Biometric Systems Engineering, B.S.B.S.E.

Degree Offered

• Bachelor of Science in Biometric Systems Engineering (B.S.B.S.E.)

Nature of the Program

Biometric systems engineering allow for personal identification based upon fundamental biometric features that are unique and time invariant, such as features derived from fingerprints, faces, irises, retinas, and voices. Biometric systems are composed of complex hardware and software designed to measure a signature of the human body, compare the signature to a database, and make a decision based on this matching process. The Bachelor of Science in Biometric Systems Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org (https:// www.abet.org/).

WVU's Bachelor of Science in Biometric Systems Engineering degree program trains engineers in the skills needed to design, build, test, and modify biometric systems, as well as the application and interpretation of data from these systems. Biometric Systems Engineering majors take fundamental coursework in circuits and electronics; in digital and computing systems; and in in computer programming, similar to our Computer Engineering majors. During their junior and senior years, Biometric Systems Engineering majors take advanced classes in image processing; in computer security; in biometric devices; and in biomedical systems. During their senior year, all Biometric Systems Engineering majors complete a two semester Capstone project in which they work with a team of students to design, build and test a device, systems or application which makes use of biometric techniques. Required courses in biology and statistics provide Biometric Systems Engineering students with a specialized skill set that distinguishes this major from other engineering disciplines. In addition, students can choose from five concentration areas for their technical electives: Microsensors and Circuits, Signal Processing, Statistics, Software Systems, and Cybersecurity.

Graduates of the Biometric Systems Engineering degree program are in high demand for engineering positions in law enforcement agencies, as well as government agencies and contractors in the defense and security fields. Demand for biometric systems engineers is also rapidly growing in commercial fields such as banking, manufacturing and consumer products that enhance the human computer interface. The continued rapid advance of integrated sensor, signal/image processing, computer, and mass storage technology promises to extend these applications further into our daily lives with even the most inanimate objects able to identify, interact with, and assist their users.

Program Educational Objectives

The Program Educational Objectives (PEO) of the Biometric Systems Engineering (BSE) program at West Virginia University is to produce graduates who will apply their knowledge and skills to achieve success in their careers in industry, research, government service or graduate study. It is expected that in the first five years after graduation our graduates will achieve success and proficiency in their profession, be recognized as leaders, and contribute to the well-being of society.

Click here to view the Suggested Plan of Study (p. 5)

Curriculum in Biometric Systems Engineering General Education Foundations

Please use this link to view a list of courses that meet each GEF requirement. (http://registrar.wvu.edu/gef/)

NOTE: Some major requirements will fulfill specific GEF requirements. Please see the curriculum requirements listed below for details on which GEFs you will need to select.

Code	Title	Hours
General Education Foundations		
F1 - Composition & Rhetoric		3-6
ENGL 101	Introduction to Composition and Rhetoric	
& ENGL 102	and Composition, Rhetoric, and Research	
or ENGL 103	Accelerated Academic Writing	
F2A/F2B - Science & Technology		4-6
F3 - Math & Quantitative Reasoning		3-4
F4 - Society & Connections		3
F5 - Human Inquiry & the Past		3
F6 - The Arts & Creativity		3
F7 - Global Studies & Diversity		3

F8 - Focus (may be satisfied by completion of a minor, double major, or dual degree)	9
Total Hours	31-37

Please note that not all of the GEF courses are offered at all campuses. Students should consult with their advisor or academic department regarding the GEF course offerings available at their campus.

Degree Requirements

Students must meet the following criteria to qualify for a Bachelor of Science in Biometric Systems Engineering degree:

- Complete a minimum of 126 credit hours
- · Satisfy WVU's undergraduate degree requirements
- Satisfy Statler College's undergraduate degree requirements (http://catalog.wvu.edu/undergraduate/collegeofengineeringandmineralresources/ #policiestext)
- · Complete all courses listed in the curriculum requirements with the required minimum grades
- Attain an overall grade point average of 2.00 or better
- Attain a WVU grade point average of 2.00 or better
- Attain a Statler grade point average of 2.00 or better
- A maximum of one math or science courses with a grade of D+, D, or D- may apply towards a Statler College degree
- Complete a survey regarding their academic and professional experiences at WVU, as well as post-graduation job placement or continuing education plans.

