<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Pre/Co-Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1035</td>
<td>General Chemistry</td>
<td>3</td>
<td>Pre: CHEM 1035 or CHEM 1055H</td>
</tr>
<tr>
<td>ENGL 1105</td>
<td>General Chemistry Lab Co: CHEM 1035</td>
<td>1</td>
<td>Pre: ENGL 1106 First-Year Writing</td>
</tr>
<tr>
<td>ENGL 1105</td>
<td>First-Year Writing</td>
<td>3</td>
<td>Pre: MATH 1225 (C-)</td>
</tr>
<tr>
<td>MATH 1225</td>
<td>Calculus of a Single Variable Pre: MATH 1225 (C-)</td>
<td>4</td>
<td></td>
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<tr>
<td>ENGE 1215</td>
<td>Foundations of Engineering Pre: ENGE 1215 (C-)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CLE (Area 2, 3, or 7)</td>
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<td>3</td>
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</tbody>
</table>

**TOTAL Credits: 16**

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>MATH 2204</td>
<td>Introduction to Multivariable Calculus Pre: MATH 1225</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ESM 2104</td>
<td>Statics MATH 2204 or MATH 2204H or MATH 2406H</td>
<td>3</td>
<td>Pre: MATH 1226, MATH 2214</td>
</tr>
<tr>
<td>BSE 2004</td>
<td>Introduction to Biological Systems Engineering Pre: ENGE 1215 or ENGE 1414</td>
<td>2</td>
<td>Pre: MATH 2224</td>
</tr>
<tr>
<td>CLE (Area 2, 3, or 7)</td>
<td></td>
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</tbody>
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**TOTAL Credits: 17**

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</tr>
</thead>
<tbody>
<tr>
<td>STAT 3704</td>
<td>Statistics for Engineering Applications Pre: MATH 2204 or MATH 2204H</td>
<td>2</td>
<td>Pre: MATH 2204</td>
</tr>
<tr>
<td>ESM 3024</td>
<td>Introduction to Fluid Mechanics Pre: ESM 2304, MATH 2204 or MATH 2204H</td>
<td>3</td>
<td>Pre: MATH 2204</td>
</tr>
<tr>
<td>BSE 3134</td>
<td>Biological Systems Engineering Seminar Pre: BSE 2004</td>
<td>1</td>
<td>Pre: MATH 2204</td>
</tr>
<tr>
<td>BSE 3154</td>
<td>Thermodynamics of Biological Systems Pre: ESM 2304, MATH 2204 or MATH 2204H; Pre: Co: Fluid Mechanics</td>
<td>3</td>
<td>Pre: MATH 2204</td>
</tr>
<tr>
<td>BSE –OR-</td>
<td>Technical Elective: Students must choose BSE 3324 Small Watershed Hydrology if planning to take BSE 3334 Nonpoint Source Pollution Assessment and Control</td>
<td>3</td>
<td>Pre: MATH 2204</td>
</tr>
<tr>
<td>CHEM Elective</td>
<td></td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL Credits: 15**

<table>
<thead>
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<th>Pre/Co-Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISE 2014</td>
<td>Engineering Economy Pre: ENGE 1215</td>
<td>2</td>
<td>Pre: ENGE 1215</td>
</tr>
<tr>
<td>BSE 4125</td>
<td>Comprehensive Design Project Pre: 3334 or (Pre: 3524 and Co: 4524)</td>
<td>2</td>
<td>Pre: BSE 4125</td>
</tr>
<tr>
<td>BSE Elective: Students must choose BSE 4524 if they complete BSE 3524</td>
<td></td>
<td>3</td>
<td>Pre: BSE 4125</td>
</tr>
<tr>
<td>Engineering Topics Elective</td>
<td></td>
<td>3</td>
<td>Pre: BSE 4125</td>
</tr>
<tr>
<td>Technical Elective</td>
<td></td>
<td>3</td>
<td>Pre: BSE 4125</td>
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<tr>
<td>CLE (Area 2, 3, or 7)</td>
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<td>3</td>
<td>Pre: BSE 4125</td>
</tr>
</tbody>
</table>

**TOTAL Credits: 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](http://www.cle.prov.vt.edu/guides/alpha.html), CLE courses need to be completed prior to graduation.

