

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 <i>Pre: None</i> | | 3 | CHEM 1036 General Chemistry <i>Pre: CHEM 1035</i> | | 3 |
| CHEM 1045 General Chemistry Lab <i>Co: CHEM 1035</i> | | 1 | ENGL 1106 First-Year Writing <i>Pre: ENGL 1105</i> | | 3 |
| ENGL 1105 First-Year Writing <i>Pre: None</i> | | 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 Found of Physics I w/lab <i>Pre: MATH 1225; Co: MATH 1226</i> | | 4 |
| ENGE 1215 Foundations of Engineering (C-) <i>Co: MATH 1225</i> | | 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,I] | BIOL 1106 Principles of Biology - OR - BIOL 1206H Honors Biology | | 3 [S,SII] |
| MATH 2114 Introduction to Linear Algebra <i>Pre: MATH 1225 (B) or MATH 1226</i> | | 3 | MATH 2214 Intro Differential Equations <i>Pre: MATH 1226, MATH 2114</i> | | 3 |
| MATH 2204 Intro Multivariable Calculus <i>Pre: MATH 1226</i> | | 3 | PHYS 2306 Foundations of Physics I w/lab <i>Pre: MATH 1226, PHYS 2305</i> | | 4 |
| ESM 2104 Statics <i>Co: MATH 2204</i> | | 3 | ESM 2304 Dynamics <i>Pre: ESM 2104, (MATH 2204 or MATH 2224); Co: MATH 2214</i> | | 3 |
| BSE 2004 Introduction to BSE <i>Pre: ENGE 1215</i> | | 2 [F,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 <i>MATH 2224 or MATH 2204 or MATH 2204H</i> | | 2 [F,S,SII] | BIOL 2604 General Microbiology <i>Pre: BIOL 1105, 1106, CHEM 1036</i> | | 3 [F,S,SII] |
| ESM 3024 Intro to Fluid Mechanics <i>Pre: ESM 2304, (MATH 2204 or MATH 2224)</i> | | 3 [F,W,SII] | BSE 3504 Transport Processes in BSE <i>Pre: 3154, ESM 3024</i> | | 3 [S] |
| BSE 3134 BSE Seminar <i>Pre: BSE 2004</i> | | 1 [F] | BSE Elective: BSE 3334 NPS Pollution Assessment and Control <i>Pre: 3324 or BSE 3524 Unit Operations in BSE Co: 3504</i> | | 3 |
| BSE 3154 Thermodynamics of Biol Systems <i>Pre: ESM 2304, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H); Pre/Co: Fluid Mechanics</i> | | 3 [F] | BSE Elective | | 3 |
| Technical Elective | | 3 | | | |
| CHEM Elective | | 3 | | | |
| TOTAL | | 15 | TOTAL | | 15 |
| FOURTH YEAR FALL SEMESTER 2019 | | Credits | FOURTH YEAR SPRING SEMESTER 2020 | | Credits |
| ISE 2014 Engineering Economy <i>Pre: ENGE 1215</i> | | 2 | BSE 4126 Comprehensive Design Project <i>Pre: 4125</i> | | 3 [S] |
| BSE 4125 Comprehensive Design Project <i>Pre: 3334 or 3524</i> | | 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 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 132 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.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);
- 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 3324 Small Watershed Hydrology
BSE 3334 NPS Pollution Assessment and Control
BSE 3524 Unit Operations in BSE
BSE 3534 Bioprocess Engineering
BSE 4224 Field Methods in Hydrology

BSE 4304 NPS Pollution Modeling and Management
BSE 4344 Geographic Information Systems for Engineers
BSE 4524 Biological Process Plant Design
BSE 4544 Protein Separation Engineering
BSE 4564 Metabolic Engineering
BSE 4604 Food Process Engineering

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

BCHM 2024 Concepts of Biochemistry
CHEM 2114 Analytical Chemistry
CHEM 2124 Analytical Chemistry Lab
CHEM 2514 Survey of Organic Chemistry
CHEM 2535-2536 Organic Chemistry
CHEM 2565-2566 Principles of Organic Chemistry

CHEM 3615 Physical Chemistry
CHEM 4615 Physical Chemistry for the Life Sciences
CSES 4314 Water Quality
CSES 4734 Environmental Soil Chemistry
GEOS 4634 Environmental Geochemistry

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 Intro to Biomedical Engineering
CEE 3104 Intro to Environmental Engineering*
CEE 4114 Fundamentals of Public Health Engineering*
CEE 4134 Sustainable Systems*
CEE 4144 Air Resources Engineering*
CEE 4154 Indoor Environmental Quality and Sustainable Facilities*
CEE 4174 Solid and Hazardous Waste Management*
CEE 4254 Municipal Engineering*
CEE 4264 Sustainable Land Development*
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
ENGE 2514 Intro to Engineering Computation and Control with Labview
ESM 2204 Mechanics of Deformable Bodies
ENGR 3124 Intro to Green Engineering

ENGR 4134 Environmental Life Cycle Assessment
ESM 3054/MSE 3054 Mechanical Behavior of Materials
ESM 3064/MSE 3064 Mechanical Behavior of Materials
ESM 4044 Mechanics of Composite Materials
ESM 4105-4106 Engineering Analysis of Physiologic Systems
ESM 4114 Nonlinear Dynamics and Chaos
ESM 4204 Musculoskeletal Biomechanics
ISE 2204 Manufacturing Processes
ISE 2214 Manufacturing Processes Lab
ISE 2404 Deterministic Operations Research I
ISE 4654 Principles of Industrial Hygiene
ISE 4015 Management Systems Theory, Applications, and Design
MSE 2034 Elements of Materials Engineering
MSE 2044 Fundamentals of Materials Engineering
MSE 2054 Fundamentals of Materials Science
MSE 3304 Physical Metallurgy
MSE 4574 Biomaterials
MSE 4584 Biomimetic Materials
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 Lab and all CHEM 2000, 3000, and 4000 level courses except 4014.
- All MATH 3000 and 4000 level courses except 4044,4625,4626,4644,4654,4664,4754,4964,4974, 4984,4994

AAEC 3314 Environmental Law

ALS 3404 Ecological Agriculture: Theory and Practice

ALS 4614 Watershed Assessment, Management, and Policy

BCHM 3114 Biochemistry for Biotech and Life Sciences

BCHM 4115-4116 General Biochemistry

BIOL 4164/CSES 4164/ENSC 4164 Environmental Microbiology

BMES 4064 Intro to Medical Physiology

BSE 4394 Water Supply and Sanitation in Developing Countries

CS 1044 Intro to Programming in C

CS 1054 Intro to Programming in Java

CS 1064 Intro to Programming in Python

CSES 3114/ENSC 3114/GEOS 3614 Soils

CSES 3124/ENSC 3124/GEOS 3624 Soils Lab

CSES 3304/GEOG 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 4594 Soil and Groundwater Pollution*

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 Exploration of the Space Environment

ENGR 1814 Energy, Resource Development, and the Environment

ENGR 2164/COS 2164 Intro 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/FOR 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 3104 Environmental Problems, Population, and Development

GEOG 1514/GEOS 1514 Intro to Meteorology

GEOG 4314 Spatial Analysis in Geographic Information Systems

GEOG 4354/GEOS 4354 Intro 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

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