BAEN 601 Advanced Agricultural Systems Analysis
Credits 3. 3 Lecture Hours.
Application of operations research tools and techniques to the analysis and management of technical systems in agriculture; optimization techniques applied to materials handling, supply chain logistics and other food and agricultural applications.
Prerequisite: Graduate classification.

BAEN 614 Renewable Energy Conversions
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Managing energy/power systems through engineering and technical aspects of quantifying and designing the suitability of several types of renewable energy resources; providing new insights of vast resources that future engineers can harness to augment diminishing supplies of non-renewable energy.
Prerequisites: BAEN 320 or approval of instructor.

BAEN 617 Fundamentals of Nanoscale Biological Engineering
Credits 3. 3 Lecture Hours.
Nanostructures, nanofabrication methods, instrumentation and applications pertinent to Biological, Food and Bioenergy systems; provides opportunity to identify and utilize key tools available for fabricating, manipulating and analysis of nanostructures used in Biological Engineering applications.
Prerequisite: Graduate classification.

BAEN 620 Food Rheology
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Principles of elasticity, viscous flow and visco-elasticity applied to solid and liquid food materials; experimental determination of rheological properties using fundamental methods and empirical textural measurements; applications to food engineering research, textural measurement and quality control.
Prerequisites: FSTC 315; PHYS 201; graduate classification.

BAEN 622 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: Fluid Mechanics, Thermodynamics, Fluid Dynamics.

BAEN 623/FSTC 623 Nanotechnology in Food Processing
Credits 3. 3 Lecture Hours.
Fundamental and applied knowledge related to nanoscale systems and technologies utilized in processing of foods; includes nanoscale physico-chemical properties of foods, applications, manufacture and analysis of nanotechnologies for food processing and preservation; relevant industrial and regulatory food nanotechnology associated aspects.
Prerequisites: FSTC 312, FSTC 313, FSTC 315, or AGSM 315/NFSC 315, or equivalent coursework, or approval of instructor.

BAEN 625 Advances in Food Process Engineering
Credits 3. 3 Lecture Hours.
Application of engineering fundamentals to the design of novel/advanced food processing systems including food irradiation, advances in thermal process, food freezing, food dehydration.
Prerequisite: Graduate classification.

BAEN 627 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: Graduate classification.

BAEN 631 Bioprocesses and Separations in Biotechnology
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Application of engineering principles to recovery and purification of biological compounds derived from cell grown in bioreactors, transgenic animals, and plants. Process development, design, and scale up of downstream processes used in biotechnology and pharmaceutical industry. Emphasis on extraction, sedimentation, membrane filtration, precipitation, and liquid chromatography.
Prerequisites: Graduate classification or approval of instructor.

BAEN 642/CVEN 642 Water-Energy-Food Nexus: Toward Sustainable Resource Management
Credits 3. 3 Lecture Hours.
Principles and application of the Water-Energy-Food nexus to state, national and international Water-Energy-Food securities and the interlinkages between them; exploration of quantitative framework to develop and assess sustainable tradeoffs of resources; hands on experiences; relevant real world projects or case studies.
Prerequisites: Strong analytical background; approval of instructor.
Cross Listing: CVEN 642/BAEN 642.

BAEN 651 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, as well as the integration of GIS with remote sensing and Global Positioning System; laboratory includes extensive use of GIS applications to conduct analyses of topics in natural resources.
Prerequisites: Graduate classification.
Cross Listing: ESSM 651 and RENR 651.

BAEN 652 Advanced Topics in Geographic Information Systems
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Advanced GIS topics with a focus on modeling actual GIS applications including relational and database theory, design and implementation and its connection to GIS; surface analysis with digital terrain models; and an introduction to spatial statistics.
Prerequisite: BAEN 651.

BAEN 653 Bioreactor Design
Credits 3. 3 Lecture Hours.
Kinetics of enzyme reactions and cell growth applied to bioreactor design, media formulation, cell culture conditions, oxygen transfer and sterilization.
Prerequisite: CHEN 651 or approval of instructor.

BAEN 661 Experimental Methods in Biological and Agricultural Engineering
Credits 3. 3 Lecture Hours.
Planning and carrying out empirical research with appropriate application of statistical methods for experimental design and analysis; experimental design, data analysis, hypothesis testing, and experimental errors.
Prerequisites: STAT 211, STAT 302, STAT 303, or STAT 651, or equivalent with approval of instructor.
BAEN 662 Statistical Methods in Biological and Agricultural Engineering  
Credits 3. 3 Lecture Hours.  
Statistical methods applied to problems in biological and agricultural engineering; parameter estimation; probability distribution fitting; time-series analysis; random variable generation; uncertainty analysis.  
**Prerequisite:** Graduate classification.

