

COLLEGE OF ENGINEERING
DEPARTMENT OF BIOLOGICAL SYSTEMS ENGINEERING
BACHELOR OF SCIENCE IN BIOLOGICAL SYSTEMS ENGINEERING (BSBSE)
FOR STUDENTS GRADUATING IN CALENDAR YEAR 2020
128 CREDITS REQUIRED FOR GRADUATION

FIRST YEAR FALL SEMESTER 2016		Credits	FIRST YEAR SPRING SEMESTER 2017		Credits
CHEM 1035 General Chemistry Co: MATH 1025 or 1225		3	CHEM 1036 General Chemistry Pre: CHEM 1035 or 1055 or 1055H		3
CHEM 1045 General Chemistry Lab Co: CHEM 1035		1	ENGL 1106 First-Year Writing Pre: ENGL 1105		3
ENGL 1105 First-Year Writing		3	MATH 1226 Calculus of a Single Variable Pre: MATH 1225 (C-)		4
MATH 1225 Calculus of a Single Variable (C-) Pre: Math Ready		4	PHYS 2305 Foundations of Physics Co: PHYS 2325 or MATH 1206 or MATH 1206H or MATH 1226; Pre: MATH 1205 or MATH 1205H or MATH 1225 or MATH 1206 or MATH 1206H or MATH 1226		4
ENGE 1215 Foundations of Engineering (C-) Co: MATH 1225		2	ENGE 1216 Foundations of Engineering (C-) Pre: ENGE 1215 (C-)		2
CLE (Area 2, 3, or 7)		3			
TOTAL		16	TOTAL		16
SECOND YEAR FALL SEMESTER 2017		Credits	SECOND YEAR SPRING SEMESTER 2018		Credits
BIOL 1105 Principles of Biology - OR - BIOL 1205H Honors Biology		3 [F,S]	BIOL 1106 Principles of Biology - OR - BIOL 1206H Honors Biology		3 [S,SII]
MATH 2114 Introduction to Linear Algebra Pre: MATH 1225 (B) or MATH 1226		3	MATH 2214 Introduction to Differential Equations Pre: (MATH 1114 or 1114H or MATH 2114 or 2114H), (MATH 1206 or MATH 1226)		3
MATH 2204 Introduction to Multivariable Calculus Pre: MATH 1226		3	PHYS 2306 Foundations of Physics Pre: (MATH 1206 or MATH 1206H or MATH 1226), PHYS 2305		4
ESM 2104 Statics Co: MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H or MATH 2406H		3	ESM 2304 Dynamics Pre: 2104, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H) Co: MATH 2214		3
BSE 2004 Introduction to Biological Systems Engineering Pre: ENGE 1024 or ENGE 1215		2 [F,S]	BSE 3144 Engineering Analysis for Biological Systems using Numerical Methods Pre/Co: MATH 2214		2 [S]
CLE (Area 2, 3, or 7)		3			
TOTAL		17	TOTAL		15
THIRD YEAR FALL SEMESTER 2018		Credits	THIRD YEAR SPRING SEMESTER 2019		Credits
STAT 3704 Statistics for Engineering Applications Pre: MATH 2224 or MATH 2204 or MATH 2204H		2 [F,S,SII]	BIOL 2604 General Microbiology 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 CHEM 1016 or ISC 2105)		3 [F,S,SII]
ESM 3024 Introduction to Fluid Mechanics Pre: 2304, (MATH 2224 or MATH 2204 or MATH 2204H)		3 [F,W,SII]	BSE 3504 Transport Processes in Biological Systems Pre: 3154, ESM 3024		3 [S]
BSE 3134 Biological Systems Engineering Seminar Pre: BSE 2004		1 [F]	BSE Elective		3
BSE 3154 Thermodynamics of Biological Systems Pre: ESM 2304, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H); Pre/Co: Fluid Mechanics		3 [F]	BSE Elective: BSE 3334 Nonpoint Source Pollution Assessment and Control Pre: 3324 -OR- BSE 3524 Unit Operations in Biological Systems Engineering Co: 3504		3
Technical Elective		3	CLE (Area 2, 3, or 7)		3
CHEM Elective		3			
TOTAL		15	TOTAL		15
FOURTH YEAR FALL SEMESTER 2019		Credits	FOURTH YEAR SPRING SEMESTER 2020		Credits
ISE 2014 Engineering Economy Pre: ENGE 1024 or ENGE 1215 or BC 1224		2	BSE 4126 Comprehensive Design Project Pre: 4125		3 [S]
BSE 4125 Comprehensive Design Project Pre: 3334 or 3524		2 [F]	BSE Elective		3
BSE Elective		3	Engineering Topics Elective		3
Engineering Topics Elective		3	Engineering Topics Elective		3
Technical Elective		3	Technical Elective		2
CLE (Area 2, 3, or 7)		3	CLE (Area 2, 3, or 7)		3
CLE (Area 6)		1			
TOTAL		17	TOTAL		17