<table>
<thead>
<tr>
<th>CLE Area</th>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area 1: Writing and Discourse (6 hrs)</td>
<td>ENGL 1105</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>ENGL 1106</td>
<td>(3)</td>
</tr>
<tr>
<td>Area 2: Ideas, Cultural Traditions, Values (6 hrs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td>Area 3: Society &amp; Human Behavior (6 hrs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td>Area 4: Scientific Reasoning and Discovery (8 hrs)</td>
<td>PHYS 2305</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>PHYS 2306</td>
<td>(4)</td>
</tr>
<tr>
<td>Area 5: Quantitative and Symbolic Reasoning (8 hrs)</td>
<td>MATH 1225</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>MATH 1226</td>
<td>(4)</td>
</tr>
<tr>
<td>Area 6: Creativity &amp; Aesthetic Experience (1 hr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Area 7: Global Issues (3 hrs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3)</td>
</tr>
</tbody>
</table>

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](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](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.
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 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 Nonpoint Source Pollution Assessment and Control
- BSE 3524 Unit Operations in Biological Systems Engineering
- BSE 3534 Bioprocess Engineering
- BSE 4224 Field Methods in Hydrology
- BSE 4304 Nonpoint Source Pollution Modeling and Management
- BSE 4344 Geographic Information Systems for Engineers
- BSE 4524 Biological Process Plant Design
- BSE 4544 CHEM 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 Laboratory Techniques and Practice
- 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/ENSC 4314 Water Quality
- CSES 4734/ENSC 4734 Environmental Soil 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
- BMES 3124 Introduction to Biomechanics
- BMES 3134 Introduction to Biomedical Imaging
- CEE 3104 Introduction to Environmental Engineering*
- CEE 4104 Water and Wastewater Treatment Design
- CEE 4114 Fundamentals of Public Health Engineering*
- CEE 4134 Environmental Sustainability - A Systems Approach*
- CEE 4144 Air Resources Engineering*
- 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*
- CEE 3054 Electrical Theory
- CEE 4194 Engineering Principles of Remote Sensing
- CEE 4364 Alternate Energy Systems
- ENGE 2514 Introduction to Engineering Computation and Control with LabVIEW
- ENGR 3124 Introduction to Green Engineering

* 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 Laboratory
CS 3304/GEOG 3304/GEOS 3304  Geomorphology
CS 3444/HORT 3444  World Crops and Cropping Systems
CS 3614/ENSC 3614  Soil Physical and Hydrological Properties
CS 3634/ENSC 3634  Physics of Pollution
CS 3644/ENSC 3644  Plant Materials for Environmental Restoration
CS 4444/ENSC 4444  Managed Ecosystems, Ecosystem Services, and Sustainability
CS 4644  Land-based Systems for Waste Treatment
CS 4764/ENSC 4764  Bioremediation
CS 4774/ENSC 4774  Reclamation of Drastically Disturbed Lands
CS 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 Scieneeering
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 3604  Climate Science
FREC 4374  Forested Wetlands
FREC 4464  Water Resource Policy & Economics
FREC 4784  Wetland Hydrology & Biogeochemistry
FST 3024  Principles of Sensory Evaluation
FST 3114  Wines & Vines
FST 3124  Brewing Science and Technology
FST 3514  Food Analysis
FST 3604/BIOL 3604  Food Microbiology
FST 4104  Applied Malting and Brewing Science
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 3434  Chemistry and Conversion of Sustainable Biomaterials
SBIO 3444  Sustainable Biomaterials and Bioenergy
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