<table>
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<tr>
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<th>FALL 2018</th>
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<tbody>
<tr>
<td>CHEM 1035</td>
<td>3</td>
<td>General Chemistry Co: MATH 1225</td>
<td>ENGL 1106 First-Year Writing Pre: ENGL 1105</td>
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<tr>
<td>CHEM 1045</td>
<td>1</td>
<td>General Chemistry Lab Co: CHEM 1035</td>
<td>MATH 1226 Calculus of a Single Variable Pre: MATH 1225</td>
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<td>ENGL 1105</td>
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<td>First-Year Writing Pre: ENGL 1105</td>
<td>PHYS 2305 Found of Physics I w/lab Pre: MATH 1225; Co: MATH 1226</td>
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<tr>
<td>MATH 1225</td>
<td>4</td>
<td>Calculus of a Single Variable Pre: Math Ready</td>
<td>ENGE 1216 Foundations of Engineering (C-) Pre: ENGE 1215</td>
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<td>ENGE 1215</td>
<td>2</td>
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<td>MATH 1114 Elementary Linear Algebra</td>
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<tr>
<td>MATH 2204</td>
<td>3</td>
<td>Intro Multivariable Calculus Pre: MATH 1226</td>
<td>CHEM 1036 General Chemistry Pre: CHEM 1035</td>
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<tr>
<td>PHYS 2306</td>
<td>4</td>
<td>Foundations of Physics I w/lab Pre: MATH 1226, PHYS 2305</td>
<td>MATH 2214 Intro Diff Equations Pre: (1114 or 2114 or 2114H or 2405H), 1226</td>
<td>3</td>
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<tr>
<td>ESM 2104</td>
<td>3</td>
<td>Statics Pre: MATH 1226 Co: MATH 2204 or MATH 2204H or MATH 2224 or MATH 2406H</td>
<td>ESM 2204 Mechanics of Deformable Bodies Pre: (2104 or 2114), (MATH 2224 or MATH 2204 or MATH 2404H)</td>
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<td>ISE 2214</td>
<td>1</td>
<td>Manufacturing Processes Lab</td>
<td>MSE 2054 Fund of Materials Science Pre: 2044</td>
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<tr>
<td>MSE 2044</td>
<td>4</td>
<td>Fund of Materials Eng (C) Pre: CHEM 1035, Co: PHYS 2305</td>
<td>MSE 2114 Math Programming MSE I Pre: 2044</td>
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<tr>
<td>MSE 2884</td>
<td>1</td>
<td>Mats Engr Professional Dev I</td>
<td>MSE 3314 Materials Lab I Pre: 2044</td>
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<tr>
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<tbody>
<tr>
<td>ECON 2005</td>
<td>3</td>
<td>Principles of Economics (Pathway 3)</td>
<td>MSE 3044 Transport Phenomena MSE Pre: 2044, MATH 2214</td>
<td>3[S]</td>
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<tr>
<td>MSE 3114</td>
<td>1[S]</td>
<td>Math Programming MSE II Pre: 2114</td>
<td>MSE 3054 (ESM 3054) Mech Behavior of Materials Pre: ESM 2204, (MSE 2034 or MSE 2044 or MSE 3094 or AOE 3094 or CEE 3684)</td>
<td>3[S]</td>
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<tr>
<td>MSE 3134</td>
<td>3[S]</td>
<td>Crystallography and Crystal Structures Pre: 2044 (C)</td>
<td>MSE 3064 (ESM 3064) Mech Behavior Mats Lab Co: 3054</td>
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<tr>
<td>MSE 4034</td>
<td>3[S]</td>
<td>Thermo of Materials Pre: 2044; Co:CHEM 1036</td>
<td>MSE 3884 Mats Engr Professional Dev II Pre: junior standing, 2884</td>
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<tr>
<td>MSE 4424</td>
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<td>Materials Lab II Pre: 2044</td>
<td>MSE 4644 Materials Design Experiments Pre: 3314 or 4424</td>
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<td>Physical</td>
<td>3</td>
<td>Materials Course</td>
<td>Physical Materials Course</td>
<td>3</td>
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<td>Materials</td>
<td>3</td>
<td>Course</td>
<td>Pathways Concept (1A)</td>
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<th>FALL 2021</th>
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<th>SPRING 2022</th>
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<tbody>
<tr>
<td>MSE 4055</td>
<td>3[S]</td>
<td>Materials Selection &amp; Design Pre: 3044, 3054, 2 of (3204,3304,4414,4554)</td>
<td>MSE 4076 Senior Design Laboratory Pre: 4075 Co: 4086,</td>
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<tr>
<td>MSE 4075</td>
<td>1[S]</td>
<td>Senior Design Laboratory Pre: 4644 Co: 4055, 4085</td>
<td>MSE 4086 Senior Design Recitation Pre: 4085 Co: 4076 or 4096H</td>
<td>1[S]</td>
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<tr>
<td>MSE 4085</td>
<td>2[S]</td>
<td>Senior Design Recitation Pre: senior standing, 3884 Co: 4075 or 4095H</td>
<td>Physical Materials Course</td>
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<tr>
<td>Technical</td>
<td>3</td>
<td>Elective from list</td>
<td>Technical Elective from list</td>
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<tr>
<td>Elective</td>
<td>3</td>
<td>from list</td>
<td>Pathways Concept (2, 3, 6a, or 7)</td>
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<td>Pathways</td>
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<td>Concept (2, 3, 6a, or 7)</td>
<td>Pathways Concept (2, 3, 6a, or 7)</td>
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</table>
General Information about checksheet: Superscripted annotation [F,S,SI,SII] in Credits column indicate 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. Color-coding key: Core, Pathways, Major.

