

# BIOSYSTEMS ENGINEERING

Biosystems engineers are trained in biological, environmental, and engineering sciences and challenged to improve the sustainability of production systems, decrease or eliminate environmental hazards, and preserve natural resources.



solve problems that  
**CHANGE THE WORLD**

[www.uky.edu/bae/](http://www.uky.edu/bae/)



## BIOENVIRONMENTAL

Improves conservation, preserves water and reduces run-off by understanding the complex interactions and mechanics of soil and water systems.



## MACHINE SYSTEMS

Increases efficiency and conservation in agricultural, food and biological systems with advanced control systems and mechanical design.



## PRE-BIOMEDICAL

Applies engineering practice to problems and opportunities related to medicine and human health.



## FOOD & BIOPROCESSING

Uses microbiological processes to develop useful products, treat municipal, industrial and agricultural wastes and improve food safety.



## CONTROLLED ENVIRONMENT

Engineers a healthy environment for living things; an essential component of animal housing, greenhouse production, aquaculture and human housing.



## PRE-MED/PRE-VET

Brings a problem solving approach to health and medicine; students gain an engineering degree while fulfilling the admissions requirements for vet/med school.

# BIOSYSTEMS ENGINEERING



DEGREE REQUIREMENTS 132 HOURS

## Biosystems engineers

- Devise practical, efficient solutions for producing, storing, transporting, processing, and packaging biological and agricultural products.
- Solve problems related to systems, processes, and machines that interact with humans, plants, animals, microorganisms, and biological materials.
- Develop solutions for responsible, alternative uses of biological products, byproducts and wastes and of our natural resources - soil, water, air, and energy.

solve problems that  
**CHANGE THE WORLD**

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The undergraduate Biosystems and Agricultural Engineering program is accredited by the Engineering Accreditation Commission of ABET.

## REQUIRED BAE COURSES

### BAE 200 Principles of Biosystems Engineering (3; Fall)

The engineering problem solving approach will be practiced to analyze engineering problems within biological systems and to demonstrate the application of mathematical and scientific principles to engineering design. Prereq: MA 113; concur with CHE 105, EGR 103, and PHY 231.

### BAE 202 Probability and Statistics for Biosystems (3; Spring)

Introduction to statistics and statistical inference reasoning. Evaluation of common claims based on statistical constructs, hypothesis tests, margins of error, confidence intervals, and analysis of variation. Identification of possible statistical obstacles, such as confounding, missing data, and inappropriate randomness. Conceptual statistics will be emphasized. Special attention will be given to include biosystems engineering problems. Prereq: MA 114.

### BAE 301 Economic Analysis of Biosystems (2; Fall)

The financial and managerial aspects of biosystems in evaluating design alternatives. Typical topics included are: concepts of present and future value, techniques of managerial economics, and biosystem design analysis in the evaluation of alternatives. Retirement/replacement policies and risk analysis. Prereq: MA 113.

### BAE 305 DC Circuits and Microelectronics (3; Spring)

An introduction to the use of digital electronics and integrated circuits in solving biosystems engineering problems. Digital circuits, microprocessor concepts, computer interfacing, transducers, signal conditioning and control applications are discussed. Lecture, two hours; laboratory, two hours per week. Prereq: EE 305 or EE 306.

### BAE 400 Senior Seminar (1; Fall)

A course for senior students in biosystems and agricultural engineering with emphasis on oral communications skills. Students will do literature searches on topics related to the biosystems engineering profession and present oral and written reports. Prereq or concur: BAE 402.

### BAE 402 Biosystems Engineering Design I (2; Fall)

A design course for seniors in BAE requiring students to solve open-ended problems. Students will use previously learned engineering principles to produce actual designs which will be built and analyzed in BAE 403. Prereq: BIO 150, 152; prereq or concur with BAE 417 or BAE 447.

### BAE 403 Biosystems Engineering Design II (2; Spring)

Student design teams evaluate and enhance design solutions, fabricate prototypes, execute performance tests, analyze results, and develop final design specifications. Oral and written reports are required. Prereq: BAE 402.

## CORE COURSES

### BAE 417 Design of Machine Systems (3; Fall)

Prereq: ME 330 or CE 341, EM 302; prereq or concur: EM 313.

### BAE 427 Structures and Environment Engineering (3; Spring)

Prereq: CE 341 or ME 330; BIO 148 and 152; prereq or concur: EM 313.

### BAE 437 Land and Water Resources Engineering (3; Spring)

Prereq: CE 341 or ME 330; BIO 148 and BIO 152.