The Statler GPA is computed based on all work taken at WVU with a subject code within Statler College (BIOM, BMEG, CE, CHE, CPE, CS, CSEE, CYBE, EE, ENGR, ENVE, ETEC, IENG, IH&S, MAE, MINE, PDA, PNGE, SAFM, SENG) excluding ENGR 140, ENGR 150, and CS 101. The WVU GPA is computed based on all work taken at WVU. The Overall GPA is computed based on all work taken at WVU and transfer work.

Curriculum Requirements

Code	Title	Hours
University Requirements		16
Fundamentals of Engineering Requ	irements	5
Math and Science Requirements		38
Biometric Systems Engineering Program Requirements		67
Total Hours		126

University Requirements

Code	Title	Hours
General Education Fo	undations (GEF) 1, 2, 3, 4, 5, 6, 7, and	8 (31-37 Credits)
Outstanding GEF Requirements 1, 5, 6, and 7		15
ENGR 191	First-Year Seminar	1
Total Hours		16

Fundamentals of Engineering Requirements

Code	Title	Hours
A minimum grade of C- is	required in all Fundamentals of Engineering courses.	
ENGR 101	Engineering Problem Solving 1	2
Engineering Problem Solving (Select one of the following):		3
CHE 102	Introduction to Chemical Engineering	
ENGR 102	Engineering Problem-Solving 2	
ENGR 103	Introduction to Nanotechnology Design	
MAE 102	Introduction to Mechanical and Aerospace Engineering Design	

Total Hours

Math and Science Requirements

Code	Title	Hours
A minimum grade of C- is required i	in all Math and Science courses.	
BIOL 115 & 115L	Principles of Biology and Principles of Biology Laboratory (GEF 8)	4
CHEM 115 & 115L	Fundamentals of Chemistry 1 and Fundamentals of Chemistry 1 Laboratory (GEF 2B)	4
Calculus I (GEF 3):		4
MATH 155	Calculus 1	
MATH 153 & MATH 154	Calculus 1a with Precalculus and Calculus 1b with Precalculus	
MATH 156	Calculus 2 (GEF 8)	4
MATH 251	Multivariable Calculus	4
MATH 261	Elementary Differential Equations	4
Math Elective (Select one of the foll	lowing):	3
CS 220	Discrete Mathematics	
MATH 343	Introduction to Linear Algebra	
MATH 373	Introduction to Cryptography	
MATH 375	Applied Modern Algebra	
PHYS 111	General Physics 1	4
& 111L	and General Physics 1 Laboratory (GEF 8)	
PHYS 112	General Physics 2	4
& 112L	and General Physics 2 Laboratory	
STAT 215	Introduction to Probability and Statistics	3
Total Hours		38

Biometric Systems Engineering Program Requirements

Code	Title	Hours
ECON 201	Principles of Microeconomics (GEF 4)	3
BIOM 201	Introduction to Biometrics Systems	1
BIOM 426	Biometric Systems	3
CSEE 380	Engineering Professionalism Seminar	1
CSEE 480	Capstone Project - Design	2
or CSEE 480S	Capstone Project - Design	
or BIOM 480	Capstone Project - Design	
CSEE 481	Capstone Project - Implementation	3
or CSEE 481S	Capstone Project - Implementation	
or BIOM 481	Capstone Project - Implementation	
CPE 271	Introduction to Digital Logic Design	3
CPE 271L	Digital Logic Laboratory	1
CPE 310	Microprocessor Systems	3
CPE 310L	Microprocessor Systems Laboratory	1
CS 110	Introduction to Computer Science	4
& 110L	and Introduction to Computer Science Laboratory	
CS 111	Introduction to Data Structures	4
& 111L	and Introduction to Data Structures Laboratory	
CS 350	Computer System Concepts	3
CS 465	Cybersecurity Principles and Practice	3
EE 221	Introduction to Electrical Engineering	3
EE 221L	Introduction to Electrical Engineering Laboratory	1
EE 223	Electrical Circuits	3
EE 223L	Electrical Circuits Laboratory	1

