

# 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.

## About Your Major

### 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.



#### BIOENVIRONMENTAL

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



#### CONTROLLED ENVIRONMENT

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



#### FOOD & BIOPROCESS ENGINEERING

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



#### MACHINE SYSTEMS AUTOMATION

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



#### 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.



#### PRE-BIOMEDICAL ENGINEERING

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

### BAE Design Electives

**BAE 417 Design of Machine Systems (3 hr | Fall)**

**BAE 427 Structures and Environment Engineering (3 hr | Spring)**

**BAE 437 Land and Water Resources Engineering (3 hr | Spring)**

**BAE 447 Bioprocess Engineering Fundamentals (3 hr | Fall)**

### What classes do you take?

#### BAE 200 Principles of Biosystems Engineering (3 hr | 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; prereq or concur with CHE 105; PHY 231; and EGR 103 or EGR 215.

#### BAE 202 Probability and Statistics for Biosystems (3 hr | 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 hr | 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: BAE 202.

#### BAE 305 DC Circuits and Microelectronics (3 hr | 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: EGR 102, EE 305 and engineering standing.

#### BAE 310 Heat and Mass Transfer in Biosystems Engineering (3 hr | Spring)

Fundamental principles of steady state and transient heat and mass transfer in biosystems engineering. Heat transfer will include conduction, convection, and radiation. Mass transfer will include liquid-gas, solid-gas, and solid-liquid equilibrium scenarios, as well as convective, diffusive, and osmotic mass transfer. Governing equations and boundary conditions for both heat and mass transfer will be included with special attention to industrial, biological, and bioenvironmental problems. Prereq: MA 214, ME 220, and engineering standing; prereq or concur with CE 341 or ME 330.

#### BAE 400 Senior Seminar (1 hr | Fall)

A course for senior students in biosystems 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 and engineering standing.

#### BAE 402 Biosystems Engineering Design I (2 hr | 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: engineering standing; BIO 148; BIO 152; ME 330 or CE 341; EM 302; prereq or concur with EM 313; BAE 310 or ME 325.

#### BAE 403 Biosystems Engineering Design II (2 hr | 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: Engineering standing; BAE 402; EM 313; BAE 310 or ME 325.





# Student Organizations

Explore opportunities beyond the classroom, connect with others with similar interests and passions, and learn from a network of peers



## Get Involved, Stay Engaged



### American Society of Agricultural and 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 can 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 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.

### Water Professionals Student Chapter

The Water Professionals student chapter meets and hosts events throughout the academic year for the combined AWWA/WEA student chapter and the EWRI student chapter. The Water Professionals is a great opportunity to meet other students and local water professionals interested in sustainability and water resources engineering, a career in the water or wastewater industries, environmental engineering and related professions. This chapter is dedicated to helping students approach the water industry, promotes the common professional interests of its members, and participates in not-for-profit activities including, but not limited to, education, training, meetings, and philanthropic work.

### Connect with us!



@UKBAE



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@UKBiosystems





# Bioenvironmental

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



## About Your Specialization



**BAE Faculty**

**Dr. Carmen Agouridis**  
Extension Professor,  
Associate Dean for Instruction in CAFE  
*Ecosystem Restoration, Stormwater Management*



**BAE Faculty**

**Dr. Bill Ford**  
Assistant Professor  
*Water Quality, Nutrient Transport*



**BAE Faculty**

**Dr. Tiffany Messer**  
Assistant Professor  
*Nutrient Transport, Environmental Impact, Emerging Sensor Technologies*

## What can you do?

Our alumni work locally and globally solving challenges related to ensuring we have clean water and a healthy environment.

### Potential Careers

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

### Potential Employers

- Hall Environmental Consultants
- Lexington Fayette Urban County Government
- Palmer Engineering
- Stantec
- Strand Associates
- U.S. Army Corps of Engineers

## What classes do you take?

First Year		Second Year	
EGR 101	EGR 103	BAE 200	BAE 202
EGR 102	MA 114	MA 213	MA 214
CHE 105	PHY 231	BIO 148	PHY 232
MA 113	PHY 241	CHE 107	PHY 242
WRD 110	WRD 111	CE 106	ME 220
	UK Core		EM 221
Third Year		Fourth Year	
BAE 301	BAE 305	BAE 400	BAE 403
CE 341	BAE 310	BAE 402	BAE 502
EE 305	BAE Design 1	BAE Design 2	BAE Design 3
EM 302	EM 313	Tech Elec 1	Tech Elec 3
BIO 152	Bio Sci Elect	Tech Elec 2	UK Core
UK Core	WRD 204	UK Core	

