



KENTUCKY STATE  
UNIVERSITY

# MASTER OF SCIENCE IN BIOLOGICAL AND AGRICULTURAL ENGINEERING

The Biological and Agricultural Engineering program is housed in the School of Engineering and Technology in the College of Business, Engineering, and Technology (CBET). The School of CBET offers programs of study leading to the Master of Science in Biological and Agricultural Engineering (MSBAE). The MSBAE degree provides students with a combination of experiences in basic research, design, and practical applications beyond the undergraduate level. Students have the option to pursue a thesis or non-thesis/capstone 36 credit hours in Master of Science degree. The specialization areas can include food process engineering, Hydrology and water systems management including soilless food systems. The Master of Science thesis option degree requires students to complete advanced course work and to become skilled in research methods and applications. Students are expected to plan, conduct and analyze a comprehensive research project, and to report the findings in a thesis. The Master of Science non-thesis/capstone option degree requires students to complete advanced coursework along with a capstone/directed studies course.

**Objective:** The MSBAE program emphasizes research competency, including designing and conducting experiments and interpreting data. There is a strong focus on developing professional ethics, communication skills, and a commitment to lifelong learning. Graduate programs are designed to extend and deepen the knowledge and skills provided in ABET-accredited undergraduate programs. By aligning with these ABET-inspired objectives and outcomes, a MS program in Biological and Agricultural Engineering ensures that its graduates are well-prepared to address complex, multidisciplinary challenges and to contribute meaningfully to the field with novel and innovative solutions.

## Admission to the Master of Science in Biological & Agricultural Engineering Program

The Master of Biological & Agricultural program (MSBAE) admits only students whose preparation indicates potential for a high level of success. All applicants must meet the minimum standards for admission to graduate study at Kentucky State University. However, applicants are admitted into the specific graduate program to which they apply. The MSBAE Graduate Admissions Committee will use the following materials for admission considerations:

- Applicants write a personal statement outlining their goals and career objectives. The application is through GradCAS and it can be found at <https://gradcas.liaisoncas.org/apply/>.
- Transcripts: Copies of all official transcripts must be submitted through GradCAS.

- GRE scores are not required.
- Three letters of recommendation (professional and/or academic) on official letterhead with a signature must be uploaded to GradCAS.
- A resume

The following types of admission will be available to candidates for the MSBAE program:

1. **Regular:** Requirements for this unconditional admission are:
  - a. A complete application package in GradCAS, including official transcripts, test scores, and letters of recommendation.
  - b. Baccalaureate degree in Biological & Agricultural Engineering or related discipline from an institution in the United States with regional accreditation or from a foreign institution with comparable accreditation.
  - c. Satisfactory completion of course prerequisites for the MSBAE program.
  - d. An overall undergraduate grade-point-average of 3.0 (on a 4.0 scale).
  - e. "TOEFL (Internet Based 70), IELTS (6.0) or Duolingo (100) score is required for international students.
2. **Provisional:** If an applicant is unable to provide all the necessary documents before the application deadline prior to matriculation but otherwise meets the admissions criteria, he/she may be granted provisional admission. Provisional admission may not be permitted for more than one semester, and all credentials must be received before the end of the semester in which the student has registered. Students must meet all regular admissions requirements to move from provisional status to regular admission status.

## Graduate Assistantships and Scholarships

A limited number of graduate assistantships may be available for full-time students pursuing the Master of Science in Biological & Agricultural Engineering program. Students holding these positions will work 20 hours per week and receive a stipend. Graduate Assistants assist the faculty members in their instructional and research activities. Assistantships are awarded on the basis of financial need and high academic achievement. Other than assistantships, there may be scholarships available to qualified domestic students. Students interested in such positions apply to the Division's office.

## Degree Requirements

The MSBAE program is made up of 36 credits including thesis or capstone project work. It should be noted that the capstone project is typically less comprehensive than a traditional master's thesis, so students choosing this option are required to take one additional elective course. Students interested in pursuing the master's degree full-time should plan to spend about two years in residence.

