricultural systems through team solution of management problems posed by agribusiness managers, farmers, extension specialists and other industry consultants; application of management principles to give experience in solving realistic problems faced by agribusiness managers; critical evaluation of results by students, staff and consultants.
Prerequisites: COMM 203; grade of C or better in AGSM 439; should be taken last spring semester prior to graduation.

AGSM 461/SPSC 461 Geographic Information Systems for Resource Management
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Geographic Information System (GIS) approach to the integration of spatial and attribute data to study the capture, analysis, manipulation and portrayal of natural resource data; examination of data types/formats; integration of GIS with remote sensing and Global Positioning System; lab use of GIS applications to conduct analyses of topics in natural resources.
Prerequisite: Junior or senior classification or approval of instructor.
Cross Listing: SPSC 461/AGSM 461.

AGSM 470 Agricultural Electronics and Control
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Technology of electronic systems in agricultural production and processing, sensors, actuators, and controllers, controller hardware and computer bases.
Prerequisite: AGSM 325; or approval of instructor.

AGSM 473 Project Management for Agricultural Systems Technology
Credits 3. 3 Lecture Hours.
Development of fundamental skill set in project management; basic knowledge of project management methods, tools and techniques; includes organization and life cycle, management processes, integration management, time management, cost management, quality management, communications management, risk management, procurement management, stakeholder management.
Prerequisites: Grade of C or better in AGSM 301; senior classification.

AGSM 475 Applied Information Technologies for Agricultural Systems
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Definition and documentation of the value of information in agriculturally-based technology companies; methods for mapping information flow within the company and across companies; articulation value of information within a value chain for a food product by simulation; and projects using project management software and web-based interactions.
Prerequisites: ISTM 209 or equivalent; junior or senior classification.

AGSM 481 Seminar
Credit 1. 1 Lecture Hour.
Professional development; ethics; career opportunities and topics of interest related to the practice of agricultural systems management.
Prerequisite: Senior classification.

AGSM 484 Internship
Credits 0 to 6. 0 to 6 Other Hours.
Practical experience working in a professional agricultural and/or food systems management setting. May be taken three times.
Prerequisites: Junior or senior classification; approval of the instructor.
AGSM 485 Directed Studies  
Credits 0 to 4. 0 to 4 Other Hours.  
Selected problems in any phase of agricultural systems management; credit and specific content depend on background and interest of student; individual consultations and reports required.  
Prerequisites: Junior classification; approval of department head; 2.0 GPR.

AGSM 489 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours.  
Special topics in an identified area of agricultural systems management. May be repeated for credit.

AGSM 491 Research  
Credits 0 to 3. 0 to 3 Lecture Hours.  
Research conducted under the direction of faculty member in agricultural systems management. May be repeated 2 times for credit. Registration in multiple sections of this course are possible within a given semester provided that the per semester credit hour limit is not exceeded.  
Prerequisites: Junior or senior classification and approval of instructor.

Biological Agricultural Engineering

BAEN 150 Introduction to Biological and Agricultural Engineering Design  
Credit 1. 2 Lab Hours.  
Introduction to the engineering design process using design problems presented by biological and agricultural engineers from industry; problem definition, information search, idea generation and development of design concepts.  
Prerequisite: Engineering major or approval of department head.

BAEN 201 Analysis of Biological and Agricultural Engineering Problems  
Credits 3. 2 Lecture Hours.  
Overview of Biological and Agricultural Engineering discipline through case studies and contemporary problems; introduction to computer programming; engineering analysis and problem solving using computer programming.  
Prerequisites: Grade of C or better in ENGR 102 or ENGR 111 and MATH 151; grade of C or better in CHEM 107 and CHEM 117, or CHEM 102 and CHEM 112.

BAEN 281 Professional Development Seminar  
Credit 1. 1 Lecture Hour.  
Familiarization with engineering design process used in professional environments where BAEN and AGSM graduates are employed; discussion of professional development topics; improvement of technical communication skills. May be taken 4 times for credit.