<table>
<thead>
<tr>
<th>Pathways to General Education (Pathways)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consult the pathways courses table: <a href="https://www.pathways.prov.vt.edu/about/table.html">https://www.pathways.prov.vt.edu/about/table.html</a></td>
<td>Pathways courses need to be completed prior to graduation.</td>
</tr>
</tbody>
</table>

### Pathways Concept 1:
- Discourse (6 hrs foundational, 3 hrs advanced)  
  - Foundational: ENGL 1105 (3)  
  - Foundational: ENGL 1106 (3)  
  - Advanced: (3)

### Pathways Concept 2:
- Critical Thinking in the Humanities (6 hrs)  
  - ECON 2005 (3)  
  - (3)

### Pathways Concept 3:
- Reasoning in the Social Sciences (6 hrs)  
  - PHYS 2305 (4)  
  - PHYS 2306 (4)

### Pathways Concept 4:
- Reasoning in the Natural Sciences (8 hrs)  
  - Foundational: MATH 1225 (4)  
  - Foundational: MATH 1226 (4)  
  - Advanced: MATH 2214 (3)

### Pathways Concept 5:
- Quantitative and Computational Thinking (11 hrs)  
  - Arts: (3)  
  - Design: ENGE 1215 + ENGE 1216 (4)

### Pathways Concept 6:
- Critique and Practice in Design and the Arts (7 hrs)  
  - (3)

### Pathways Concept 7*:
- Critical Analysis of Identity & Equity in the US (3 hrs)  
  - *Pathways Concept 7 should be double counted with either Pathways Concept 2, 3 or 6a to avoid taking any additional credit hours.

**Electives:** The MSE degree requires 9 credits technical electives from list. Technical Electives must be taken for a grade (Pass/Fail is not acceptable).

**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 MSE Department fully supports this policy. Specific expectations for satisfactory progress for Materials Science and Engineering 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](http://www.undergradcatalog.registrar.vt.edu/1617/academic-policies.html#22))
- Maintain an in-major GPA of 2.0 or better and an overall GPA of 2.0 or better. (In-major GPA is calculated using all courses taken under the MSE designator)
- Students may not earn a semester GPA less than 2.0 in any 2 consecutive semesters
- Students must complete a minimum of 9 credits per semester satisfying the MSE checksheet,
- A grade of C or better in MSE 2044 is required as a prerequisite for all MSE courses, and
- Students are allowed to take MSE 2044 a maximum of two times in their attempt to achieve a grade of C or better.

**Statement of Hidden Prerequisites:** Prerequisites 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 prerequisite course. There are no hidden prerequisites in the program of study. Prerequisites may change from what is indicated. Be sure to consult the timetable for the most current prerequisites.

**Graduation Requirements:** Each student must complete at least 125 semester credit hours with a minimum overall GPA of 2.00 and a minimum in-major GPA of 2.00. In-major GPA is calculated using all courses taken under the MSE designator.

**Additional Checksheet Comments:**
1. Programming elective: The following may be substituted for 2114/3114 pair: CS 1044, Intro Prog in C (3c), CS 1064, Intro to Prog in Python (3c), CS 1114, Intro Software Design (3cr); AOE 2074 Comp Methods (2c); BIT 2405, Quant Methods (3c); ECE 1574 Engr Prob Solv C++ (3c), ENGE 2514 Intro Engr Labview (2c).
2. Honors students may substitute MSE 4095H/4096H Honors Senior Project Lab for MSE 4075/4076.
3. Physical Materials Courses:
   - MSE 3204F,S Fund Electronic Materials Pre: 2054, PHYS 2306
   - MSE 3304F,S Physical Metallurgy Pre: 2044 (C)
   - MSE 4414F,S Physical Ceramics Pre: 2044 (C)
   - MSE 4554F,S Polymer Engineering Pre: 2044 (C)
4. MATH 2114 Linear Algebra (3c) may be substituted for MATH 1114 Linear Algebra (2c)
5. Students interested in focusing in the area of polymers are strongly encouraged to take CHEM 1036 Freshman Spring semester and to speak with the MSE undergraduate advisor.
Elective Requirements Effective for Students Graduating in Calendar Year 2022

TECHNICAL ELECTIVES: Twelve (9) credits are required from the list below [1,2]. A minimum of 6 credits must be taken from group 1 and the balance may be taken from group 2. All 9 credits may be satisfied from group 1. Courses must be taken for a grade (Pass/Fail not acceptable). Other courses not listed may be counted with special approval; initiate requests through the MSE Undergraduate Academic Advisor.

