BIOLOGICAL SYSTEMS ENGINEERING MAJOR

Program Curriculum

Code	Title	Credits
Degree Core Requirements		
BIOL 2604	General Microbiology	3
BSE 2004	Introduction to Biological Systems Engineering	3
BSE 3144	Engineering Analysis for Biological Systems using Numerical Methods	2
BSE 3154	Thermodynamics of Biological Systems	3
BSE 3504	Transport Processes in Biological Systems	3
BSE 4125	Comprehensive Design Project	2
ESM 2104	Statics	3
ESM 3024	Introduction to Fluid Mechanics	3
ISE 2014	Engineering Economy	2
Subtotal		24
Major Requirements		
BIOL 1105	Principles of Biology	3
BIOL 1106	Principles of Biology	3
BSE 4126	Comprehensive Design Project	3
CHEM 1036	General Chemistry	3
MATH 2114	Introduction to Linear Algebra	3
MATH 2204	Introduction to Multivariable Calculus	3
PHYS 2306	Foundations of Physics	4
STAT 3704	Statistics for Engineering Applications	2
Subtotal		24
Restricted Electives		
Select 2 BSE Fundamental Courses		6
Select 1 CHEM Elective		3
Select 3 BSE Electives where 1 course must have a lab component.		9
Select 3 Engineering Topics Electives		9
Select 2 Technical Electives		6
Subtotal		33
Pathways to General Education		
Pathways Concept 1 - Discourse		
ENGL 1105	First-Year Writing (1F)	3
ENGL 1106	First-Year Writing (1F)	3
ISE 3034	Technical Communication for Engineers (1A)	3
Pathways Concept 2 - Critical Thinking in the Humanities		
Select six hours in Pathway 2 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G02)		6
Pathways Concept 3 - Reasoning in the Social Sciences		
Select six hours in Pathway 3 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G03)		6
Pathways Concept 4 - Reasoning in the Natural Sciences		
CHEM 1035 & CHEM 1045	General Chemistry and General Chemistry Laboratory	4
PHYS 2305	Foundations of Physics	4
Pathways Concept 5 - Quantitative and Computational Thinking		
MATH 1225	Calculus of a Single Variable (5F ; C-)	4
MATH 1226	Calculus of a Single Variable (5F ;)	4
MATH 2214	Introduction to Differential Equations (5A)	3
Pathways Concept 6 - Critique and Practice in Design and the Arts		
Select three Arts credits in Pathway 6a (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06A)		3
ENGE 1215 & ENGE 1216	Foundations of Engineering and Foundations of Engineering (6D ;)	4
Pathways Concept 7 - Critical Analysis of Identity and Equity in the United States		
Pathway 7 should be double-counted with either Pathways 2, 3, or 6a to avoid taking additional credit hours.		
Subtotal		47
Total Credits		**128**

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 and BSE 3334 Nonpoint Source Pollution Assessment and Control.

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

Restricted Electives

Biological Systems Engineering (BSE) Electives

(9 credit hours required, where 1 course must have a lab component.)

Code	Title	Credits
BSE 2304	Landscape Measurements and Modeling	3
BSE 4224	Field Methods in Hydrology	3
BSE 4304	Introduction to Watershed Modeling	3
BSE 4324	Applied Fluvial Geomorphology	3
BSE 4344	Geographic Information Systems for Engineers	3
BSE 4524	Biological Process Plant Design	3
BSE 4534	Bioprocess Engineering Lab	1
BSE 4544	Protein Separation Engineering	3
BSE 4564	Metabolic Engineering	3
BSE 4604	Food Process Engineering	3

Chemistry (CHEM) Electives

(3 credit hours required)

Code	Title	Credits
BCHM 2024	Concepts of Biochemistry	3
CHEM 2114	Analytical Chemistry	3
CHEM 2124	Analytical Chemistry Laboratory Techniques and Practice	1
CHEM 2514	Survey of Organic Chemistry	3
CHEM 2535 & CHEM 2536	Organic Chemistry and Organic Chemistry	6
CHEM 2565 & CHEM 2566	Principles of Organic Chemistry and Principles of Organic Chemistry	6
CHEM 3615	Physical Chemistry	3
CHEM 4615	Physical Chemistry for the Life Sciences	3
ENSC 4314	Water Quality	3

ENSC 4734	Environmental Soil Chemistry	3
GEOS 4634	Environmental Geochemistry	3

Engineering Topics Electives

(9 credit hours required – students must request to be force-added to major-restricted courses)