BAEN 284 Internship  
Credits 0. 0 Lecture Hours. 0 Lab Hours. 0 Other Hours.  
No Credit. Practical experience working in a professional biological and agricultural engineering setting. May be taken three times.  
Prerequisite: Freshman or sophomore classification; approval of the instructor.

BAEN 285 Directed Studies  
Credits 0 to 4. 0 to 4 Other Hours.  
Selected problems in any phase of agricultural engineering; credit and specific content dependent upon background, interest, ability and needs of student enrolled; individual consultations and reports required.  
Prerequisites: Freshman or sophomore classification; approval of department head.

BAEN 289 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours.  
Selected topics in an identified area of agricultural engineering. May be repeated for credit.  
Prerequisite: Approval of instructor.

BAEN 291 Research  
Credits 0 to 3. 0 to 3 Other Hours.  
Research conducted under the direction of faculty member in biological and agricultural engineering.  
Prerequisites: Freshman or sophomore classification and approval of instructor.

BAEN 301 Biological and Agricultural Engineering Fundamentals I  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Fundamental engineering concepts related to agricultural systems including the environment (soil, water, and air), plant and animal production systems and processing, and associated machines and facilities; application of techniques for data collection and analysis to problems in biological and agricultural engineering; design of experiments and communication of experimental results.  
Prerequisite: Grade of C or better in MEEN 221 or concurrent enrollment.

BAEN 302 Biological and Agricultural Engineering Fundamentals II  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Fundamentals of microbiology and biochemistry as they apply to biological and agricultural engineering systems to produce useful products and/or benign wastes; topics include microbiology, chemistry of biomolecules, microbial metabolism, bioenergetics, kinetics, mass transfer, bioreactor design, bioprocesses, and downstream processing.  
Prerequisites: Grade of C or better in BIOL 113 or BIOL 111; Grade of C or better in CHEM 222 or CHEM 227 or concurrent enrollment.

BAEN 320 Engineering Thermodynamics  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
First and second laws of thermodynamics; properties of pure substances; analysis of closed and open systems; applications to steady-flow and non-flow processes; power and refrigeration cycles; psychrometrics.  
Prerequisites: Grade of C or better in MEEN 221 or CVEN 221; grade of C or better in MATH 251 or MATH 253 or concurrent enrollment.

BAEN 340 Fluid Mechanics  
Credits 3. 3 Lecture Hours.  
Fundamentals of fluid properties; basic conservation principles of momentum, energy and continuity; flow through closed conduits; open channel flow; principles of turbomachines and compressible flow.  
Prerequisites: Grade of C or better in BAEN 221; grade of C or better in BAEN 320 or concurrent enrollment.

BAEN 354 Engineering Properties of Biological Materials  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Relationships between composition, structure and properties of biological materials; definition and measurement of mechanical, physical, thermal and other material properties; variability of properties; application of properties to engineering analysis and design of biological and agricultural processes and systems.  
Prerequisite: Grade of C or better in MEEN 222/MSEN 222 or MSEN 222/MEEN 222.
BAEN 365 Unit Operations for Biological and Agricultural Engineering
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Theoretical and practical understanding of basic unit operations required to design processes and equipment in the agricultural, biological, environmental, and food industries, with unique constraints presented by biological and agricultural systems considered in design of all units.
Prerequisites: Grade of C or better in BAEN 340; grade of C or better in CVEN 305 or concurrent enrollment; junior or senior classification.

BAEN 366 Transport Processes in Biological Systems
Credits 3. 3 Lecture Hours.
Basic principles governing transport of energy and mass; application of these principles to analysis and design of processes involving biological, environmental and agricultural systems.
Prerequisites: Grade of C or better in BAEN 320, BAEN 340, and BAEN 365 or concurrent enrollment; grade of C or better in MATH 308; junior or senior classification.

