

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 2023-2024

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 1205 or MATH 1205H or MATH1225) or (MATH 1206 or MATH 1206H or MATH 1226); Co: 2325 or (MATH 1206 or MATH 1206H or MATH 1226)</i>	4	
ENGE 1215 Foundations of Engineering	2		ENGE 1216 Foundations of Engineering <i>Pre: ENGE 1215</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 ¹ <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		Pathways Core Concept 2, 3, 6a, or 7	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: (1114 or 2114 or 2114H or 2405H or ISC 2105), 1226</i>	3	
ESM 2104 Statics ¹ <i>Pre: MATH 1226; Co: MATH 2204</i>	3		PHYS 2306 Foundations of Physics <i>Pre: (MATH 1206 or MATH 1206H or MATH 1226), 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: CHEM 1036, PHYS 2305, (MATH 2204 or MATH 2204H)</i>	3[F]		BSE Fundamental Course	3	
ESM 3024 Introduction to Fluid Mechanics ¹ <i>Pre: ESM 2104, PHYS 2305</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 2224 or MATH 2224H or MATH 2204 or MATH 2204H or MATH 2406H or CMDA 2005</i>	2 [F,S,SII]		BIOL 2604 General Microbiology ¹ <i>Pre: (BIOL 1105 or ISC 2105), BIOL 1106, (CHEM 1036 or CHEM 1056 or CHEM 1056H or ISC 2105)</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	
BSE Elective	3		Engineering Topics Elective	3	
Engineering Topics Elective	3		Technical Elective	3	
Engineering Topics Elective	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 General Education (Pathways)

Consult the pathway courses table: <https://www.pathways.prov.vt.edu/students-and-advisors/pathways-guides.html>. Pathway courses need to be completed prior to graduation

Pathway 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)
Pathway Concept 2: Critical Thinking in the Humanities (6 hrs)		(3)		(3)
Pathway Concept 3: Reasoning in the Social Sciences (6 hrs)		(3)		(3)
Pathway Concept 4: Reasoning in the Natural Sciences (8 hrs)	CHEM 1035 + CHEM 1045	(4)	PHYS 2305	(4)
Pathway 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)
Pathway 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)
Pathway 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 credits fundamental elective sequence, 9 credits of BSE electives (1 BSE elective must have 1-credit of lab), 3 credits of chemistry electives, 9 credits of engineering topics electives, and 6 credits 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.

BSE Fundamental Elective Sequence: There are 2 fundamental sequences to choose from (6 credits 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:

- 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, and 2484.

Statement of Hidden Prerequisites: Prerequisites 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 prerequisite 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.

Additional Checksheet Comments:

1. ENGE 1414 (4 cr) may be substituted for ENGE 1215 (2 cr) + ENGE 1216 (2 cr)
2. MATH 2405H (5 cr) may be substituted for MATH 2114 (3 cr)
3. MATH 2405H (5 cr) + MATH 2406H (5 cr) may be substituted for MATH 2114 (3 cr) + MATH 2204 (3 cr) + MATH 2214 (3 cr)
4. Students are strongly encouraged to take CHEM 1036 first year Spring semester.
5. Students might also choose to take the BIOL 1105-1106 sequence during the first year if their schedule permits.

Biological Systems Engineering Electives

Courses with substantial duplication of courses taken previously will not qualify for credit.

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 (9 credits, where 1 course must have a lab component, L):**

