

COLLEGE OF ENGINEERING  
DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

**BACHELOR OF SCIENCE IN MATERIALS SCIENCE AND ENGINEERING**

FOR STUDENTS GRADUATING IN CALENDAR YEAR 2022 AND FOR STUDENT DATE OF ENTRY UNDER UG CATALOG 2020-2021

125 CREDITS REQUIRED FOR GRADUATION

FALL 2018		Credits	SPRING 2019		Credits
CHEM 1035 General Chemistry Co: MATH 1225		3	ENGL 1106 First-Year Writing Pre: ENGL 1105		3
CHEM 1045 General Chemistry Lab Co: CHEM 1035		1	MATH 1226 Calculus of a Single Variable Pre: MATH 1225		4
ENGL 1105 First-Year Writing		3	PHYS 2305 Found of Physics I w/lab Pre: MATH 1225; Co: MATH 1226		4
MATH 1225 Calculus of a Single Variable (C-) Pre: Math Ready		4	ENGE 1216 Foundations of Engineering (C-) Pre: ENGE 1215		2
ENGE 1215 Foundations of Engineering (C-)		2	MATH 1114 Elementary Linear Algebra		2
	<b>TOTAL</b>	<b>13</b>		<b>TOTAL</b>	<b>15</b>
FALL 2019		Credits	SPRING 2020		Credits
MATH 2204 Intro Multivariable Calculus Pre: MATH 1226		3	CHEM 1036 General Chemistry Pre: CHEM 1035		3
PHYS 2306 Foundations of Physics I w/lab Pre: MATH 1226, PHYS 2305		4	MATH 2214 Intro Diff Equations Pre: (1114 or 2114 or 2114H or 2405H), 1226		3
ESM 2104 Statics Pre: MATH 1226 Co: MATH 2204 or MATH 2204H or MATH 2224 or MATH 2406H		3	ESM 2204 Mechanics of Deformable Bodies Pre: (2104 or 2114), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)		3
ISE 2214 Manufacturing Processes Lab		1	MSE 2054 Fund of Materials Science Pre: 2044		3 <sup>[S]</sup>
MSE 2044 Fund of Materials Eng (C) Pre: CHEM 1035, Co: PHYS 2305		4 <sup>[F,S]</sup>	MSE 2114 Math Programming MSE I Pre: 2044		1 <sup>[S]</sup>
MSE 2884 Matls Engr Professional Dev I		1 <sup>[F]</sup>	MSE 3314 Materials Lab I Pre: 2044		1 <sup>[S]</sup>
			Pathways Concept (2, 3, 6a, or 7)		3
	<b>TOTAL</b>	<b>16</b>		<b>TOTAL</b>	<b>17</b>
FALL 2020		Credits	SPRING 2021		Credits
ECON 2005 Principles of Economics (Pathway 3)		3	MSE 3044 Transport Phenomena MSE Pre: 2044, MATH 2214		3 <sup>[S]</sup>
MSE 3114 Math Programming MSE II Pre: 2114		1 <sup>[F]</sup>	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)		3 <sup>[F,S]</sup>
MSE 3134 Crystallography and Crystal Structures Pre: 2044 (C)		3 <sup>[F]</sup>	MSE 3064 (ESM 3064) Mech Behavior Matls Lab Co: 3054		1 <sup>[F,S]</sup>
MSE 4034 Thermo of Materials Pre: 2044; Co:CHEM 1036		3 <sup>[F]</sup>	MSE 3884 Matls Engr Professional Dev II Pre: junior standing, 2884		1 <sup>[S]</sup>
MSE 4424 Materials Lab II Pre: 2044		1 <sup>[F]</sup>	MSE 4644 Materials Design Experiments Pre: 3314 or 4424		3 <sup>[S]</sup>
Physical Materials Course		3	Physical Materials Course		3
Physical Materials Course		3	Pathways Concept (1A)		3
	<b>TOTAL</b>	<b>17</b>		<b>TOTAL</b>	<b>17</b>
FALL 2021		Credits	SPRING 2022		Credits
MSE 4055 Materials Selection & Design Pre: 3044, 3054, 2 of (3204,3304 4414, 4554)		3 <sup>[F]</sup>	MSE 4076 Senior Design Laboratory Pre: 4075 Co: 4086,		2 <sup>[S]</sup>
MSE 4075 Senior Design Laboratory Pre: 4644 Co: 4055, 4085		1 <sup>[F]</sup>	MSE 4086 Senior Design Recitation Pre: 4085 Co: 4076 or 4096H		1 <sup>[S]</sup>
MSE 4085 Senior Design Recitation Pre: senior standing, 3884 Co: 4075 or 4095H		2 <sup>[F]</sup>	Physical Materials Course		3
Technical Elective from list		3	Technical Elective from list		3
Technical Elective from list		3	Pathways Concept (2, 3, 6a, or 7)		3
Pathways Concept (2, 3, 6a, or 7)		3	Pathways Concept (2, 3, 6a, or 7)		3
	<b>TOTAL</b>	<b>15</b>		<b>TOTAL</b>	<b>15</b>