General Information about Checksheet: Superscripted annotation [F,S,SI,SII] in Credits column indicates that a course is known to be offered in terms other than when shown. Course offerings are subject to change and the availability of sufficient resources. Students should confirm course offerings in advance with their department

Curriculum for Liberal Education (CLE)

Consult the CLE Alphabetical Listing at: <http://www.cle.prov.vt.edu/guides/alpha.html>, CLE courses need to be completed prior to graduation

CLE Area 1: Writing and Discourse (6 hrs)	ENGL 1105	(3)	ENGL 1106	(3)
CLE Area 2: Ideas, Cultural Traditions, Values (6 hrs)		(3)		(3)
CLE Area 3: Society & Human Behavior (6 hrs)		(3)		(3)
CLE Area 4: Scientific Reasoning and Discovery (8 hrs)	PHYS 2305	(4)	PHYS 2306	(4)
CLE Area 5: Quantitative and Symbolic Reasoning (8 hrs)	MATH 1225	(4)	MATH 1226	(4)
CLE Area 6: Creativity & Aesthetic Experience (1 hr)				(1)
CLE Area 7: Global Issues (3 hrs)				(3)

If a CLE course is double-counted to satisfy two different CLE areas, a free elective(s) must be taken to maintain a minimum of 128 credits.

Electives: BSE majors must take 12 hours of BSE electives, 3 hours of chemistry electives, 9 hours of engineering topics electives, and 8 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.engr.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);
- Be registered for at least one BSE-prefix course per semester, excluding BSE 2094, 2294, 2484, and 4994; and,
- Repeat no BSE course required in the major more than twice, including attempts ending in course withdrawal.

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
2020 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 4304 Nonpoint Source Pollution Modeling and Management
BSE 3324 Small Watershed Hydrology	BSE 4344 Geographic Information Systems for Engineers
BSE 3334 Nonpoint Source Pollution Assessment and Control	BSE 4524 Biological Process Plant Design
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

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	ENGR 3124 Introduction to Green Engineering
BMES 3124 Introduction to Biomechanics	ENGR 4134 Environmental Life Cycle Assessment
BMES 3134 Introduction to Biomedical Imaging	ESM 3054/MSE 3054 Mechanical Behavior of Materials
CEE 3104 Introduction to Environmental Engineering*	ESM 3064/MSE 3064 Mechanical Behavior of Materials Laboratory
CEE 4104 Water and Wastewater Treatment Design	ESM 4044 Mechanics of Composite Materials
CEE 4114 Fundamentals of Public Health Engineering*	ESM 4105-4106 Engineering Analysis of Physiologic Systems
CEE 4134 Environmental Sustainability - A Systems Approach*	ESM 4114 Nonlinear Dynamics and Chaos
CEE 4144 Air Resources Engineering*	ESM 4204 Musculoskeletal Biomechanics
CEE 4174 Solid and Hazardous Waste Management*	ISE 2204 Manufacturing Processes
CEE 4254 Municipal Engineering*	ISE 2214 Manufacturing Processes Laboratory
CEE 4264 Sustainable Land Development*	ISE 2404 Deterministic Operations Research I
CEE 4314 Groundwater Resources*	ISE 4654 Principles of Industrial Hygiene
CEE 4324 Open Channel Flow*	ISE 4015 Management Systems Theory, Applications, and Design
CEE 4334 Hydraulic Structures*	MSE 2034 Elements of Materials Engineering
CEE 4344 Water Resources Planning*	MSE 2044 Fundamentals of Materials Engineering
ECE 3054 Electrical Theory	MSE 2054 Fundamentals of Materials Science
ECE 4194 Engineering Principles of Remote Sensing	MSE 3304 Physical Metallurgy
ECE 4364 Alternate Energy Systems	MSE 4574 Biomaterials
ENGE 2514 Introduction to Engineering Computation and Control with LabVIEW	MSE 4584 Biomimetic Materials
ESM 2204 Mechanics of Deformable Bodies	MSE 4604 Composite Materials