BAEN 665 Design of Biological Waste Treatment Systems  
Credits 3. 3 Lecture Hours.  
Management and treatment of high organic content waste streams, with emphasis on agricultural; municipal, and agro-Industry wastewater; engineering design of biological waste treatment processes; resource recovery from waste streams; recycle and reuse of finished effluents.  
**Prerequisite:** Graduate classification or approval of instructor.

BAEN 667 Entropy Theory and its Application in Water and Environmental Engineering  
Credits 3. 3 Lecture Hours.  
Entropy theory, probability distributions, parameter estimation, hydrologic design, rainfall-runoff, infiltration and soil moisture, frequency analyses, sediment yield, velocity distributions, flow forecasting, hydraulic geometry, geomorphic structure, water distribution reliability and water availability assessment.  
**Prerequisites:** Graduate classification; knowledge of calculus and statistics at the undergraduate level and approval of instructor.

BAEN 669 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:** AGEN 350 or equivalent; SCSC 301; ENGR 214; graduate classification.

BAEN 670 Air Pollution Engineering  
Credits 3. 3 Lecture Hours.  
Current topics in air pollution engineering including design and operation of air pollution abatement systems (cyclone, bag filters and scrubbers), emission factors, dispersion modeling, permitting, odor sensing and control, EPA/State Air Pollution Regulatory Agency (SAPRA), TSP, PM10, and PM2.5.  
**Prerequisites:** BAEN 477 or MEEN 477, or approval of instructor.

BAEN 672 Small Watershed Hydrology  
Credits 3. 3 Lecture Hours.  
Hydrology of small agricultural watersheds; precipitation frequency analysis; infiltration; runoff; erosion theory; sediment transport theory; evapotranspiration, and use of hydrological models.  
**Prerequisites:** Graduate classification.

BAEN 673 Modeling Small Watersheds  
Credits 3. 3 Lecture Hours.  
Transport of water and chemicals in small agricultural watersheds; simulation using hydrologic models coupled with geographical information systems (GIS); impact of land use on the quality of surface water and groundwater evaluated.  
**Prerequisites:** Graduate classification.

BAEN 674 Vadose Zone Hydrology  
Credits 3. 3 Lecture Hours.  
Fundamental concepts and advanced mathematical and experimental techniques for quantifying water, chemical, microorganism, and heat transport in the vadose zone (between soil surfaces and groundwater); provides a common platform for addressing issues related to soil and water resources, hydrology, geochemistry, microbiology, ecology, hydrogeology, and environmental engineering.  
**Prerequisite:** Graduate classification.

BAEN 675 Hydrology Across Scale  
Credits 3. 3 Lecture Hours.  
Advanced concepts of surface and subsurface hydrologic processes, measurements, and modeling techniques across different spatio-temporal scales; contemporary issues related to the soil and water resources, hydrogeology, geochemistry, microbiology, ecology, hydrology, and environmental engineering.  
**Prerequisite:** Graduate classification in any engineering, agricultural science or geoscience program with environmental focus.

BAEN 681 Seminar  
Credit 1. 1 Other Hour.  
Reviews, reports and discussion of ideas, recent advances and current topics.  
**BAEN 683 Peer-Review Process and Publication**  
Credit 1. 1 Lecture Hour.  
Techniques for communicating results of research that are defendable in a peer review process; student and advisor will select a research topic, identifying an appropriate target refereed journal; no thesis/dissertation preparation as a writing project accepted; critique other papers; prepare paper for review by instructor.  
**Prerequisite:** Graduate classification in Biological and Agricultural Engineering only.

BAEN 684 Professional Internship  
Credits 1 to 6. 1 to 6 Other Hours.  
An on-the-job supervised experience program, conducted on an individual basis in the area of the student’s specialization in mechanized agriculture.  
**Prerequisite:** Graduate classification or approval of instructor.

BAEN 685 Directed Studies  
Credits 1 to 4. 1 to 4 Other Hours.  
Advanced laboratory or field problems not related to student’s thesis.  
**Prerequisite:** Graduate classification.

BAEN 689 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.  
Selected topics in an identified area of agricultural engineering. May be repeated for credit.

BAEN 690 Theory of Research  
Credit 1. 1 Lecture Hour.  
Development of research inquiry and discussion of applicable experimental design, theoretical techniques and methodological principles of conducting original research; evaluation of current research of faculty and students in and engineering and scientific literature. Communication of research proposals and results. May be repeated for credit.  
**Prerequisites:** Graduate classification.

BAEN 691 Research  
Credits 1 to 23. 1 to 23 Other Hours.  
Research for thesis or dissertation.