## Thesis Option

The thesis option degree requires students to complete advanced course work and to become skilled in research methodology. Students are expected to plan, conduct and analyze a comprehensive research project, and to report the findings in a thesis, a scholarly document of research in proper scientific publication style. It is distributed at the orientation at the beginning of your first semester. Experience in the literature review, experimental design, data collection, statistical analysis, and manuscript preparation are obtained by students completing the thesis option. Students who intend to further their graduate education (e.g., obtain a doctoral degree) should choose this option because doctoral programs

often require students to demonstrate their ability to successfully complete a master's thesis. Required courses and a thesis topic must be approved by the student's graduate committee.

## Capstone Project Option

Graduate students enrolled in the non-thesis option are required to complete a capstone project as determined by their major professor and approved by their committee. Examples might include a literature review, a public service project, etc. A detailed proposal is submitted for approval to the student's committee before the project is conducted, and a final project report must be approved by the student's committee.

## Required Courses (18 credit hours)

Code	Title	Hours
BAE 501		3
BAE 514		3
BAE 517		3
BAE 520		3
BAE 522		3
BAE 525		3
<b>Total Hours</b>		<b>18</b>

## Elective Courses (9 hours for Thesis Option; 12 hours for Non-Thesis/Capstone)

Code	Title	Hours
BAE 527		3
BAE 531		3
BAE 542		3
BAE 551/ ENV 508		3
BAE 552/ ENV 585		3
BAE 555		3
BAE 561		3
BAE 562		3
BAE 565		3
BAE 569		3
BAE 570		3
BAE 572		3
BAE 574		3
BAE 575		3
BAE 589		3

## Thesis Option

Code	Title	Hours
BAE 584		3
BAE 600		3
BAE 601		3
Select Elective courses		9
<b>Total Hours</b>		<b>18</b>

## Non-Thesis/Capstone Option

Code	Title	Hours
BAE 584		3
BAE 699		3

Select Elective courses	12
<b>Total Hours</b>	<b>18</b>

## Time Limitation of Assistantships

Graduate students are expected to complete the requirements for the M.S. Degree within two years based on Graduate Research Assistantships (GRA's). The master's degree program must be completed within six years of initial enrollment as a degree-seeking graduate student. Please also see Section II under Graduate Academic Regulations and Policies in this publication.

## Graduate Committee

The Graduate Committee consists of three School of Engineering and Technology faculty members, and it can include one additional member from outside the school/college. Students are required to hold their first committee meeting during their first semester and present a thesis/capstone proposal in the second semester of study.

The major professor will guide the student on research, analysis, writing, and other scholarly aspects of the work. Members of the student's committee contribute, but the primary responsibility is that of the major professor.

Submission of a thesis or Capstone manuscript is defined as the time at which the first complete draft of such is submitted to the major professor for review. After the major professor approves the draft for committee revision, the student will then submit the manuscript for critical review by the committee. Each may suggest improvements and refuse approval pending additional work. When committee members and the major professor sign the Approval Page, they certify that the thesis or capstone manuscript is clear and accurate, that it represents an original and worthwhile contribution, that the suggestions made by them are incorporated into the final work, and that the work conforms to the standards of Kentucky State University College of Business, Engineering and Technology (CBET). No faculty member will sign a thesis until it is of foremost quality and meets all requirements. The major professor and committee members must sign their names personally. There can be no temporary substitute members and no other person may sign a committee member's name on an Approval Page, even with the authorization of the committee member involved and the major professor. Electronic signatures are allowed for students completing their degree online.

## Written Comprehensive Exams

All MSBAE students pursuing a thesis or non-thesis/capstone track will complete a written comprehensive exam to be administered by the faculty mentor with questions from the student's faculty mentor and committee members. This exam must be administered before the student defends and must have a majority of the committee members award a passing grade to the questions they have provided.

