

College of Engineering  
Department of Biological Systems Engineering  
Degree: Bachelor of Science in Biological Systems Engineering  
Major: Biological Systems Engineering

For students graduating in calendar year 2022 and for student date of entry under UG Catalog 2020-2021

Credits Required for Graduation: 128

FALL SEMESTER FIRST YEAR		Credits	SPRING SEMESTER FIRST YEAR		Credits
CHEM 1035 General Chemistry <i>Co: MATH 1025 or MATH 1225</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: Math Ready</i>	4		PHYS 2305 Foundations of Physics <i>Pre: (MATH 1205 or MATH 1205H or MATH 1225) or (MATH 1206 or MATH 1206H or MATH 1226). Co: PHYS 2325 or (MATH 1206 or MATH 1206H or 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	3				
<b>TOTAL</b>	<b>16</b>		<b>TOTAL</b>	<b>16</b>	
FALL SEMESTER SECOND YEAR		Credits	SPRING SECOND YEAR		Credits
BIOL 1105 Principles of Biology	3 [F,S]		BIOL 1106 Principles of Biology	3 [S,SII]	
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	
MATH 2204 Introduction to Multivariable Calculus <i>Pre: MATH 1226</i>	3		PHYS 2306 Foundations of Physics <i>Pre: (MATH 1206 or MATH 1206H or MATH 1226), PHYS 2305</i>	4	
ESM 2104 Statics <sup>(1)</sup> <i>Pre: MATH 1226; Co: MATH 2204 or MATH 2204H or MATH 2224 or MATH 2406H</i>	3		ESM 2304 Dynamics <sup>(1)</sup> <i>Pre: (ESM 2104 or ESM 2114), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H), Co: MATH 2214</i>	3	
BSE 2004 Introduction to Biological Systems Engineering <sup>(1)</sup> <i>Pre: ENGE 1024 or ENGE 1215 or ENGE 1414</i>	2 [F,S]		BSE 3144 Engineering Analysis for Biological Systems using Numerical Methods <sup>(1)</sup> <i>Co: MATH 2214</i>	2 [S]	
Pathways	3				
<b>TOTAL</b>	<b>17</b>		<b>TOTAL</b>	<b>15</b>	
FALL SEMESTER THIRD YEAR		Credits	SPRING SEMESTER THIRD YEAR		Credits
STAT 3704 Statistics for Engineering Applications <i>Pre: MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H or MATH 2406H</i>	2 [F,S,SII]		ISE 2014 Engineering Economy	2	
ESM 3024 Introduction to Fluid Mechanics <sup>(1)</sup> <i>Pre: ESM 2304</i>	3 [F,W, SII]		BIOL 2604 General Microbiology <sup>(1)</sup> <i>Pre: (BIOL 1005 or BIOL 1105 or BIOL 1205H or ISC 2105), (BIOL 1006 or BIOL 1106 or BIOL 1206H), (CHEM 1036 or CHEM 1056 or CHEM 1036H or CHEM 1056H or ISC 2105)</i>	3 [F,S,SII]	
BSE 3134 Biological Systems Engineering Seminar <i>Pre: BSE 2004</i>	1 [F]		BSE 3504 Transport Processes in Biological Systems <sup>(1)</sup> <i>Pre: 3154, ESM 3024</i>	3 [S]	
BSE 3154 Thermodynamics of Biological Systems <sup>(1)</sup> <i>Pre: ESM 2304, (MATH 2204 or MATH 2204H); Pre/Co: Fluid Mechanics</i>	3 [F]		BSE Elective: BSE 3334 Nonpoint Source Pollution Assessment and Control <i>Pre: 3324 –OR- BSE 3524 Unit Operations in Biological Systems Engineering Co: 3504 and 3534</i>	3 [S]	
BSE –OR- Technical Elective: students must choose BSE 3324 Small Watershed Hydrology if planning to take BSE 3334 Nonpoint Source Pollution Assessment and Control	3		BSE –OR- Technical Elective: Students must choose BSE 3534 Bioprocess Engineering if planning to take BSE 3524 Unit Operations in Biological Systems Engineering	3 [S]	
CHEM Elective	3		Pathways	3	
<b>TOTAL</b>	<b>15</b>		<b>TOTAL</b>	<b>17</b>	
FALL SEMESTER FOURTH YEAR		Credits	SPRING SEMESTER FOURTH YEAR		Credits
BSE 4125 Comprehensive Design Project <sup>(1)</sup> <i>Pre: 3334 or 3524</i>	2 [F]		BSE 4126 Comprehensive Design Project <i>Pre: 4125</i>	3 [S]	
BSE Elective	3		Engineering Topics Elective	3	
BSE Elective	1		Engineering Topics Elective	3	
BSE Elective	2		Engineering Topics Elective	3	
Engineering Topics Elective	3		Engineering Topics Elective	3	

<sup>(1)</sup>Indicates a degree core requirement.