**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. Color-coding key: **Core**, **Pathways**, **Major**.

**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

<b>Pathways Concept 1:</b> Discourse (6 hrs foundational, 3 hrs advanced)	<i>Foundational:</i> ENGL 1105	(3)	<i>Foundational:</i> ENGL 1106	(3)
	<i>Advanced:</i>			(3)
<b>Pathways Concept 2:</b> Critical Thinking in the Humanities (6 hrs)		(3)		(3)
<b>Pathways Concept 3:</b> Reasoning in the Social Sciences (6 hrs)	ECON 2005	(3)		(3)
<b>Pathways Concept 4:</b> Reasoning in the Natural Sciences (8 hrs)	PHYS 2305	(4)	PHYS 2306	(4)
<b>Pathways Concept 5:</b> Quantitative and Computational Thinking (11 hrs)	<i>Foundational:</i> MATH 1225	(4)	<i>Foundational:</i> MATH 1226	(4)
	<i>Advanced:</i> MATH 2214			(3)
<b>Pathways Concept 6:</b> Critique and Practice in Design and the Arts (7 hrs)	<i>Arts:</i>			(3)
	<i>Design:</i> ENGE 1215 + ENGE 1216			(4)
<b>Pathways Concept 7*:</b> Critical Analysis of Identity & Equity in the US (3 hrs)				(3)

\*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>

**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#22><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:
  - o MSE 3204<sup>[F,S]</sup> Fund Electronic Materials Pre: 2054, PHYS 2306
  - o MSE 3304<sup>[F,S]</sup> Physical Metallurgy Pre: 2044 (C)
  - o MSE 4414<sup>[F,S]</sup> Physical Ceramics Pre: 2044 (C)
  - o MSE 4554<sup>[F,S]</sup> 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]**

BIOL 2124	Cell & Mol Biol For Engineers	MSE 4044	Powder Processing
BSE 3494	Advanced Welding Technology	MSE 4164	Princ Matls Corrosion
CHEM 2154	Majors Analytical Chemistry	MSE 4234	Semiconductor Processing
CHEM 2535	Organic Chemistry	MSE 4304	Metals and Alloys
CHEM 2536	Organic Chemistry	MSE 4305	Metal Casting
CHEM 2555	Organic Synthesis and Techniques Lab	MSE 4306	Metal Casting
CHEM 2565	Principles Org Chem	MSE 4384	Nuclear Materials
CHEM 3615	Physical Chemistry	MSE 4574	Biomaterials
CHEM 4534	Organic Chemistry of Polymers	MSE 4614	Nanomaterials
CHEM 4615	Physical Chemistry for Life Sciences	MSE 5024	Math Methods in Materials Research
CHEM 4634	Polymer and Surface Chemistry	MSE 5124	Materials Opt. Through Designed Exper
CHEM 4994	Undergraduate Research In CHEM	NANO 3015	Nano Synth & Characterization
ECE 3054	Electrical Theory	NANO 3016	Nano Synth & Characterization
ECE 3254	Industrial Electronics	NSEG 3145	Fundamentals of Nuclear Engr
ENGR 3124	Green Engineering	NSEG 3146	Fundamentals of Nuclear Engr
ENGR 4134	Environmental Life Cycle Assessment	PHYS 3324	Modern Physics
ESM 2304	Dynamics	PHYS 3355	Intermediate Mechanics
ESM 4024	Advanced Mechanical Behavior of Materials	PHYS 3405	Interned Elec & Mag
ESM 4044	Mechanics Composite Materials	PHYS 4574	Nanotechnology
ESM 4105	Engineering Analysis of Physiologic Systems	PHYS 4714	Intro to Biophysics
ESM 4106	Engineering Analysis of Physiologic Systems	SBIO 3444	Sust Biomaterials & Bioenergy
GEOS 4634	Environmental Geochemistry	STAT 3704	Stat for Eng Apps
		STAT 4604	Stat Methods for Engr
		MSE 3xxx	Any non-required MSE 3xxx [2]
		MSE 4xxx	Any non-required MSE 4xxx [2]
		MSE 5xxx	

**Group 2: Materials Non-Specific Courses [4,5]**

BMES 2104	Intro Biomedical Engineering	MATH 4564	Operational Methods
BMES 4064	Intro to Med Physiology	MATH 4574	Vector/Complex Analysis
CEE 3104	Intro Environ Engr	ME 3514	System Dynamics
CEE 3604	Intro Transport Engr	ME 4194	Sustainable Energy Solutions
CHE 4144	Bus & Mktg For Proc Industries	ME 4994	Undergraduate Research
CHEM 2545	Organic Chemistry Laboratory	NSEG 4204	Nuclear Fuel Cycle
CHEM 4114	Instrumental Analysis	PHYS 3655	Intro to Astrophysics
CS 3824	Intro Comp Bio Bioinformatics	PHYS 3656	Introduction to Astrophysics
ESM 3154	Solid Mechanics	PHYS 3704	Thermal Physics
ESM 3234	Fluid Mech I Control Volumes	SBIO 3434	Chem & Conv of Sust BiomatlS
ESM 3334	Fluid Mech II Diff Analysis	GEOS 3504 / MSE 3104	Mineralogy
MATH 3214	Calculus of Several Variables	ISE 2204	Manufacturing Processes
MATH 4445	Intro to Numer Analysis		

[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.