EE 327	Signals and Systems 1	3
BIOM 425	Bioengineering	3
EE 465	Introduction to Digital Image Processing	3
Bioscience Elective (Select		3
BIOL 235	Human Physiology	
BMEG 480	Cellular Machinery	
Area of Emphasis in Cybers	security or Concentration Area (CA) Coursework	12
CA1: MicroSensors and C		
EE 251	Digital Electronics	
& 251L	and Digital Electronics Laboratory	
Choose two of the following	g:	
PHYS 314	Introductory Modern Physics	
PHYS 321	Optics	
EE 355	Analog Electronics	
& 355L	and Analog Electronics Laboratory	
EE 450	Device Design and Integration	
EE 455	Introduction to Microfabrication	
CA2: Signal Processing		
EE 251	Digital Electronics	
& 251L	and Digital Electronics Laboratory	
EE 329 & 329L	Signals and Systems 2 and Signals and Systems Laboratory	
Choose one of the following		
CS 453	Data and Computer Communications	
EE 463	Digital Signal Processing Fundamentals	
EE 565	Advanced Image Processing	
CA3: Statistics	Advanced mage rideessing	
Choose either the Applied of	nr Theory Ontion	
Applied Option		
STAT 312	Intermediate Statistical Methods	
Choose two of the following		
STAT 313	Introductory Design and Analysis	
STAT 331	Sampling Methods	
STAT 421	Statistical Analysis System (SAS)	
Theory Option		
STAT 312	Intermediate Statistical Methods	
STAT 461	Introduction to Probability Theory	
STAT 462	Theoretical Introduction to Statistical Inference	
CA4: Software Systems		
CS 230	Introduction to Software Engineering	
& 230L	and Introduction to Software Engineering Laboratory	
or CPE 484	Real-Time Systems Development	
Choose two of the following	g:	
CPE 442	Introduction to Digital Computer Architecture	
or CS 455	Computer Architecture	
CS 430	Advanced Software Engineering	
CS 450	Operating Systems Structure	
& 450L	and Operating Systems Structure Laboratory	
CS 453	Data and Computer Communications	
CS 472	Artificial Intelligence	
Total Hours		67

Suggested Plan of Study

It is important for students to take courses in the order specified as much as possible; all prerequisites and concurrent requirements must be observed. A typical B.S.B.S.E. degree program, which completes degree requirements in four years, is as follows.

First Year			
Fall	Hours	Spring	Hours
CS 110		4 CHEM 115	4
& 110L		& 115L (GEF 2)	
ENGL 101 (GEF 1)		3 CS 111 & 111L	4
ENGR 101		2 ENGR 102	3
ENGR 191		1 MATH 156 (GEF 8)	4
MATH 155 (GEF 3)		4 PHYS 111 & 111L (GEF 8)	4
GEF 5		3	
		17	19
Second Year			
Fall	Hours	Spring	Hours
BIOL 115 & 115L		4 BIOM 201	1
EE 221		3 CPE 271	3
EE 221L		1 CPE 271L	1
MATH 251		4 EE 223	3
PHYS 112 & 112L		4 EE 223L	1
		ENGL 102 (GEF 1)	3
		MATH 261	4
		16	16
Third Year			
Fall	Hours	Spring	Hours
BIOM 426		3 CPE 310	3
CS 350		3 CPE 310L	1
BIOM 425		3 CS 465	3
EE 327		3 EE 465	3
STAT 215		3 Bioscience Elective	3
CSEE 380		1 Math Elective	3
		16	16
Fourth Year			
Fall	Hours	Spring	Hours
CSEE 480		2 CSEE 481	3
ECON 201 (GEF 4)		3 AoE or CA Course 4	3
AoE or CA Course 1		3 GEF 6	3
AoE or CA Course 2		3 GEF 7	3
AoE or CA Course 3		3	
		14	12