Indicates a course used to satisfy Pathways requirements.

Technical Elective	3	Pathways	3
Pathways	3	Pathways	3
<b>TOTAL</b>	<b>17</b>	<b>TOTAL</b>	<b>15</b>

**General Information about Checksheet:** Superscripted annotation [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

<b>Pathway 1:</b> Discourse (6 hrs foundational, 3 hrs advanced)	<i>Foundational: ENGL 1105</i>	<b>(3)</b>	<i>Foundational: ENGL 1106</i>	<b>(3)</b>
	<i>Advanced:</i>			<b>(3)</b>
<b>Pathway 2:</b> Critical Thinking in the Humanities (6 hrs)		<b>(3)</b>		<b>(3)</b>
<b>Pathway 3:</b> Reasoning in the Social Sciences (6 hrs)		<b>(3)</b>		<b>(3)</b>
<b>Pathway 4:</b> Reasoning in the Natural Sciences (8 hrs)	<b>CHEM 1035 + CHEM 1045</b>	<b>(4)</b>	<b>PHYS 2305</b>	<b>(4)</b>
<b>Pathway 5:</b> Quantitative and Computational Thinking (11 hrs)	<i>Foundational: MATH 1225</i>	<b>(4)</b>	<i>Foundational: MATH 1226</i>	<b>(4)</b>
	<i>Advanced: MATH 2214</i>			<b>(3)</b>
<b>Pathway 6:</b> Critique and Practice in Design and the Arts (7 hrs)	<i>Arts (6a):</i>			<b>(3)</b>
	<i>Design: ENGE 1215 + ENGE 1216</i>			<b>(4)</b>
<b>Pathway 7*:</b> 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			<b>(3)</b>

**Electives:** BSE majors must take 12 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.

**Change of Major Requirements:** Please see <http://www.enge.vt.edu/undergraduate-changing-majors.html>

**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>);
- 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  
2022 Checksheet**

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 (12 credit hours required):**

BSE 2304 Landscape Measurement and Modeling	BSE 4344 Geographic Information Systems for Engineers
BSE 3324 Small Watershed Hydrology	BSE 4524 Biological Process Plant Design
BSE 3334 Nonpoint Source Pollution Assessment and Control	BSE 4534 Biological Process Engineering Lab
BSE 3524 Unit Operations in Biological Systems Engineering	BSE 4544/CHE 4544 Protein Separation Engineering
BSE 3534 Bioprocess Engineering	BSE 4564 Metabolic Engineering
BSE 4224 Field Methods in Hydrology	BSE 4604 Food Process Engineering
BSE 4304 Introduction to Watershed Modeling	

**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	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 2204 Mechanics of Deformable Bodies
BMES 3124 Introduction to Biomechanics	ESM 3054/MSE 3054 Mechanical Behavior of Materials
BMES 3134 Introduction to Biomedical Imaging	ESM 3064/MSE 3064 Mechanical Behavior of Materials Laboratory
CEE 3104 Introduction to Environmental Engineering*	ESM 4044 Mechanics of Composite Materials
CEE 4104 Water and Wastewater Treatment Design	ESM 4105-4106 Engineering Analysis of Physiologic Systems
CEE 4114 Fundamentals of Public Health Engineering*	ESM 4114 Nonlinear Dynamics and Chaos
CEE 4134 Environmental Sustainability - A Systems Approach*	ESM 4204 Musculoskeletal Biomechanics
CEE 4144 Air Resources Engineering*	ISE 2204 Manufacturing Processes
CEE 4174 Solid and Hazardous Waste Management*	ISE 2214 Manufacturing Processes Laboratory
CEE 4254 Municipal Engineering*	ISE 2404 Deterministic Operations Research I
CEE 4264 Sustainable Land Development*	ISE 4015 Management Systems Theory, Applications, and Design
CEE 4314 Groundwater Resources*	ISE 4654 Principles of Industrial Hygiene
CEE 4324 Open Channel Flow*	MSE 2034 Elements of Materials Engineering
CEE 4334 Hydraulic Structures*	MSE 2044 Fundamentals of Materials Engineering
CEE 4344 Water Resources Planning*	MSE 2054 Fundamentals of Materials Science
ECE 3054 Electrical Theory	MSE 3304 Physical Metallurgy
ECE 4194 Engineering Principles of Remote Sensing	MSE 4574 Biomaterials
ECE 4364 Alternate Energy Systems	MSE 4584 Biomimetic Materials
ENGR 3124 Introduction to Green Engineering	MSE 4604 Composite Materials
ENGR 4134 Environmental Life Cycle Assessment	