## Tech Electives

- BAE 532** Intro to Stream Restoration
- BAE 536** Fluvial Hydraulics
- BAE 538** GIS for Water Resources
- BAE 541** Intermediate Fluid Mechanics
- CE 211** Surveying
- CE 303** Intro to Construction Engineering
- CE 351** Intro Environmental Engineering
- CE 461G** Water Resource Engineering
- CE 471G** Soil Mechanics
- CE 525** CE Applications of Geographical Information Systems
- CE 551** Water and Wastewater Treatment
- EES 530** Low Temperature Geochemistry
- EES 585** Hydrogeology
- GEO 309** Intro to GIS
- GEO 451G** Fluvial Forms and Processes
- NRE 556** Contemporary Geospatial Applications for Land Analysis

Enrolled students, scan for full list of tech electives







# Controlled Environment

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



## About Your Specialization



**BAE Faculty**

**Dr. Donald Colliver**

Professor  
*Environmental Design*



**BAE Faculty**

**Dr. Morgan Hayes**

Assistant Extension Professor  
*Livestock Systems*



**BAE Faculty**

**Dr. Josh Jackson**

Assistant Extension Professor  
*Livestock Systems*

## What classes do you take?

First Year		Second Year	
EGR 101	EGR 103	BAE 200	BAE 202
EGR 102	MA 114	MA 213	MA 214
CHE 105	PHY 231	BIO 148	PHY 232
MA 113	PHY 241	CHE 107	PHY 242
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CE 341	BAE 310	BAE 402	BAE 502
EE 305	BAE Design 1	BAE Design 2	BAE Design 3
EM 302	EM 313	Tech Elec 1	Tech Elec 3
BIO 152	Bio Sci Elect	Tech Elec 2	UK Core
UK Core	WRD 204	UK Core	

### Tech Electives

**BAE 580** Heating, Ventilating & Air Conditioning

**BAE 583** Industrial Energy Utilization and Assessment

**EGR 540** Power Economics and Public Policy

**EGR 542** Electric Power Generation Technologies

**EGR 546** Electric Power System Fundamentals

**ME 440** Design Control Systems



## What can you do?

Our alumni work locally and globally solving challenges related to energy demands and control systems for indoor environments.

### Potential Careers

- Air Quality
- Energy Engineering
- Geothermal Energy
- Greenhouse
- HVAC
- Livestock
- Net Zero Emissions
- Power Engineering
- Solar Power
- Structural Design
- Water Quality

### Potential Employers

- Alpha Energy Solutions
- Big Ass Solutions
- CMTA, Inc.
- Duke Energy
- Kentucky Division of Air Quality
- Trane
- USDA

Enrolled students, scan for full list of tech electives



# Food & Bioprocessing

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



## About Your Specialization



BAE Faculty

**Dr. Akinbode Adedeji**  
Associate Professor  
Food Process Engineering



BAE Faculty

**Dr. Tyler Barzee**  
Assistant Professor  
Fermentation



BAE Faculty

**Dr. Czarena Crofcheck**  
Professor  
Downstream Processing



BAE Faculty

**Dr. Michael Montross**  
Professor, Chair  
Grain and Biomass



BAE Faculty

**Dr. Sue Nokes**  
Professor, Associate Dean for Faculty Affairs and Facilities  
Microbial Systems



BAE Faculty

**Dr. Jian Shi**  
Associate Professor  
Lignocellulose Conversion

## What can you do?

Our alumni work locally and globally identifying opportunities for sustainable solutions related to food, energy, and water demands.

### Potential Careers

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

### Potential Employers

- Alltech
- Chiquita
- Haskell
- Kraft
- Nestle
- Novozymes
- USDA
- Yum!