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

***# Chemistry (CHEM) Electives (3 credits required):**

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

***# Engineering Topics Electives (9 credits 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	ISE 2404 Deterministic Operations Research I
BMES 3124 Introduction to Biomechanics	ISE 4015 Management Systems Theory, Applications, and Design
BMES 3134 Introduction to Biomedical Imaging	ISE 4654 Principles of Industrial Hygiene
BMES 3144 Biomedical Devices	MSE 2034 Elements of Materials Engineering
CEE 3104 Introduction to Environmental Engineering	MSE 2054 Fundamentals of Materials Science
CEE 4104 Water and Wastewater Treatment Design	MSE 3304 Physical Metallurgy
CEE 4114 Fundamentals of Public Health Engineering	MSE 4584 Biomimetic Materials
CEE 4134 Environmental Sustainability - A Systems Approach	MSE 4604 Composite Materials
CEE 4144 Air Resources Engineering	
CEE 4174 Solid and Hazardous Waste Management	
CEE 4314 Groundwater Resources	
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 2304 Dynamics	
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	
ESM 4204 Musculoskeletal Biomechanics	
ISE 3204 Manufacturing Processes	

*** Prerequisites:** Most of courses listed under the page 3 & 4 headers have pre/corequisites; 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 credits required – students must request to be force-added to major-restricted courses):**

- 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 3000 and 4000 level MATH courses except 4044,4625,4626,4644,4664,4754,4964,4974, 4984,4994
- All 3000, 4000, or 5000 level engineering courses, with no more than 3 credits of undergraduate research and no more than 3 credits of independent study. Technical Elective courses cannot double-count for Engineering Topics Elective credit (and vice versa).

AAEC 3314 Environmental Law	FST 2544 Functional Foods for Health
ALS 3404 Ecological Agriculture: Theory and Practice	FST 3024 Principles of Sensory Evaluation
ALS 4614/WATR 4614 Watershed Assessment, Management, and Policy	FST 3114/HORT 3114 Wines & Vines
BCHM 3114 Biochemistry for Biotechnology and the Life Sciences	FST 3124 Brewing Science and Technology
BCHM 4115-4116 General Biochemistry	FST 3514 Food Analysis (4)
BIOL 4164/ENSC 4164 Environmental Microbiology	FST 3604/BIOL 3604 Food Microbiology (4)
BMES 4064/BMVS 4064 Introduction to Medical Physiology	FST 4104 Applied Malting and Brewing Science
BSE 4394 Water Supply and Sanitation in Developing Countries	FST 4504 Food Chemistry
BSE 4554/FREC 4554/HORT 4554/LAR 4554/SPIA 4554 Creating the Ecological City	GEOG 1514 Introduction to Meteorology
CS 1044 Introduction to Programming in C	GEOG 3104 Environmental Problems, Population, and Development
CS 1054 Introduction to Programming in Java	GEOG 3304/GEOS 3304/CSES 3304 Geomorphology
CS 1064 Introduction to Programming in Python	GEOG 4354/GEOS 4354 Introduction to Remote Sensing
CS 1114: Intro to Software Design	GEOS 2104 Elements of Geology
CS 2064: Intermediate Programming	GEOS 3014 Environmental Geosciences
CSES 3114/GEOS 3614 Soils	GEOS 3034 Oceanography
CSES 3124/GEOS 3624 Soils Laboratory (1)	GEOS 4804 Groundwater Hydrology
CSES 3614 Soil Physical and Hydrological Properties	ISE 4004 Theory of Organization
CSES 4854 Wetland Soils and Mitigation	ISE 4304 Global Issues in Industrial Management
ENSC 3634 Physics of Pollution	LAR 3044 Land Analysis and Site Planning
ENSC 3644 Plant Materials for Environmental Restoration	MINE 2504 Introduction to Mining Engineering
ECE 2164/AOE 2664 Exploration of the Space Environment	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 4324/FREC 4324 Genetics of Natural and Managed Populations	SPES 2244 World Crops and Cropping Systems
FIW 4614 Fish Ecology	SYSB 2024 Fundamentals of Systems Biology
FIW 4624 Marine Ecology	SYSB 2034 Mathematical Methods in Systems Biology
FREC 4374 Forested Wetlands	SYSB 3115 Network Dynamics & Cell Physiology (4)
FREC 4464/AAEC 4424/WATR 4464 Water Resource Policy & Economics	UAP 3354 Introduction to Environmental Policy and Planning
FREC 4784 Wetland Hydrology & Biogeochemistry	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/corequisites; 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.