\*CEE courses are major-restricted at course request, but will be made available for non-CEE majors three days after the opening of drop/add.

**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	FIW/FREC 4324 Genetics of Natural and Managed Populations
ALS 3404 Ecological Agriculture: Theory and Practice	FIW 4614 Fish Ecology
ALS 4614/WATR 4614 Watershed Assessment, Management, and Policy	FIW 4624 Marine Ecology
BCHM 3114 Biochemistry for Biotechnology and the Life Sciences	FREC 3604 Climate Science
BCHM 4115-4116 General Biochemistry	FREC 4374 Forested Wetlands
BIOL 4164/CSES 4164/ENSC 4164 Environmental Microbiology	FREC 4464 Water Resource Policy & Economics
BMES 4064/BMVS 4064 Introduction to Medical Physiology	FREC 4784 Wetland Hydrology & Biogeochemistry
BSE 4394 Water Supply and Sanitation in Developing Countries	FST 3024 Principles of Sensory Evaluation
CS 1044 Introduction to Programming in C	FST 3114 Wines & Vines
CS 1054 Introduction to Programming in Java	FST 3124 Brewing Science and Technology
CS 1064 Introduction to Programming in Python	FST 3514 Food Analysis
CSES 3114/ENSC 3114/GEOS 3614 Soils	FST 3604/BIOL 3604 Food Microbiology
CSES 3124/ENSC 3124/GEOS 3624 Soils Laboratory	FST 4104 Applied Malting and Brewing Science
CSES 3304/GEOS 3304/GEOS 3304 Geomorphology	FST 4504 Food Chemistry
CSES 3444/HORT 3444 World Crops and Cropping Systems	GEOG 1514 Introduction to Meteorology
CSES 3614/ENSC 3614 Soil Physical and Hydrological Properties	GEOG 3104 Environmental Problems, Population, and Development
CSES 3634/ENSC 3634 Physics of Pollution	GEOG 4354/GEOS 4354 Introduction to Remote Sensing
CSES 3644/ENSC 3644 Plant Materials for Environmental Restoration	GEOS 2104 Elements of Geology
CSES 4444/ENSC 4444 Managed Ecosystems, Ecosystem Services, and Sustainability	GEOS 3014 Environmental Geosciences
CSES 4644 Land-based Systems for Waste Treatment	GEOS 3034 Oceanography
CSES 4764/ENSC 4764 Bioremediation	GEOS 4804 Groundwater Hydrology
CSES 4774/ENSC 4774 Reclamation of Drastically Disturbed Lands	ISE 4004 Theory of Organization
CSES 4854/ENSC 4854 Wetland Soils and Mitigation	ISE 4304 Global Issues in Industrial Management
ECE 2164/AOE 2164 Exploration of the Space Environment	LAR 3044 Land Analysis and Site Planning
ENGR 1814 Energy, Resource Development, and the Environment	MINE 2504 Introduction to Mining Engineering
ENGR 2164/COS 2164 Introduction to Scieneering	SBIO 2124 Structure and Properties of Sustainable Biomaterials
ENSC 3604 Fundamentals of Environmental Science	SBIO 3434 Chemistry and Conversion of Sustainable Biomaterials
ENSC 4414 Monitoring and Analysis of the Environment	SBIO 3444 Sustainable Biomaterials and Bioenergy
ESM 4194/ME 4194 Sustainable Energy Solutions for a Global Society	SYSB 2025, 2026 Introduction to Systems Biology
	SYSB 3115 Network Dynamics & Cell Physiology
	UAP 3354 Introduction to Environmental Policy and Planning
	UAP 4344 Law of Critical Environmental Areas
	UAP 4374 Land Use and Environment: Planning and Policy
	UAP 4384 Pollution Control Planning and Policy