## What classes do you take?

First Year		Second Year	
EGR 101	EGR 103	BAE 200	BAE 202
EGR 102	MA 114	MA 213	MA 214
CHE 105	PHY 231	BIO 148	PHY 232
MA 113	PHY 241	CHE 107	PHY 242
WRD 110	WRD 111	CE 106	ME 220
	UK Core		EM 221
Third Year		Fourth Year	
BAE 301	BAE 305	BAE 400	BAE 403
CE 341	BAE 310	BAE 402	BAE 502
EE 305	BAE Design 1	BAE Design 2	Tech Elec 2
EM 302	EM 313	BAE Design 3	Tech Elec 3
BIO 152	Bio Sci Elect	Tech Elec 1	UK Core
UK Core	WRD 204	UK Core	

## Tech Electives

- ABT 360** Genetics
- ABT 495** Experimental Methods
- AEN 341** Brewing Science and Technology
- BAE 542** Biofuels and Bioproducts
- BAE 549** Biological Process Engineering
- BCH 401G** Fundamentals of Biochemistry
- CHE 230** Organic Chemistry I
- CHE 236** Survey of Organic Chem
- CME 599** Topics in Chemical Engineering
- FSC 434G** Food Chemistry
- FSC 530** Food Microbiology
- FSC 536** Advanced Food Technology
- FSC 538** Food Fermentation

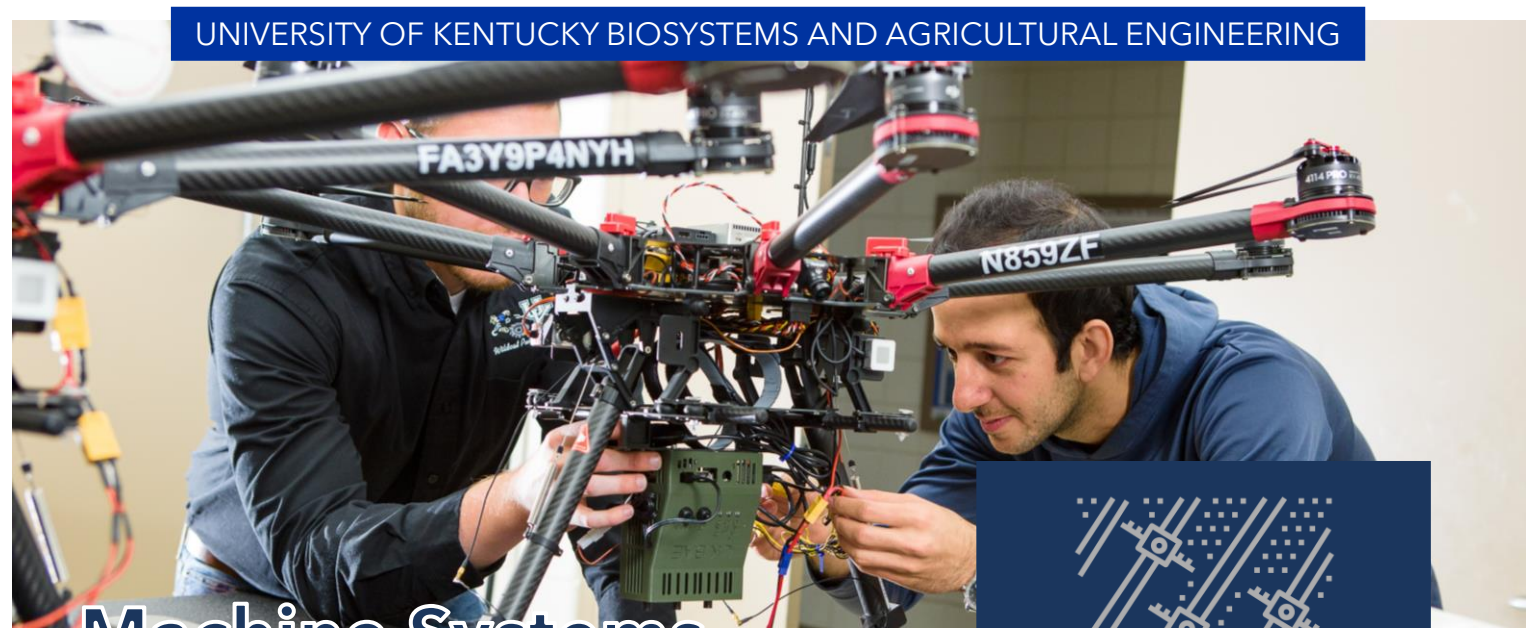
Enrolled students, scan for full list of tech electives