BAEN 370 Measurement and Control of Biological Systems and Agricultural Processes
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Theory and application of sensors and techniques in the design of systems for automatic control in biological systems and agricultural production and processing; sensor operation; signal processing; control techniques; automation and robotics.
Prerequisite: Grade of C or better in ECEN 215.

BAEN 375 Design Fundamentals for Agricultural Machines and Structures
Credits 3. 3 Lecture Hours.
Applications of stress/strain relationships and failure theory to the design of agricultural machines and structures; structural properties of engineering materials; finite element analysis and computer aided engineering design.
Prerequisite: Grade of C or better in CVEN 305.

BAEN 399 Professional Development
Credits 0. 0 Other Hours.
Participation in an approved high-impact learning practice; reflection on professional outcomes from the National Society of Professional Engineers’ Engineering Body of Knowledge; documentation and self-assessment of learning experience.
Prerequisites: Junior or senior classification; or approval of instructor.

BAEN 412 Hydraulic Power
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Hydraulic power systems; energy and power relationships; hydraulic fluid properties; frictional loses in pipelines; hydraulic pumps, cylinders, valves and motors; servo and proportional valves; circuit design and analysis; conductors, fittings and ancillary devices; maintenance of hydraulic systems; pneumatic components and circuits; electrical controls and fluid logic; electro-hydraulic systems.
Prerequisites: Grade of C or better in BAEN 340 or equivalent, or approval of instructor.

BAEN 414 Renewable Energy Conversions
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Energy/power systems through engineering and technical aspects of quantifying and designing the suitability of several types of renewable energy resources; new insights of vast resources that future engineers can harness to augment diminishing supplies of nonrenewable energy.
Prerequisite: Grade of C or better in BAEN 320 or equivalent, or approval of instructor.

BAEN 417 Fundamentals of Nanoscale Biological Engineering
Credits 3. 3 Lecture Hours.
Nanostructures, nanofabrication methods, instrumentation and applications pertinent to Biological, Food and Bioenergy systems; identification and utilization of key tools available for fabricating, manipulating and analysis of nanostructures used in biological engineering applications.
Prerequisite: Senior classification in engineering or approval of instructor.

BAEN 422/CHEN 422 Unit Operations in Food Processing
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Design of food process engineering systems; basic concepts of rheology and physical properties of foods; fundamentals of heat and mass transfer and process control.
Prerequisites: CHEN 205 and 304, or CVEN 305.
Cross Listing: CHEN 422/BAEN 422.

BAEN 427 Engineering Aspects of Packaging
Credits 3. 3 Lecture Hours.
Introduction to properties and engineering aspects of materials for use as components of a package and/or packaging system; principles of design and development of packages; evaluation of product-package-environment interaction mechanisms; testing methods; environmental concerns; regulations.
Prerequisite: Junior or senior classification or approval of instructor.

BAEN 431/CHEN 431 Fundamentals in Bioseparations
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Design principles and application of chemical engineering unit operations to the production of therapeutic and bioactive molecules.
Prerequisite: Grade of C or better in BAEN 302, BMEN 282, CHEN 282, or CHEN 382.
Cross Listing: CHEN 431/BAEN 431.

BAEN 460 Principles of Environmental Hydrology
Credits 3. 3 Lecture Hours.
Hydrologic cycle; precipitation, evaporation, evapotranspiration, infiltration, percolation, runoff, streamflow; groundwater and surface water flow; transport of contaminants in surface water; measurement and analysis of hydrologic data for engineering design.
Prerequisites: Grade of C or better in BAEN 340.

BAEN 464 Irrigation and Drainage Engineering
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Engineering principles and design of both surface and pressurized irrigation systems; introduction to the design of surface and subsurface drainage systems including crop water requirements, soil moisture, irrigation scheduling, surface irrigation, sprinkler irrigation, trickle irrigation, pumps, pipelines, irrigation canals, irrigation wells, and surface and subsurface drainage.
Prerequisite: BAEN 340.

