

College of Engineering
Department of Biological Systems Engineering
Degree: Bachelor of Science in Biological Systems Engineering
Major: Biological Systems Engineering
For students entering under UG Catalog 2022-2023

Credits Required for Graduation: 128

FALL SEMESTER FIRST YEAR		Credits	SPRING SEMESTER FIRST YEAR		Credits
CHEM 1035 General Chemistry <i>Pre: Eligible to enroll</i>	3		CHEM 1036 General Chemistry <i>Pre: CHEM 1035 or 1055 or 1055H</i>	3	
CHEM 1045 General Chemistry Laboratory <i>Co: CHEM 1035</i>	1		ENGL 1106 First-Year Writing <i>Pre: ENGL 1105</i>	3	
ENGL 1105 First-Year Writing	3		MATH 1226 Calculus of a Single Variable <i>Pre: MATH 1225 (C-)</i>	4	
MATH 1225 Calculus of a Single Variable (C-) <i>Pre: Eligible to enroll</i>	4		PHYS 2305 Foundations of Physics <i>Pre: MATH 1225 or MATH 1226; Co: MATH 1226</i>	4	
ENGE 1215 Foundations of Engineering (C-)	2		ENGE 1216 Foundations of Engineering (C-) <i>Pre: ENGE 1215 (C-)</i>	2	
Pathways Core Concept 2, 3, 6a, or 7	3				
TOTAL	16		TOTAL	16	
FALL SEMESTER SECOND YEAR		Credits	SPRING SEMESTER SECOND YEAR		Credits
BSE 2004 Introduction to Biological Systems Engineering <i>Pre: ENGE 1215 or ENGE 1414</i>	3 [F]		BSE 3144 Engineering Analysis for Biological Systems using Numerical Methods ¹ <i>Co: MATH 2214</i>	2 [S]	
BIOL 1105 Principles of Biology	3 [F,S]		BIOL 1106 Principles of Biology	3 [S,SII]	
MATH 2204 Introduction to Multivariable Calculus <i>Pre: MATH 1226</i>	3		ESM 2304 Dynamics ¹ <i>Pre: (ESM 2104 or ESM 2114), (MATH 2204 or MATH 2204H), Co: MATH 2214</i>	3	
MATH 2114 Introduction to Linear Algebra <i>Pre: MATH 1225 (B) or MATH 1226</i>	3		MATH 2214 Introduction to Differential Equations <i>Pre: (MATH 1114 or MATH 2114 or MATH 2114H), MATH 1226</i>	3	
ESM 2104 Statics ¹ <i>Pre: MATH 1226; Co: MATH 2204 or MATH 2204H or MATH 2224 or MATH 2406H</i>	3		PHYS 2306 Foundations of Physics <i>Pre: MATH 1226, PHYS 2305</i>	4	
ISE 2014 Engineering Economy ¹	2				
TOTAL	17		TOTAL	15	
FALL SEMESTER THIRD YEAR		Credits	SPRING SEMESTER THIRD YEAR		Credits
BSE Fundamental Course or Technical Elective	3		BSE Fundamental Course or Technical Elective	3	
BSE 3154 Thermodynamics of Biological Systems ¹ <i>Pre: ESM 2304, (MATH 2204 or MATH 2204H)</i>	3 [F]		BSE Fundamental Course	3	
ESM 3024 Introduction to Fluid Mechanics ¹ <i>Pre: ESM 2304</i>	3 [F]		BSE 3504 Transport Processes in Biological Systems ¹ <i>Pre: 3154, ESM 3024</i>	3 [S]	
STAT 3704 Statistics for Engineering Applications <i>Pre: MATH 2204 or MATH 2204H or MATH 2406H</i>	2 [F,S,SII]		BIOL 2604 General Microbiology ¹ <i>Pre: BIOL 1105, BIOL 1106, (CHEM 1036 or CHEM 1056 or CHEM 1036H or CHEM 1056H)</i>	3 [F,S,SII]	
CHEM Elective	3		ISE 3034 Technical Communication for Engineers <i>Pre: ENGL 1106</i>	3 [S]	
Pathways Core Concept 2, 3, 6a, or 7	3				
TOTAL	17		TOTAL	15	
FALL SEMESTER FOURTH YEAR		Credits	SPRING SEMESTER FOURTH YEAR		Credits
BSE 4125 Comprehensive Design Project ¹ <i>Pre: 3334 or 3524</i>	2 [F]		BSE 4126 Comprehensive Design Project <i>Pre: 4125</i>	3 [S]	
BSE Elective	3		BSE Elective	3	
Engineering Topics Elective	3		Engineering Topics Elective	3	
Engineering Topics Elective	3		Technical Elective	3	
Pathways Core Concept 2, 3, 6a, or 7	3		Pathways Core Concept 2, 3, 6a, or 7	3	
Pathways Core Concept 2, 3, 6a, or 7	3				
TOTAL	17		TOTAL	15	