### BAE 447 Bioprocess Engineering Fundamentals (3; Fall)

Prereq: BIO 148 and BIO 152; prereq or concur with ME 325.



# BIOENVIRONMENTAL



FRESHMAN			
FALL		SPRING	
EGR 101	1	EGR 103	2
EGR 102	2	MA 114	4
CHE 105	4	PHY 231	4
MA 113	4	PHY 241	1
WRD 110	3	WRD 111	3
		UK Core	3
	14		17
SOPHOMORE			
FALL		SPRING	
BAE 200	3	BAE 202	3
BIO 148	3	MA 214	3
MA 213	4	PHY 232	4
CHE 107	3	PHY 242	1
CE 106	3	ME 220	3
		EM 221	3
	16		17
JUNIOR			
FALL		SPRING	
BAE 301	2	BAE 305	2
CE 341	4	BAE 437	3
EE 305	3	EM 302	3
EM 313	3	TECH	3
BIO 152	3	WRD 204	3
UK Core	3	UK CORE	3
	18		18
SENIOR			
FALL		SPRING	
BAE 400	1	BAE 403	2
BAE 402	2	BAE 502	3
ME 325		BAE 427	3
BAE 447	3	TECH	3
CE 555	3	UK CORE	3
TECH	3		
UK CORE	3		
	18		15

## TECHNICAL ELECTIVES

BAE 435G Waste Management for Biosystems (MA 214, BIO 152)  
 BAE 532 Intro to Stream Restoration  
 BAE 536 Fluvial Hydraulics (CE 341 or ME 330 and Eng. Standing)  
 BAE 538 GIS Applications for Water Resources  
 BAE 541 Intermediate Fluid Mechanics  
 CE 211 Surveying (CE 106, MA 114)  
 CE 351 Introduction to Envir. Eng.  
 CE 451 Water and Wastewater Treatment (CE 341, CE 351)  
 CE 461G Water Resources Engineering

CE 471G Soil Mechanics (EM 302, coGLY 220)  
 CE 525 Civil Engineering Applications of Geographic Information Systems  
 CE 551 Water and Wastewater Engineering  
 EES 530 Low Temperature Geochemistry  
 EES 585 Hydrogeology  
 GEO 309 Intro to GIS  
 GEO 451G Fluvial Forms and Processes  
 NRE 556 Geospatial Application for Land Analysis



## FACULTY



Dr. Agouridis  
 Extension Associate Professor  
 Ecosystem Restoration, Stormwater Management



Dr. Edwards  
 Professor  
 Surface Water Hydrology, Water Quality



Dr. Ford  
 Assistant Professor  
 Water Quality, Nutrient Transport



Dr. Taraba  
 Extension Professor  
 Nutrient Management

## CAREER AREAS

Water Resources  
 Environmental Engineering  
 Civil Engineering  
 Stream Restoration  
 Low-Impact Development  
 Ecosystem Design  
 Irrigation  
 Hydrology  
 Sustainability  
 Conservation  
 Stormwater Management  
 Wetlands Protection  
 Waste Water  
 Mine Reclamation





# MACHINE SYSTEMS



FRESHMAN			
FALL		SPRING	
EGR 101	1	EGR 103	2
EGR 102	2	MA 114	4
CHE 105	4	PHY 231	4
MA 113	4	PHY 241	1
WRD 110	3	UK Core	3
		WRD 111	3
	14		17

SOPHOMORE			
FALL		SPRING	
BAE 200	3	BAE 202	3
BIO 148	3	MA 214	3
MA 213	4	PHY 232	4
CHE 107	3	PHY 242	1
CE 106	3	ME 220	3
		EM 221	3
	18		17

JUNIOR			
FALL		SPRING	
BAE 301	2	BAE 305	3
CE 341	4	EM 302	3
EE 305	3	PLS 366	4
EM 313	3	WRD 204	3
BIO 152	3	UK CORE	3
UK Core	3		
	18		16

SENIOR			
FALL		SPRING	
BAE 400	1	BAE 403	2
BAE 402	2	BAE 502	3
BAE 417	3	TECH	3
BAE 447	3	TECH	3
ME 325	3	UK CORE	3
TECH	3	BAE 437	3
UK CORE	3		
	18		15