Code	Title	Credits
BMES 2104	Introduction to Biomedical Engineering	3
BMES 3124	Introduction to Biomechanics	3
BMES 3134	Introduction to Biomedical Imaging	3
BMES 3144	Biomedical Devices	3
CEE 3104	Introduction to Environmental Engineering	3
CEE 4104	Water and Wastewater Treatment Design	3
CEE 4114	Fundamentals of Public Health Engineering	3
CEE 4134	Environmental Sustainability - A Systems Approach	3
CEE 4144	Air Resources Engineering	3
CEE 4174	Solid and Hazardous Waste Management	3
CEE 4314	Groundwater Resources	3
CEE 4324	Open Channel Flow	3
CEE 4334	Hydraulic Structures	3
CEE 4344	Water Resources Planning	3
ECE 3054	Electrical Theory	3
ECE 4194	Engineering Principles of Remote Sensing	3
ECE 4364	Alternate Energy Systems	3
ENGR 3124	Introduction to Green Engineering	3
ENGR 4134	Environmental Life Cycle Assessment	3
ESM 2204	Mechanics of Deformable Bodies	3
ESM 2304	Dynamics	3
ESM 3054	Mechanical Behavior of Materials	3
ESM 3064	Mechanical Behavior of Materials Laboratory	1
ESM 4044	Mechanics of Composite Materials	3
ESM 4105 & ESM 4106	Engineering Analysis of Physiologic Systems and Engineering Analysis of Physiologic Systems	6
ESM 4114	Nonlinear Dynamics and Chaos	3
ESM 4204	Musculoskeletal Biomechanics	3
ISE 2404	Deterministic Operations Research I	3
ISE 3204	Manufacturing Processes	3
ISE 4015	Management Systems Theory, Applications, and Design	3
ISE 4654	Principles of Industrial Hygiene	3
MSE 2034	Elements of Materials Engineering	3
MSE 2054	Fundamentals of Materials Science	3
MSE 3304	Physical Metallurgy	3
MSE 4584	Biomimetic Materials	3
MSE 4604	Composite Materials	3

Technical Electives

(6 credit hours 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 MATH 3000 and 4000 level courses except 4044,4625,4626,4644,4664,4754,4964,4974, 4984,4994.
- All 3000, 4000, and 5000 level engineering courses, with no more tan 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.

Code	Title	Credits
AAEC 3314	Environmental Law	3
ALS 3404	Ecological Agriculture: Theory and Practice	3
ALS 4614	Watershed Assessment, Management, and Policy	2
BCHM 3114	Biochemistry for Biotechnology and the Life Sciences	3
BCHM 4115 & BCHM 4116	General Biochemistry and General Biochemistry	7
BIOL 4164	Environmental Microbiology	3
BMES 4064	Introduction to Medical Physiology	3
BSE 4394	Water Supply and Sanitation in Developing Countries	3
BSE 4554	Creating the Ecological City	3
CS 1044	Introduction to Programming in C	3
CS 1054	Introduction to Programming in Java	3
CS 1064	Introduction to Programming in Python	3
CS 1114	Introduction to Software Design	3
CS 2064	Intermediate Programming in Python	3
CSES 3114	Soils	3
CSES 3124	Soils Laboratory	1
CSES 3614	Soil Physical and Hydrological Properties	3
CSES 4854	Wetland Soils and Mitigation	3
ENSC 3634	Physics of Pollution	3
ENSC 3644	Plant Materials for Environmental Restoration	3
ECE 2164	Exploration of the Space Environment	3
ENSC 3604	Fundamentals of Environmental Science	3
ENSC 4414	Monitoring and Analysis of the Environment	2
ESM 4194	Sustainable Energy Solutions for a Global Society	3
FIW 4324	Genetics of Natural and Mangaged Populations	3
FIW 4614	Fish Ecology	3
FIW 4624	Marine Ecology	3
FREC 4374	Forested Wetlands	3
FREC 4464	Water Resources Policy and Economics	3
FREC 4784	Wetland Hydrology and Biogeochemistry	3
FST 2544	Functional Foods for Health	3
FST 3024	Principles of Sensory Evaluation	3
FST 3114	Wines and Vines	3
FST 3124	Brewing Science and Technology	3
FST 3514	Food Analysis	4
FST 3604	Food Microbiology	4
FST 4104	Applied Malting and Brewing Science	3
FST 4504	Food Chemistry	3
GEOG 1514	Introduction to Meteorology	3
GEOG 3104	Environmental Problems, Population, and Development	3