Certificate in Distillation,  
Wine and Brewing Studies

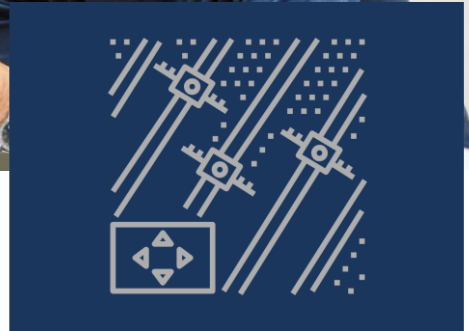






# Machine Systems

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



## About Your Specialization



**BAE Faculty**

**Dr. Joe Dvorak**  
Associate Professor  
*Machinery Controls*



**BAE Faculty**

**Dr. Mike Sama**  
Associate Professor  
*Control Systems*



**BAE Faculty**

**Dr. Tim Stombaugh**  
Extension Professor  
*Precision Agriculture*

## What classes do you take?

First Year		Second Year	
EGR 101	EGR 103	BAE 200	BAE 202
EGR 102	MA 114	MA 213	MA 214
CHE 105	PHY 231	BIO 148	PHY 232
MA 113	PHY 241	CHE 107	PHY 242
WRD 110	WRD 111	CE 106	ME 220
	UK Core		EM 221
Third Year		Fourth Year	
BAE 301	BAE 305	BAE 400	BAE 403
CE 341	BAE 310	BAE 402	BAE 502
EE 305	EM 313	BAE Design 1	BAE Design 3
EM 302	Bio Sci Elect	BAE Design 2	Tech Elec 2
BIO 152	WRD 204	Tech Elec 1	Tech Elec 3
UK Core	UK Core	UK Core	

## Tech Electives

- BAE 514** Component Design
- BAE 515** Fluid Power Systems
- BAE 516** Control of Off-Road Vehicles
- EE 402G** Electrical Instrumentation & Measurement
- GEO 309** Intro to GIS
- ME 321** Engineering Thermodynamics II
- ME 344** Mechanical Design
- ME 395** Independent Research in ME
- ME 440** Design of Control Systems
- ME 501** Mechanical Design with Finite Element Methods
- ME 503** Lean Manufacturing Principles and Practices
- ME 513** Mechanical Vibrations
- ME 532** ADV Strength Materials

## What can you do?

Our alumni work locally and globally identifying opportunities to apply new technologies to improve agricultural production systems.

### Potential Careers

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

### Potential Employers

- Agco
- Altec
- Boeing
- Clark
- CNH
- Cummins
- John Deere
- Link-Belt
- Toyota

Enrolled students, scan for full list of tech electives

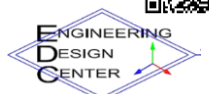




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# Pre-Med/Pre-Vet

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



## About Your Specialization

### What classes do you take?

First Year		Second Year		Third Year			Fourth Year	
EGR 101	EGR 103	BAE 200	BAE 202	BAE 301	BAE 305	EM 313	BAE 400	BAE 403
EGR 102	MA 114	MA 213	MA 214	CE 341	BAE 310	WRD 204	BAE 402	BAE 502
CHE 105	PHY 231	BIO 148	EM 221	EE 305	Bio Sci Elect		BAE Design 1	BAE Design 3
CHE 111*	PHY 241	WRD 111	BIO 152	ME 220	CE 106		BAE Design 2	Tech Elec 3
MA 113	CHE 107	PHY 232	BIO 155*	CHE 232*	EM 302		Tech Elec 2	UK Core
WRD 110	CHE 113*	PHY 242	CHE 230	CHE 233*			UK Core	UK Core
			CHE 231*				UK Core	

### Pre-Med & Pre-Vet Requirements

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 and Pre-Vet students are encouraged to speak with a Pre-Professional advisor for current trends and updates.

\*These courses do not fulfill any graduation requirements for the Biosystems Engineering program.

### What can you do?

Our alumni work in medical facilities and healthcare-related industries, as well as veterinary clinics and animal care facilities.