**BAE 501 Agricultural Systems Analysis:** Application of data analytic thinking and data science techniques to the analysis and management of technical systems in agriculture; introduction to supervised and unsupervised methods applied to business problems in the food and agricultural sectors. Prerequisite: Graduate classification.

**Credit Hours: 3**

**Contact Hours: 3**

**BAE 514 Renewable Energy Conversions:** 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: PHY 320 or approval of instructor.

**Credit hours: 3**  
**Lecture hours: 2**  
**Lab hours: 2**

**BAE 517 Fundamentals of Nanoscale Biological Engineering:** 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.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 520 Food Rheology:** 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: EGR 220 or BAE 422 ; PHY 211 or equivalent; graduate classification; or approval from instructor.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 522 Experimental Methods in Bio. & Ag. Engineering:** 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: MAT 200 or equivalent with approval of instructor.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 525 Food Process Engineering:** 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.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 527 Engineering Aspects of Packaging:** 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.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 531 Bioprocesses and Separations in Biotechnology:** 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.

**Credit hours: 3**  
**Lecture hours: 2**  
**Lab hours: 2**

**BAE 542 Water-Energy-Food Nexus: Toward Sustainable Resource Management:** 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.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 551/ENV 508 Geographic Information System for Resource Management:** 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: ENV 508.

**Credit hours: 3**  
**Lecture hours: 2**  
**Lab hours: 2**

**BAE 552/ENV 585 Advanced Topics in Precision Ag. Systems:** 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: BAE 551. Cross Listing: ENV 585.

**Credit hours: 3**  
**Lecture hours: 2**  
**Lab hours: 2**

**BAE 555 Principles of Modern Optical Spectroscopy:** Optical spectroscopic techniques-their principles, based on the fundamentals of electromagnetism, interaction of light with matter and modern physics; Laser Induced Fluorescence; fluorescence correlation spectroscopy—single molecule spectroscopy; Raman spectroscopy ; optical coherence tomography; low coherence speckle interferometry; optical tweezers; imaging and microscopy beyond diffraction limit. Prerequisites: Graduate classification.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 561 Unit Operations in Food Processing:** 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: EGR 320, PHY 320.

**Credit hours: 3**  
**Lecture hours: 2**  
**Lab hours: 2**

**BAE 562 Statistical Methods in Bio. & Ag. Engineering:** 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.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 565 Design of Biological Waste Treatment Systems:** 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.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 569 Water Quality Engineering:** Nonpoint source pollution processes including transport mechanisms and contaminant fate; design of best management practices for abating nonpoint source pollution. Prerequisites: graduate classification.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 570 Air Pollution Engineering:** 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: Graduate classification or approval of instructor.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 572 Small Watershed Hydrology:** Hydrology of small agricultural watersheds; precipitation frequency analysis; infiltration; runoff; erosion theory; sediment transport theory; evapotranspiration, and use of hydrological models. Prerequisites: Graduate classification.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 574 Vadose Zone Hydrology:** 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.

**Credit Hours: 3**  
**Contact Hours: 3**

**BAE 575 Hydrology Across Scale:** 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.

**Credit Hours: 3**

**Contact Hours: 3**

**BAE 584 Professional Internship:** 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.

**Credit Hours: 3**  
**Other Hours: 1-3**

**BAE 589 Special Topics in.:** Selected topics in an identified area of agricultural engineering. May be repeated for credit.

**Credit hours: 1- 3**  
**Lecture hours: 1-3**  
**Lab hours: 0-3**

**BAE 600 Research:** 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 and in engineering and scientific literature. Communication of research proposals and results. May be repeated for credit. Prerequisites: Graduate classification.

**Credit Hours: 1-3**  
**Other Hours: 1-3**

**BAE 601 Thesis:** Research for thesis or dissertation.

**Credit Hours: 3**  
**Other Hours: 3**

**BAE 699 Directed Studies/ Capstone:** Advanced laboratory or field problems not related to student's thesis. Prerequisite: Graduate classification.

**Credit Hours: 3**  
**Other Hours: 3**