*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 (8 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
 ALS 3404 Ecological Agriculture: Theory and Practice
 ALS 4614/NR 4614 Watershed Assessment, Management, and Policy
 BCHM 3114 Biochemistry for Biotechnology and the Life Sciences
 BCHM 4115-4116 General Biochemistry
 BIOL 4164/CSES 4164/ENSC 4164 Environmental Microbiology
 BMES 4064/BMVS 4064 Introduction to Medical Physiology
 BSE 4394 Water Supply and Sanitation in Developing Countries
 CS 1044 Introduction to Programming in C
 CS 1054 Introduction to Programming in Java
 CS 1064 Introduction to Programming in Python
 CSES 3114/ENSC 3114/GEOS 3614 Soils
 CSES 3124/ENSC 3124/GEOS 3624 Soils Laboratory
 CSES 3304/GEOS 3304/GEOS 3304 Geomorphology
 CSES 3444/HORT 3444 World Crops and Cropping Systems
 CSES 3614/ENSC 3614 Soil Physical and Hydrological Properties
 CSES 3634/ENSC 3634 Physics of Pollution
 CSES 3644/ENSC 3644 Plant Materials for Environmental Restoration
 CSES 4444/ENSC 4444 Managed Ecosystems, Ecosystem Services, and Sustainability
 CSES 4644 Land-based Systems for Waste Treatment
 CSES 4764/ENSC 4764 Bioremediation
 CSES 4774/ENSC 4774 Reclamation of Drastically Disturbed Lands
 CSES 4854/ENSC 4854 Wetland Soils and Mitigation
 ECE 2164/AOE 2164 Exploration of the Space Environment
 ENGR 1814 Energy, Resource Development, and the Environment
 ENGR 2164/COS 2164 Introduction to Scieneering
 ENSC 3604 Fundamentals of Environmental Science

ENSC 4414 Monitoring and Analysis of the Environment
 ESM 4194/ME 4194 Sustainable Energy Solutions for a Global Society
 FIW/FREC 4324 Genetics of Natural and Managed Populations
 FIW 4614 Fish Ecology
 FIW 4624 Marine Ecology
 FREC 4374 Forested Wetlands
 FST 3024: Principles of Sensory Evaluation
 FST 3124 Brewing Science and Technology
 FST 3604/BIOL 3604 Food Microbiology
 FST 4504 Food Chemistry
 GEOG 1514 Introduction to Meteorology
 GEOG 3104 Environmental Problems, Population, and Development
 GEOG 4354/GEOS 4354 Introduction to Remote Sensing
 GEOS 2104 Elements of Geology
 GEOS 3014 Environmental Geosciences
 GEOS 3034 Oceanography
 GEOS 4804 Groundwater Hydrology
 ISE 4004 Theory of Organization
 ISE 4304 Global Issues in Industrial Management
 LAR 3044 Land Analysis and Site Planning
 MINE 2504 Introduction to Mining Engineering
 SBIO 2124 Structure and Properties of Sustainable Biomaterials
 SBIO 3114 Biodeterioration, Bioconversion and Bioenergy
 SBIO 3434 Chemistry and Conversion of Sustainable Biomaterials
 SBIO 3444 Sustainable Biomaterials and Bioenergy
 SYSB 2025-2016 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