#### Potential Careers

- Anesthesiology
- Cardiology
- Emergency Medicine
- General Practice
- Healthcare Administration and Management
- Internal Medicine
- Oncology
- Pediatrics
- Sports Medicine
- Animal Welfare
- Equine Industry
- Large or Small Animal Vet Clinics
- Veterinary Lab Technician

#### Potential Employers

- Mayo Clinic
- Medical Centers
- Private Practices
- Universities
- Veterinary Clinics and Diagnostic Labs

### Tech Electives

- ABT 360** - Genetics
- ABT 495** - Experimental Methods
- ASC 325** - Animal Physiology
- ASC 364** - Reproductive Physiology
- BCH 401G** - Fundamentals of Biochemistry
- BIO 302** - Intro to Neuroscience
- BIO 303** - Intro to Evolution
- BIO 304** - Principles of Genetics
- BIO 305** - Intro to Neuroscience Techniques
- BIO 315** - Cell Biology
- BIO 350** - Animal Physiology
- BIO 395** - Research In Biology
- BME 301** - Fundamentals of Biomedical Engineering
- BME 395** - Independent Research in BME
- BME 472** - Human Biomechanics
- BME 473** - Fundamentals of Biofluid Mechanics
- BME 488** - Introduction to Biomaterials
- BME 491** - Tops in Biomedical Egr
- BME 540** - Biomedical Instrumentation
- BME 550** - Intro to Biomedical Imaging
- BME 571** - Mechanical Modeling of Human Motion
- BME 579** - Neural Engineering
- BME 599** - Topics in BME
- CHE 230** - Organic Chemistry I
- CHE 236** - Survey of Organic Chem
- PGY 412G** - Principles of Human Physiology

Enrolled students, scan for full list of tech electives



# Pre-Biomedical

Applies engineering practice to problems and opportunities related to medicine, human health, and healthcare



## About Your Specialization

Most biomedical engineers pursue advanced degrees, considering both medicine and engineering are highly specialized.

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 3 additional classes beyond the BAE requirements.

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

## What can you do?

Our alumni work locally and globally solving healthcare-related challenges or pursue advanced degrees in biomedical engineering programs.

### Potential Careers

- Artificial Joints
- Biomaterials
- Biomechanics
- Biometrics
- Drug Delivery
- Medical Devices
- Medical Implants
- Nanotechnology
- Neuroscience
- Pharmaceuticals
- Polymer Science
- Product Development
- Prosthetics
- Quality Assurance
- Regulatory Affairs
- Research

### Potential Employers

- Hangar
- Integra LifeSciences
- Johnson & Johnson
- Pfizer
- Smith & Nephew
- United Therapeutics Corporation
- U.S. Air Force

## What classes do you take?

### First Year

EGR 101  
EGR 102  
CHE 105  
MA 113  
WRD 110  
EGR 103  
MA 114  
PHY 231  
PHY 241  
WRD 111  
UK Core

### Second Year

BAE 200  
MA 213  
BIO 148  
CHE 107  
CE 106  
BAE 202  
MA 214  
PHY 232  
PHY 242  
ME 220  
EM 221

### Third Year

BAE 301  
CE 341  
EE 305  
EM 302  
BIO 152  
UK Core  
BAE 305  
BAE 310  
BAE Design 1  
EM 313  
Bio Sci Elect  
WRD 204

### Fourth Year

BAE 400  
BAE 402  
BAE Design 2  
Tech Elec 1  
Tech Elec 2  
UK Core  
BAE 403  
BAE 502  
BAE Design 3  
Tech Elec 3  
UK Core

## Tech Electives

- ABT 360** - Genetics
- ABT 495** - Experimental Methods
- BCH 401G** - Fundamentals of Biochemistry
- BIO 302** - Intro to Neuroscience
- BME 301** - Fundamentals of Biomedical Engineering
- BME 395** - Independent Research in BME
- BME 472** - Human Biomechanics
- BME 473** - Fundamentals of Biofluid Mechanics
- BME 488** - Introduction to Biomaterials
- BME 491** - Topics in Biomedical Egr
- BME 540** - Biomedical Instrumentation
- BME 550** - Intro to Biomedical Imaging
- BME 571** - Mechanical Modeling of Human Motion
- BME 579** - Neural Engineering
- BME 599** - Topics in BME
- CHE 230** - Organic Chemistry I
- CHE 236** - Survey of Organic Chem
- PGY 412G** - Principles of Human Physiology

Enrolled students, scan for full list of tech electives