## TECHNICAL ELECTIVES

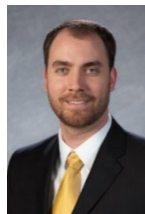
BAE 514 Component Design  
 BAE 515 Fluid Power Systems  
 BAE 516 Control of Off-Road Vehicles  
 BAE 517 Off-Road Vehicle Design  
 BAE 450/599 Special Problems  
 EE 402G Electronic Instrumentation and Measurements (PHY 242)  
 GEO 309 Introduction to GIS  
 ME 321 Engineering Thermodynamics II (ME 220, MA 214)  
 ME 344 Mechanical Design (ME 251, EM 302, coEM 313)  
 ME 440 Design Control Systems (Eng. Stand, ME 340 and ME 310)  
 ME 501 Mech. Des. w Finite Element Meth. (ME 205, co ME 344)  
 ME 503 Lean Manufacturing  
 ME 513 Mechanical Vibrations (EM 313, EM 302)  
 ME 532 Advanced Strength of Materials (EM 302)



## FACULTY



Dr. Dvorak  
 Assistant Professor  
 Machinery Controls



Dr. Sama  
 Assistant Professor  
 Control Systems



Dr. Stombaugh  
 Extension Professor  
 Precision Agriculture

## CAREER AREAS

Design Engineer  
 Test Engineer  
 Quality Engineer  
 Mechanical Engineer  
 Product Engineer  
 Sales Engineer  
 Manufacturing  
 Machinery  
 Off-Road  
 Construction  
 Agriculture  
 Hydraulics  
 Analytical  
 Heavy Equipment  
 Automation



# PRE-BIOMEDICAL

Considering both medicine and engineering are highly specialized, most biomedical engineers have a Master's or PhD in biomedical engineering. The push for biomedical engineers to get a graduate degree has resulted in some programs like UK to only offer graduate programs.

Biosystems Engineering students take all the classes they need for biomedical engineering graduate school as part of their undergraduate program – meaning no extra classes!

The Department of Biomedical Engineering offers a BME minor. The BME minor requires only 2 classes beyond the BAE requirements.

Undergraduate research opportunities are available and highly encouraged! Research areas at UK in Biomedical Engineering Graduate Program include biomaterials & tissue engineering, biophotonics, cardiovascular & neural control, and biomechanics.



FRESHMAN			
FALL		SPRING	
EGR 101	1	EGR 103	2
EGR 102	2	MA 114	4
CHE 105	4	PHY 231	4
MA 113	4	PHY 241	1
WRD 110	3	UK Core	3
		WRD 111	3
	14		17
SOPHOMORE			
FALL		SPRING	
BAE 200	3	BAE 202	3
BIO 148	3	MA 214	3
MA 213	4	PHY 232	4
CHE 107	3	PHY 242	1
CE 106	3	ME 220	3
		EM 221	3
	16		17
JUNIOR			
FALL		SPRING	
BAE 301	2	BAE 305	2
CE 341	4	BAE 437	3
EE 305	3	EM 302	3
EM 313	3	BIO 208	3
BIO 152	3	WRD 204	3
UK Core	3	UK CORE	3
	18		18
SENIOR			
FALL		SPRING	
BAE 400	1	BAE 403	2
BAE 402	2	BAE 502	3
BAE 417	3	TECH	4
BAE 447	3	TECH	3
TECH	3	UK CORE	3
ME 325	3		
UK CORE	3		
	18		15

## TECHNICAL ELECTIVES

BME 301 Foundation of Biomed Eng. (F)  
 BME 395 Independent Research in Biomedical Engineering  
 BME 472 Human Biomechanics  
 BME 481G Topics in Biomedical Engineering  
 BME 485 Fundamentals of Biofluid Mechanics (S)  
 BME 488 Introduction to Biomaterials (MSE 201) (F)  
 BME 530 Biomedical Instrumentation (S)  
 BME 540 Mechanical Modeling of Human Motion  
 BME 579 Neural Engineering (EE 422G) (S)  
 BME 580 Introduction of Biomedical Imaging (EE 305) (F)  
 BME 599 Topics in Biomedical Engineering  
 BCH 401G Fund. of Biochemistry (CHE 107, CHE 236, BIO 152)  
 CHE 236 Organic Chemical Survey  
 PGY 412G Principles of Human Physiology Lectures  
 ABT 360 Genetics  
 ABT 495 Experimental Methods  
 BIO 302 Intro to Neuroscience

## CAREER AREAS

Biology  
 Prosthetics  
 Medical Devices  
 Pharmaceutical  
 Artificial Joints  
 Medical Implants  
 Polymer Science  
 Biomaterials  
 Drug Delivery  
 Neuroscience  
 Nanotechnology  
 Mechanobiology  
 Biomimetics  
 Biometrics