GEOG 3304	Geomorphology	3
GEOG 4354	Introduction to Remote Sensing	3
GEOS 2104	Elements of Geology	3
GEOS 3014	Environmental Geosciences	3
GEOS 3034	Oceanography	3
GEOS 4804	Groundwater Hydrology	3
ISE 4004	Theory of Organization	3
ISE 4304	Global Issues in Industrial Management	3
LAR 3044	Land Analysis and Site Planning	3
MINE 2504	Introduction to Mining Engineering	3
SBIO 2124	Structure and Properties of Sustainable Biomaterials	3
SBIO 2504	Circular Economy Analytics for Sustainable Systems	3
SBIO 3434	Chemistry and Conversion of Sustainable Biomaterials	3
SBIO 3444	Sustainable Biomaterials and Bioenergy	3
SPES 2244	World Crops: Food and Culture	3
SYSB 2024	Fundamentals of Systems Biology	3
SYSB 2034	Mathematical Methods in Systems Biology	3
SYSB 3115	Network Dynamics and Cell Physiology	4
UAP 3354	Introduction to Environmental Policy and Planning	3
UAP 4344	Law of Critical Environmental Areas	3
UAP 4374	Land Use and Environment: Planning and Policy	3

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.

Credits Required for Graduation: 128

General Information about Checksheet
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

Change of Major Requirements

Please see https://eng.vt.edu/em (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 2484 .

Statement of Hidden Prerequisites

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

Prerequisites: Most courses have pre-/co-requisites; please consult the University Course Catalog or check with your advisor.

- 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.

Electives

BSE majors choose a focused 6 credits fundamental elective sequence, 9 credits of BSE electives, 3 credits of chemistry electives, 9 credits 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. 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.

Roadmap

Course	Title	Credits
First Year		
Fall Semester		
CHEM 1035	General Chemistry	3
CHEM 1045	General Chemistry Laboratory	1
ENGL 1105	First-Year Writing	3
MATH 1225	Calculus of a Single Variable (C-)	4
ENGE 1215	Foundations of Engineering (C-)	2
Pathways 2 or 3 or 6A or 7		3
	Credits	**16**
Spring Semester		
CHEM 1036	General Chemistry	3
ENGL 1106	First-Year Writing	3
MATH 1226	Calculus of a Single Variable	4
PHYS 2305	Foundations of Physics	4
ENGE 1216	Foundations of Engineering	2
	Credits	**16**
Second Year		
Fall Semester		
BSE 2004	Introduction to Biological Systems Engineering	3
BIOL 1105	Principles of Biology	3
MATH 2204	Introduction to Multivariable Calculus	3
MATH 2114	Introduction to Linear Algebra	3
ESM 2104	Statics	3

ISE 2014	Engineering Economy	2
	Credits	**17**
Spring Semester		
BSE 3144	Engineering Analysis for Biological Systems using Numerical Methods	2
BIOL 1106	Principles of Biology	3
Pathways Core Concept 2, 3, 6a, or 7		3
MATH 2214	Introduction to Differential Equations	3
PHYS 2306	Foundations of Physics	4
	Credits	**15**
Third Year		
Fall Semester		
BSE Fundamental Course or Technical Elective		3
BSE 3154	Thermodynamics of Biological Systems	3
ESM 3024	Introduction to Fluid Mechanics	3
STAT 3704	Statistics for Engineering Applications	2
CHEM Elective		3
Pathways Core Concept 2, 3, 6a, or 7		3
	Credits	**17**
Spring Semester		
BSE Fundamental Course or Technical Elective		3
BSE Fundamental Course		3
BSE 3504	Transport Processes in Biological Systems	3
BIOL 2604	General Microbiology	3
ISE 3034	Technical Communication for Engineers	3
	Credits	**15**
Fourth Year		
Fall Semester		
BSE 4125	Comprehensive Design Project	2
BSE Elective		3
BSE Elective		3
Engineering Topics Elective		3
Engineering Topics Elective		3
Pathways Core Concept 2, 3, 6a, or 7		3
	Credits	**17**
Spring Semester		
BSE 4126	Comprehensive Design Project	3
BSE Elective		3
Engineering Topics Elective		3
Technical Elective		3
Pathways Core Concept 2, 3, 6a, or 7		3
	Credits	**15**
	Total Credits	**128**