General Information about Checksheet: Superscripted annotation after the course number (1) indicates core course of the degree. Additionally, [F,S,SI,SII] in credits column indicates terms when a course is expected to be offered. Course offerings are subject to change and the availability of sufficient resources. Students should confirm course offerings in advance with their department.

Pathways to General Education (Pathways)

Consult the pathways courses table: <https://www.pathways.prov.vt.edu/about/table.html>. Pathways courses need to be completed prior to graduation

Pathways Concept 1: Discourse (6 hrs foundational, 3 hrs advanced)	<i>Foundational: ENGL 1105</i>	(3)	<i>Foundational: ENGL 1106</i>	(3)
	<i>Advanced: ISE 3034^[S]</i>			(3)
Pathways Concept 2: Critical Thinking in the Humanities (6 hrs)		(3)		(3)
Pathways Concept 3: Reasoning in the Social Sciences (6 hrs)		(3)		(3)
Pathways Concept 4: Reasoning in the Natural Sciences (8 hrs)	CHEM 1035 + CHEM 1045	(4)	PHYS 2305	(4)
Pathways Concept 5: Quantitative and Computational Thinking (11 hrs)	<i>Foundational: MATH 1225</i>	(4)	<i>Foundational: MATH 1226</i>	(4)
	<i>Advanced: MATH 2214</i>			(3)
Pathways Concept 6: Critique and Practice in Design and the Arts (7 hrs)	<i>Arts (6a):</i>			(3)
	<i>Design: ENGE 1215 + ENGE 1216</i>			(4)
Pathways Concept 7*: Critical Analysis of Identity & Equity in the US (3 hrs)	*Pathway 7 should be double-counted with either Pathways 2, 3, or 6a to avoid taking additional credit hours			(3)

Electives: BSE majors choose a focused 6 hour fundamental elective sequence, 6 hours of BSE electives, 3 hours of chemistry electives, 9 hours of engineering topics electives, and 6 hours of technical electives. Students choose from the courses listed under each respective requirement, noting that some courses are not available to all students because some courses have prerequisites and some are restricted to majors in the offering department. Courses with substantial duplication (as determined by the BSE Undergraduate Curriculum Committee) of courses previously taken will not qualify for credit. Independent study (BSE 4974) and undergraduate research (BSE 4994) courses cannot be used as electives.

BSE Fundamental Elective Sequence: There are 2 fundamental sequences to choose from (6-hours total):

For *Watershed Science and Environmental Health*: BSE 3324 Small Watershed Hydrology^[F] and BSE 3334^[S] Nonpoint Source Pollution Assessment and Control.

For *Biotechnology, Food Engineering, and Health Professions*: BSE 3524^[S] Unit Operations in Biological Systems Engineering & BSE 3534^[S] Bioprocess Engineering.

Change of Major Requirements: Please see <https://eng.vt.edu/em>

Foreign Language Requirements: Students must have had 2 years of a foreign language in high school or one year at the college level (6 credit hours) of the same language. College-level credits used to meet this requirement do not count towards the degree.

Satisfactory Progress Towards Degree: University Policy 91 outlines university-wide minimum criteria to determine if students are making satisfactory progress towards the completion of their degrees. The BSE Department fully supports this policy. Specific expectations for satisfactory progress for BSE majors are as follows:

- Each student must meet the minimum University-wide criteria as described in Policy 91 and summarized in the Undergraduate Catalog (<http://www.undergradcatalog.registrar.vt.edu/1617/academic-policies.html#22><http://www.undergradcatalog.registrar.vt.edu/1617/academic-policies.html#22>);
- Maintain overall and in-major GPAs of at least 2.0 (in-major GPA based on all BSE-prefix courses taken); and,
- Be registered for at least one BSE-prefix course per semester, excluding BSE 2094, 2294, 2484, and 4994.

Statement of Hidden Prerequisites: Pre-requisites for each course are listed after the course title. The (letter grade) notation, such as (C-), indicates the minimum grade students must earn in the pre-requisite course.