# FOOD & BIOPROCESSING



FRESHMAN			
FALL		SPRING	
EGR 101	1	EGR 103	2
EGR 102	2	MA 114	4
CHE 105	4	PHY 231	4
MA 113	4	PHY 241	1
WRD 110	3	UK Core	3
		WRD 111	3
	14		17
SOPHOMORE			
FALL		SPRING	
BAE 200	3	BAE 202	3
BIO 148	3	MA 214	3
MA 213	4	PHY 232	4
CHE 107	3	PHY 242	1
CE 106	3	ME 220	3
		EM 221	3
	16		17
JUNIOR			
FALL		SPRING	
BAE 301	2	BAE 305	2
CE 341	4	BAE 437	3
EE 305	3	EM 302	3
EM 313	3	BIO 208	3
BIO 152	3	WRD 204	3
UK CORE	3	UK CORE	3
	18		18
SENIOR			
FALL		SPRING	
BAE 400	1	BAE 403	2
BAE 402	2	BAE 502	3
BAE 417	3	TECH	4
BAE 447	3	TECH	3
TECH	3	UK CORE	3
ME 325	3		
UK CORE	3		
	18		15

## TECHNICAL ELECTIVES

ABT 360 Genetics  
 ABT 495 Experimental Methods  
 AEN 341 Brewing Science & Technology  
 BAE 504 Biofuels Production and Properties  
 BAE 549 Biological Process Engineering  
 BCH 401G Fund. of Biochemistry (CHE 107, CHE 236, BIO 152)  
 CHE 236 Organic Chemistry Survey  
 EGR 542 Electric Power Generation Technologies  
 FSC 434G Food Chemistry  
 FSC 530 Food Microbiology  
 FSC 536 Advanced Food Technology  
 FSC Food Fermentation and Thermal Processing

## FACULTY



**Dr. Adedeji**  
 Assistant Professor  
 Food Process Engineering



**Dr. Crofcheck**  
 Associate Dean,  
 Lewis Honors College  
 & Professor  
 Downstream Processing



**Dr. Montross**  
 Professor & Chair  
 Grain & Biomass



**Dr. Nokes**  
 Professor  
 Microbial Systems



**Dr. Shi**  
 Assistant Professor  
 Lignocellulose Conversion



## CAREER AREAS

Food Engineer  
 Process Engineer  
 Biology  
 Microbiology  
 Enzymes  
 Agriculture  
 Organic  
 Packing Engineer  
 Raw Materials  
 Chemistry  
 Biofuels  
 Systems  
 Modeling  
 Quality Control  
 Fermentation  
 Distillation  
 Sanitation  
 Storage





# CONTROLLED ENVIRONMENT



FRESHMAN			
FALL		SPRING	
EGR 101	1	EGR 103	2
EGR 102	2	MA 114	4
CHE 105	4	PHY 231	4
MA 113	4	PHY 241	1
WRD 110	3	UK Core	3
		WRD 111	3
	14		17
SOPHOMORE			
FALL		SPRING	
BAE 200	3	BAE 202	3
BIO 148	3	MA 214	3
MA 213	4	PHY 232	4
CHE 107	3	PHY 242	1
CE 106	3	ME 220	3
		EM 221	3
	16		17
JUNIOR			
FALL		SPRING	
BAE 301	2	BAE 305	2
CE 341	4	BAE 437	3
EE 305	3	EM 302	3
EM 313	3	BIO 208	3
BIO 152	3	WRD 204	3
UK Core	3	UK CORE	3
	18		18
SENIOR			
FALL		SPRING	
BAE 400	1	BAE 403	2
BAE 402	2	BAE 502	3
BAE 417	3	BAE 427	4
ME 325	3	TECH	3
TECH	3	UK CORE	3
TECH	3		
UK CORE	3		
	18		15

### TECHNICAL ELECTIVES

- BAE 450 Special Topics
- BAE 580 Heating, Ventilation & Air Conditioning
- BAE 599 Energy Assessment 1 & 2
- EGR 599 Solar Design
- EGR 540 Power Economics & Public Policy
- EGR 542 Electric Power Generation Technologies
- EGR 546 Electric Power System Fundamentals
- ME 440 Design of Control Systems (ME 310, ME 340)

## FACULTY



**Dr. Colliver**  
Professor  
Environmental Design



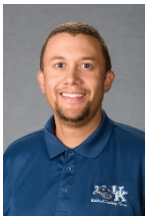
**Dr. Day**  
Adjunct Instructor  
Agricultural Facilities



**Dr. Overhults**  
Extension Professor  
Livestock Housing



**Dr. Hayes**  
Assistant Extension  
Professor  
Livestock Systems



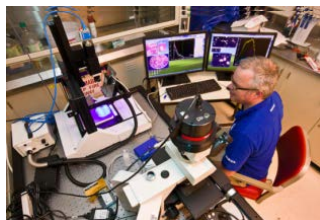
**Dr. Jackson**  
Assistant Extension  
Professor  
Livestock Systems