**Group 1: Materials Specific Courses (Must choose a minimum of 6 credits) [3,4,5]**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIOL 2124</td>
<td>Cell &amp; Mol Biol For Engineers</td>
<td>MSE 4044</td>
</tr>
<tr>
<td>BSE 3494</td>
<td>Advanced Welding Technology</td>
<td>MSE 4164</td>
</tr>
<tr>
<td>CHEM 2154</td>
<td>Majors Analytical Chemistry</td>
<td>MSE 4234</td>
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<tr>
<td>CHEM 2535</td>
<td>Organic Chemistry</td>
<td>MSE 4304</td>
</tr>
<tr>
<td>CHEM 2536</td>
<td>Organic Chemistry</td>
<td>MSE 4305</td>
</tr>
<tr>
<td>CHEM 2555</td>
<td>Organic Synthesis and Techniques Lab</td>
<td>MSE 4306</td>
</tr>
<tr>
<td>CHEM 2565</td>
<td>Principles Org Chem</td>
<td>MSE 4384</td>
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<td>CHEM 3615</td>
<td>Physical Chemistry</td>
<td>MSE 4574</td>
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<tr>
<td>CHEM 4534</td>
<td>Organic Chemistry of Polymers</td>
<td>MSE 4614</td>
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<tr>
<td>CHEM 4615</td>
<td>Physical Chemistry for Life Sciences</td>
<td>MSE 5024</td>
</tr>
<tr>
<td>CHEM 4634</td>
<td>Polymer and Surface Chemistry</td>
<td>MSE 5124</td>
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<tr>
<td>CHEM 4994</td>
<td>Undergraduate Research In CHEM</td>
<td>NANO 3015</td>
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<tr>
<td>ECE 3054</td>
<td>Electrical Theory</td>
<td>NANO 3016</td>
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<tr>
<td>ECE 3254</td>
<td>Industrial Electronics</td>
<td>NSEG 3145</td>
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<td>ENGR 3124</td>
<td>Green Engineering</td>
<td>NSEG 3146</td>
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<td>ENGR 4134</td>
<td>Environmental Life Cycle Assessment</td>
<td>PHYS 3324</td>
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<tr>
<td>ESM 2304</td>
<td>Dynamics</td>
<td>PHYS 3355</td>
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<tr>
<td>ESM 4024</td>
<td>Advanced Mechanical Behavior of Materials</td>
<td>PHYS 3405</td>
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<tr>
<td>ESM 4044</td>
<td>Mechanics Composite Materials</td>
<td>PHYS 4574</td>
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<tr>
<td>ESM 4105</td>
<td>Engineering Analysis of Physiologic Systems</td>
<td>PHYS 4714</td>
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<tr>
<td>ESM 4106</td>
<td>Engineering Analysis of Physiologic Systems</td>
<td>SBIO 3444</td>
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<td>GEOS 4634</td>
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<td>STAT 3704</td>
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<td>MSE 5xxx</td>
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**Group 2: Materials Non-Specific Courses [4,5]**

<table>
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<th>Course Name</th>
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<tbody>
<tr>
<td>BMES 2104</td>
<td>Intro Biomedical Engineering</td>
<td>MATH 4564</td>
</tr>
<tr>
<td>BMES 4064</td>
<td>Intro to Med Physiology</td>
<td>MATH 4574</td>
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<tr>
<td>CEE 3104</td>
<td>Intro Environ Engr</td>
<td>ME 3514</td>
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<tr>
<td>CEE 3604</td>
<td>Intro Transport Engr</td>
<td>ME 4194</td>
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<tr>
<td>CHE 4144</td>
<td>Bus &amp; Mkgt For Proc Industries</td>
<td>ME 4994</td>
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<tr>
<td>CHEM 2545</td>
<td>Organic Chemistry Laboratory</td>
<td>NSEG 4204</td>
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<tr>
<td>CHEM 4114</td>
<td>Instrumental Analysis</td>
<td>PHYS 3655</td>
</tr>
<tr>
<td>CS 3824</td>
<td>Intro Comp Bio Bioinformatics</td>
<td>PHYS 3656</td>
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<td>ESM 3154</td>
<td>Solid Mechanics</td>
<td>PHYS 3704</td>
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<tr>
<td>ESM 3234</td>
<td>Fluid Mech I Control Volumes</td>
<td>SBIO 3434</td>
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<tr>
<td>ESM 3334</td>
<td>Fluid Mech II Diff Analysis</td>
<td>GEOS 3504 / MSE 3104</td>
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<tr>
<td>MATH 3214</td>
<td>Calculus of Several Variables</td>
<td>ISE 2204</td>
</tr>
<tr>
<td>MATH 4445</td>
<td>Intro to Numer Analysis</td>
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</table>

[1] Technical elective credit may be earned in study abroad opportunities. Please see your MSE undergraduate academic advisor.
[2] 4974 + 4994 total credit hours limited to a maximum of 6 without prior approval.
[3] MSE 3094 / AOE 3094 may not be taken as a technical elective.
[4] Check the timetable for prerequisite requirements.
[5] Not all courses are 3 credits. Check the course catalog for corresponding credit hours.