BAEN 465 Design of Biological Waste Treatment Systems
Credits 3. 3 Lecture Hours.
Management and treatment of high organic content wastes, with emphasis on agricultural and food processing wastes; engineering design of biological waste treatment processes; regulatory aspects affecting management of agricultural wastes.
Prerequisites: Grade of C or better in BIOL 113 and CHEM 222, or BAEN 302.
BAEN 468 Soi and Water Conservation Engineering  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Engineering principles of soil and water conservation; open channel flow principles, hydraulic grade stabilization, erosion control, storm water management, design of structures for floodwater routing, culvert design, design of waterways and agricultural reservoirs, stream bank protection, water quality assessment, groundwater flow, surface water modeling.  
Prerequisites: Grade of C or better in BAEN 340.  

BAEN 469 Water Quality Engineering  
Credits 3. 3 Lecture Hours.  
Nonpoint source pollution processes including transport mechanisms and contaminant fate; design of best management practices for abating nonpoint source pollution.  
Prerequisites: Grade of C or better in BAEN 340 or equivalent.  

BAEN 471/CHEN 471 Bioreactor Engineering  
Credits 3. 3 Lecture Hours.  
Fundamentals of microbial and enzyme kinetics; basic biochemical reaction theory and reactor systems; heterogeneous reactions and transport considerations in enzyme and cell reactors, and immobilized systems; bioreactor design considerations in bioprocessing.  
Prerequisite: Grade of C or better in CHEN 282, CHEN 382, or BAEN 302; junior or senior classification or approval of instructor.  
Cross Listing: CHEN 471/BAEN 471.  

BAEN 477 Air Pollution Engineering  
Credits 3. 3 Lecture Hours.  
Design of air pollution abatement equipment and systems to include cyclones, bag filters and scrubbers; air pollution regulations; permitting; dispersion modeling; National Ambient Air Quality Standards.  
Prerequisite: Grade of C or better in BAEN 340, CVEN 311/EVEN 311, or MEEN 344.  
Cross Listing: MEEN 477 and SENG 477.  

BAEN 479 Biological and Agricultural Engineering Design I  
Credits 3. 3 Lecture Hours.  
Capstone design project selection from problems posed by biological and agricultural engineers in industrial practice; completion of project feasibility study and outline; design philosophy, teamwork and communication; economics; product liability and reliability; use of standards and codes; goal setting, professional development, and time management; project to be completed in BAEN 480.  
Prerequisites: Grade of C or better in BAEN 340 and BAEN 365; grade of C or better in BAEN 366 or BAEN 370; Grade of C or better in BAEN 354 and BAEN 375 or concurrent enrollment.  

BAEN 480 Biological and Agricultural Engineering Design II  
Credits 3. 6 Lab Hours.  
Continuation of engineering design experience through team solution of design problem developed in BAEN 479; preparation of design solution under supervision of biological and agricultural engineering staff and clients; critical evaluation of results by students; staff and industrial consultants.  
Prerequisites: Grade of C or better in BAEN 479.  

BAEN 484 Internship  
Credits 0. 0 Lecture Hours. 0 Lab Hours. 0 Other Hours.  
No Credit. Practical experience working in a professional biological and agricultural engineering setting. May be taken three times.  
Prerequisite: Junior or senior classification; approval of the instructor.  

BAEN 485 Directed Studies  
Credits 0 to 4. 0 to 4 Other Hours.  
Selected problems in any phase of agricultural engineering. Credit and specific content dependent upon background, interest, ability and needs of student enrolled. Individual consultations and reports required.  
Prerequisites: Junior or senior classification and approval of department head.  

BAEN 489 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.  
Special topics in an identified area of agricultural engineering. May be repeated for credit.  
Prerequisite: Approval of department head.  

BAEN 491 Research  
Credits 0 to 3. 0 to 3 Other Hours.  
Research conducted under the direction of faculty member in biological and agricultural engineering. May be repeated 2 times for credit.  
Registration in multiple sections of this course are possible within a given semester provided that the per semester credit hour limit is not exceeded.  
Prerequisites: Junior or senior classification and approval of instructor.