### CAREER AREAS

- Mass & Energy Balance
- Air Quality
- Water Quality
- HVAC
- Livestock
- Beam Stress Analysis
- Geothermal
- Solar Power
- Net Zero Emissions
- Greenhouse
- Power Engineering
- Energy Engineering



# PRE-MED / PRE-VET



FRESHMAN				SOPHOMORE				JUNIOR				SENIOR					
FALL		SPRING		FALL		SPRING		FALL		SPRING		SUMMER		FALL		SPRING	
EGR 101	1	EGR 103	2	BAE 200	3	BAE 202	3	BAE 301	2	BAE 305	3	WRD 204	3	BAE 400	1	BAE 403	2
EGR 102	2	CHE 107	3	BIO 148	3	MA 214	3	CE 341	4	ME 220	3	EM 313	3	BAE 402	2	BAE 427	3
CHE 105	4	CHE 113	2	WRD 111	3	EM 221	3	EE 305	3	BIO 208	3			BAE 417	3	BAE 502	3
CHE 111	1	MA 114	4	MA 213	4	BIO 152	3	TECH	3	TECH	3			BAE 447	3	UK CORE	3
WRD 110	3	PHY 231	4	PHY 232	4	BIO 155	1	CHE 232	3	UK CORE	3			CE 106	3	UK CORE	3
MA 113	4	PHY 241	1	PHY 242	1	CHE 230	3	CHE 233	2	EM 302	3			ME 325	3		
						CHE 231	2							UK CORE	3		
	15		16		18		17		17		18		6		18		17



## PRE-MED & PRE-VET REQUIREMENTS

*These do not fulfill any graduation requirements\**

BIO 155	Biology Lab
CHE 231	Organic Chemistry I Lab
CHE 232	Organic Chemistry II
CHE 233	Organic Chemistry II Lab

\*In addition to one year of General and Organic Chemistry and Biology, most medical schools recommend that students have an additional background in: Biochemistry, Microbiology, Cell Biology and Anatomy.

All Pre-Med & Pre-Vet Students are required to have an additional advisor: Pre-Med through the Stuckert Career Center and Pre-Vet with the Department of Veterinary Science.

## PRE-MED TECHNICAL ELECTIVES

ABT 360	Genetics
ABT 495	Experimental Methods in Biotechnology
BCH 401G	Fundamentals of Biochemistry (CHE 107, CHE 236, BIO 152)
BIO 302	Introduction to Neuroscience
BIO 303	Introduction to Evolution (BIO 148, 152, 155)
BIO 304	Principles of Genetics (BIO 148, 152, 155, CHE 107, CHE 113)
BIO 315	Cell Biology (BIO 303, BIO 304)
BIO 395	Research in Biology
CHE 230	Organic Chemistry I
PGY 412G	Principles of Human Physiology
	Any BME course

## PRE-VET TECHNICAL ELECTIVES

ASC 325	Animal Physiology (BIO 152, CHE 115)
ASC 364	Reproductive Physiology (BIO 152, CHE 230)
BIO 350	Animal Physiology (BIO 315, CHE 105, CHE 107)
	Any of the pre-med technical electives



# STUDENT ORGANIZATIONS



## American Society of Agricultural & Biological Engineers

BAE Student Branch is a chapter of the ASABE which holds biweekly meetings that focus on a variety of topics such as areas of specialization, career opportunities, and social events. Students have the opportunity to visit other schools as part of the Southern and Midwest Regional Rallies. An annual lawnmower clinic serves as the group's fundraiser and allows students to get hands-on experience in the Agricultural Machinery Research Lab.



## Wildcat Pulling Quarter Scale Tractor Team

The Quarter Scale Tractor Team provides a 360° engineering experience: The team is responsible for design, manufacturing and testing of its tractor. Each year the team travels to Peoria, Ill., for a week-long ASABE-sponsored competition, during which a panel of industry experts evaluate design and performance. UK's team has placed in the top 3 since 2012, including three national championship wins in 2012, 2014 and 2015.



## Alpha Epsilon Honor Society

Alpha Epsilon is an honor society for outstanding agricultural, biological and food engineers. The objectives of the honor society are to promote the high ideals of the engineering profession, to give recognition to those who manifest worthy qualities of character, scholarship and professional attainment, and to encourage and support the profession. Graduate students in the UK chapter sponsor a peer mentoring program for undergraduate students.

On-Campus Organizations  
(complete lists available online)