- There are no hidden prerequisites in this program of study.
- Prerequisites may change from what is indicated. Be sure to consult the University Catalog or check with your advisor for the most current requirements.
- A student must obtain a C- or better in all BSE courses.

Graduation Requirements: Students must pass all required courses, with a minimum grade of C- in all BSE-prefix courses. Both the overall and in-major GPA must be at least 2.0, where in-major GPA is based on all BSE-prefix courses taken. Only free electives and courses only offered on a Pass/Fail basis may be taken Pass/Fail.

Biological Systems Engineering Electives

Courses with substantial duplication of courses taken previously will not qualify for credit. Independent study (DEPT NAME 4974) and undergraduate research (DEPT NAME 4994) courses cannot be used as electives.

Choose from the courses listed under each respective requirement, noting that some courses are not available to all students because some courses have prerequisites and some are restricted to majors in the offering department.

***# Biological Systems Engineering (BSE) Electives (6 credit hours required):**

BSE 2304 Landscape Measurement and Modeling	BSE 4524 Biological Process Plant Design
BSE 4224 Field Methods in Hydrology	BSE 4534 Biological Process Engineering Lab (1)
BSE 4304 Introduction to Watershed Modeling	BSE 4544/CHE 4544 Protein Separation Engineering
BSE 4324 Fluvial Geomorphology	BSE 4564 Metabolic Engineering
BSE 4344 Geographic Information Systems for Engineers	BSE 4604 Food Process Engineering

***# Chemistry (CHEM) Electives (3 credit hours required):**

BCHM 2024 Concepts of Biochemistry	CHEM 3615 Physical Chemistry
CHEM 2114 Analytical Chemistry	CHEM 4615 Physical Chemistry for the Life Sciences
CHEM 2124 Analytical Chemistry Laboratory Techniques and Practice (1)	CSES 4314/ENSC 4314 Water Quality
CHEM 2514 Survey of Organic Chemistry	CSES 4734/CHEM 4734/ENSC 4734 Environmental Soil Chemistry
CHEM 2535-2536 Organic Chemistry	GEOS 4634 Environmental Geochemistry
CHEM 2565-2566 Principles of Organic Chemistry	

***# Engineering Topics Electives (9 credit hours required – students must request to be force-added to major-restricted courses):**

All courses listed as Biological Systems Engineering electives, from top list, above

BMES 2104 Introduction to Biomedical Engineering	ESM 4204 Musculoskeletal Biomechanics
BMES 3124 Introduction to Biomechanics	ISE 2204 Manufacturing Processes
BMES 3134 Introduction to Biomedical Imaging	ISE 2404 Deterministic Operations Research I
BMES 3144 Biomedical Devices	ISE 4015 Management Systems Theory, Applications, and Design
CEE 3104 Introduction to Environmental Engineering	ISE 4654 Principles of Industrial Hygiene
CEE 4104 Water and Wastewater Treatment Design	MSE 2034 Elements of Materials Engineering
CEE 4114 Fundamentals of Public Health Engineering	MSE 2054 Fundamentals of Materials Science
CEE 4134 Environmental Sustainability - A Systems Approach	MSE 3304 Physical Metallurgy
CEE 4144 Air Resources Engineering	MSE 4574 Biomaterials
CEE 4174 Solid and Hazardous Waste Management	MSE 4584 Biomimetic Materials
CEE 4314 Groundwater Resources	MSE 4604 Composite Materials
CEE 4324 Open Channel Flow	
CEE 4334 Hydraulic Structures	
CEE 4344 Water Resources Planning	
ECE 3054 Electrical Theory	
ECE 4194 Engineering Principles of Remote Sensing	
ECE 4364 Alternate Energy Systems	
ENGR 3124 Introduction to Green Engineering	
ENGR 4134 Environmental Life Cycle Assessment	
ESM 2204 Mechanics of Deformable Bodies	
ESM 3054/MSE 3054 Mechanical Behavior of Materials	
ESM 3064/MSE 3064 Mechanical Behavior of Materials Laboratory (1)	
ESM 4044/CEE 4610 Mechanics of Composite Materials	
ESM 4105-4106 Engineering Analysis of Physiologic Systems	
ESM 4114/AOE 4514 Nonlinear Dynamics and Chaos	

*** Prerequisites:** Most of courses listed under the page 3 & 4 headers have pre-/co-requisites; please consult the University Course Catalog or check with your advisor.

Unless otherwise designated (i.e., (1), (2), (4)), all courses listed under page 3 & 4 headers are 3-credit hour courses.