Total credit hours: 126

Areas of Emphasis

- Cybersecurity (p. 6)
- MicroSensors and Circuits (p. 6)
- Signal Processing (p. 6)

- Statistics (p. 6)
- Software Systems (p. 7)

AREA OF EMPHASIS IN CYBERSECURITY

Code	Title	Hours
A minimum grade of C- is requ	uired in each course.	
CS 453	Data and Computer Communications	3
CS 465	Cybersecurity Principles and Practice	3
CYBE 366	Secure Software Development	3
CYBE 467	Ethical Hacking & Penetration Testing	3
Select one of the following:		3
CPE 435	Computer Incident Response	
CYBE 466	Host Based Cyber Defense	
Total Hours		15

MICROSENSORS AND CIRCUITS AREA OF EMPHASIS REQUIREMENTS

Code	Title	Hours
EE 251 & 251L	Digital Electronics and Digital Electronics Laboratory	4
Choose two of the following:		6
PHYS 314	Introductory Modern Physics	
PHYS 321	Optics	
EE 355 & 355L	Analog Electronics and Analog Electronics Laboratory	
EE 450	Device Design and Integration	
EE 455	Introduction to Microfabrication	
Total Hours		10

SIGNAL PROCESSING AREA OF EMPHASIS REQUIREMENTS

Code	Title	Hours
EE 251	Digital Electronics	4
& 251L	and Digital Electronics Laboratory	
EE 329	Signals and Systems 2	4
& 329L	and Signals and Systems Laboratory	
Choose one of the following:		3
CS 453	Data and Computer Communications	
EE 463	Digital Signal Processing Fundamentals	
EE 565	Advanced Image Processing	
Total Hours		11

STATISTICS AREA OF EMPHASIS REQUIREMENTS

Code	Title	Hours	
Choose either the Applied or Theory Option		9	
Applied Option			
STAT 312	Intermediate Statistical Methods		
Choose two of the following:			
STAT 313	Introductory Design and Analysis		
STAT 331	Sampling Methods		

STAT 421	Statistical Analysis System (SAS)	
Theory Option		
STAT 312	Intermediate Statistical Methods	
STAT 461	Introduction to Probability Theory	
STAT 462	Theoretical Introduction to Statistical Inference	
Total Hours		9

SOFTWARE SYSTEMS AREA OF EMPHASIS REQUIREMENTS

Code	Title	Hours
CS 230	Introduction to Software Engineering	3-4
& 230L	and Introduction to Software Engineering Laboratory	
or CPE 484	Real-Time Systems Development	
Choose two of the following:		6
CPE 442	Introduction to Digital Computer Architecture	
or CS 455	Computer Architecture	
CS 430	Advanced Software Engineering	
CS 450	Operating Systems Structure	
& 450L	and Operating Systems Structure Laboratory	
CS 453	Data and Computer Communications	
CS 472	Artificial Intelligence	
Total Hours		9

Total Hours

Program Educational Objectives

The Program Educational Objectives (PEO) of the Biometric Systems Engineering (BSE) program at West Virginia University is to produce graduates who will apply their knowledge and skills to achieve success in their careers in industry, research, government service or graduate study. It is expected that in the first five years after graduation our graduates will achieve success and proficiency in their profession, be recognized as leaders, and contribute to the well-being of society.

Major Learning Outcomes **BIOMETRIC SYSTEMS ENGINEERING**

Upon graduation, all Bachelor of Science in Biometric Systems Engineering students will have:

- 1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- 2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- 3. An ability to communicate effectively with a range of audiences.
- 4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- 5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- 6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- 7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
- 8. An ability to understand the significance of biometric traits, explain the components of a biometric system, and assess its performance.