***# Technical Electives (6 credit hours required – students must request to be force-added to major-restricted courses):**

- All courses listed as Chemistry or Engineering Topics Electives, except 4754, 4964, 4974, 4984, 4994 in any department.
- All BIOL 1XXX laboratories and all 2000, 3000, and 4000 level courses, except 3504.
- CHEM 1046 General Chemistry Laboratory and all CHEM 2000, 3000, and 4000 level courses except 4014.
- All MATH 3000 and 4000 level courses except 4044,4625,4626,4644,4664,4754,4964,4974, 4984,4994

AAEC 3314 Environmental Law	FREC 3604 Climate Science
ALS 3404 Ecological Agriculture: Theory and Practice	FREC 4374 Forested Wetlands
ALS 4614/WATR 4614 Watershed Assessment, Management, and Policy	FREC 4464/AAEC 4424/WATR 4464 Water Resource Policy & Economics
BCHM 3114 Biochemistry for Biotechnology and the Life Sciences	FREC 4784 Wetland Hydrology & Biogeochemistry
BCHM 4115-4116 General Biochemistry	FST 2544 Functional Foods for Health
BIOL 4164/CSES 4164/ENSC 4164 Environmental Microbiology	FST 3024 Principles of Sensory Evaluation
BMES 4064/BMVS 4064 Introduction to Medical Physiology	FST 3114/HORT 3114 Wines & Vines
BSE 4394 Water Supply and Sanitation in Developing Countries	FST 3124 Brewing Science and Technology
BSE 4554/FREC 4554/HORT 4554/LAR 4554/SPIA 4554 Creating the Ecological City	FST 3514 Food Analysis (4)
CS 1044 Introduction to Programming in C	FST 3604/BIOL 3604 Food Microbiology (4)
CS 1054 Introduction to Programming in Java	FST 4104 Applied Malting and Brewing Science
CS 1064 Introduction to Programming in Python	FST 4504 Food Chemistry
CSES 3114/ENSC 3114/GEOS 3614 Soils	GEOG 1514 Introduction to Meteorology
CSES 3124/ENSC 3124/GEOS 3624 Soils Laboratory (1)	GEOG 3104 Environmental Problems, Population, and Development
CSES 3304/GEOG 3304/GEOS 3304 Geomorphology	GEOG 4354/GEOS 4354 Introduction to Remote Sensing
CSES 3444/HORT 3444 World Crops and Cropping Systems	GEOS 2104 Elements of Geology
CSES 3614/ENSC 3614 Soil Physical and Hydrological Properties	GEOS 3014 Environmental Geosciences
CSES 3634/ENSC 3634 Physics of Pollution	GEOS 3034 Oceanography
CSES 3644/ENSC 3644 Plant Materials for Environmental Restoration	GEOS 4804 Groundwater Hydrology
CSES 4764/ENSC 4764 Bioremediation	ISE 4004 Theory of Organization
CSES 4774/ENSC 4774 Reclamation of Drastically Disturbed Lands	ISE 4304 Global Issues in Industrial Management
CSES 4854/ENSC 4854 Wetland Soils and Mitigation	LAR 3044 Land Analysis and Site Planning
ECE 2164/AOE 2164 Exploration of the Space Environment	MINE 2504 Introduction to Mining Engineering
ENGR 2164/COS 2164 Introduction to Scieneering (1)	SBIO 2124 Structure and Properties of Sustainable Biomaterials
ENSC 3604 Fundamentals of Environmental Science	SBIO 2504 Circular Economy Analytics
ENSC 4414 Monitoring and Analysis of the Environment (2)	SBIO 3434 Chemistry and Conversion of Sustainable Biomaterials
ESM 4194/ME 4194 Sustainable Energy Solutions for a Global Society	SBIO 3444 Sustainable Biomaterials and Bioenergy
FIW/FREC 4324 Genetics of Natural and Managed Populations	SYSB 2025, 2026 Introduction to Systems Biology
FIW 4614 Fish Ecology	SYSB 3115 Network Dynamics & Cell Physiology (4)
FIW 4624 Marine Ecology	UAP 3354 Introduction to Environmental Policy and Planning
	UAP 4344 Law of Critical Environmental Areas
	UAP 4374 Land Use and Environment: Planning and Policy

* **Prerequisites:** Most of courses listed under the page 3 & 4 headers have pre-/co-requisites; please consult the University Course Catalog or check with your advisor.

Unless otherwise designated (i.e., (1), (2), (4)), all courses listed under page 3 & 4 headers are 3-credit hour courses.