

COLLEGE OF ENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING
DEGREE: BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING
MAJOR: CHEMICAL ENGINEERING
FOR STUDENTS ENTERING UNDER UG CATALOG 2022-2023
CREDITS REQUIRED FOR GRADUATION: 130

FALL SEMESTER FIRST YEAR		Credits	SPRING SEMESTER FIRST YEAR		Credits
CHEM 1035 General Chemistry	<i>Pre: Eligible to enroll</i>	3	CHEM 1036 General Chemistry	<i>Pre: CHEM 1035</i>	3
CHEM 1045 General Chemistry Laboratory	<i>Co: CHEM 1035</i>	1	CHEM 1046 General Chemistry Laboratory	<i>Pre: CHEM 1045 Co: CHEM 1036</i>	1
ENGL 1105 First-Year Writing		3	ENGL 1106 First-Year Writing	<i>Pre: ENGL 1105</i>	3
MATH 1225 Calculus of a Single Variable (C-)	<i>Pre: Eligible to enroll</i>	4	P MATH 1226 Calculus of a Single Variable	<i>Pre: MATH 1225</i>	4
ENGE 1215 Foundations of Engineering (C-)		2	P PHYS 2305 Foundations of Physics w/lab	<i>Pre: MATH 1225 or MATH 1226; Co: MATH 1226</i>	4
Elective (Pathways Concept 2, 3, or 7)		3	P ENGE 1216 Foundations of Engineering (C-)	<i>Pre: ENGE 1215 (C-)</i>	2
TOTAL		16	TOTAL		17
FALL SEMESTER SECOND YEAR		Credits	SPRING SEMESTER SECOND YEAR		Credits
CHEM 2535 Organic Chemistry	<i>Pre: CHEM 1036 or CHEM 1056 or CHEM 1056H</i>	3 ^[F, S] or 3 ^[F]	CHEM 2536 Organic Chemistry	<i>Pre: (CHEM 2535 or CHEM 2565 or CHEM 2565H)</i>	3 ^[S, SII] or 3 ^[S]
CHEM 2565 Principles of Organic Chem	<i>Pre: CHEM 1036 or CHEM 1056 or CHEM 1036H or CHEM 1056H</i>		CHEM 2566 Principles of Organic Chemistry	<i>Pre: CHEM 2565</i>	
CHEM 2545 Organic Chemistry Lab	<i>Pre: CHEM 1046 or CHEM 1066; Co: CHEM 2535 or 2565</i>	1 ^[F, S]	CHEM 2546 Organic Chemistry Laboratory	<i>Pre: CHEM 2545, Co: CHEM 2536</i>	1 ^[S, SIII]
CHEM 2545 Organic Chemistry Lab	<i>Pre: CHEM 1046 or CHEM 1066; Co: CHEM 2535 or 2565</i>	1 ^[F, S]	CHEM 3615 Physical Chemistry	<i>Pre: (CHEM 1035 or CHEM 1055 or CHEM 1055H), (CHEM 1036 or CHEM 1056 or CHEM 1056H), PHYS 2306, (MATH 2204 or MATH 2204H)</i>	3 ^[F, S]
CHE 2114 ¹ Mass & Energy Balances (C-)	<i>Pre: (MATH 1226), (CHEM 1036 or 1056 or 1056H)</i>	3 ^[F, S]	CHE 2004 CHE Sophomore Seminar (P/F)		1 ^[S]
PHYS 2306 Foundations of Physics & Lab	<i>Pre: PHYS 2305, MATH 1226</i>	4	CHE 2164 ¹ CHE Thermodynamics	<i>Pre: CHE 2114 (C-). Co: CHEM 3615</i>	3 ^[F, S]
MATH 1114 Elementary Linear Algebra	OR	2 or 3	MATH 2214 Introduction to Differential Equations	<i>Pre: (MATH 1114 or MATH 2114 or MATH 2114H or MATH 2405H), MATH 1226</i>	3
MATH 2114 Introduction to Linear Algebra	<i>Pre: (MATH 1225 (B) or 1226)</i>				
MATH 2204 Introduction to Multivariable Calculus	<i>Pre: MATH 1226</i>	3	Elective (Pathways Concept 2, 3, or 7)		3
TOTAL		16	TOTAL		17
FALL SEMESTER THIRD YEAR		Credits	SPRING SEMESTER THIRD YEAR		Credits
ENGL 3764 Technical Writing	<i>Junior Standing, Pre: ENGL 1106</i>	3	CHEM 3625 Physical Chemistry Laboratory	<i>Pre: CHEM 3615 or CHEM 3615H or CHEM 4615</i>	1 ^[F, S, SII]
CHE 3114 ¹ Fluid Transport	<i>Pre: 2114, PHYS 2305, (MATH 2204); Co: MATH 4564</i>	3 ^[F, S]	CHE 3015 ¹ Process Measurement & Control	<i>Pre: MATH 4564; Co: (CHE 2124 or CHE 3124), CHE 3184, CHE 3044</i>	3 ^[S]
CHE 3134 ¹ Separation Processes	<i>Pre: CHE 2114. Co: (CHEM 3615 or CHE 2164)</i>	3 ^[F, S]	CHE 3044 ¹ Heat Transfer	<i>Pre: CHE 2164, CHE 3114, MATH 4564</i>	2 ^[S]
CHE 3124 CHE Simulations and Modeling	<i>Pre: CHE 2114 (C-), MATH 2214; Co: CHE 3114, MATH 4564</i>	3 ^[F, S]	CHE 3144 ¹ Mass Transfer	<i>Pre: CHE 2164, CHE 3114, MATH 4564</i>	3 ^[S]
MATH 4564 Operational Methods for Engineers	<i>Pre: MATH 2214 or MATH 2214H or MATH 2406H</i>	3	CHE 3184 ¹ Chem Reactor Analysis & Design	<i>Pre: CHE 2164, (MATH 2214 or 2214H); Co: CHE 3144, CHE 3044</i>	3 ^[S]
			STAT 4604 Statistical Methods for Engineers	<i>Pre: MATH 1226</i>	3
			OR		
			STAT 4705 Probability & Statistics for Engineers	<i>Pre: MATH MATH 2204MATH 2204H or MATH 2406H</i>	
			STAT 4714 Probability and Statistics for Electrical Engineers	<i>Pre: MATH 2204 or MATH 2204H or MATH 2406H</i>	
TOTAL		15	TOTAL		15

SUMMER BETWEEN THIRD AND FOURTH YEARS		Credits		
CHE 4014 CHE LABORATORY <i>PRE: CHE 3015, CHE 3044, CHE 3124, CHE 3134, CHE 3144, CHE 3184, ENGL 3764, *</i>	5 ^[SI, SII]			
TOTAL	5			
FALL SEMESTER FOURTH YEAR		Credits	SPRING SEMESTER FOURTH YEAR	
CHE 4185 Process & Plant Design <i>Pre: CHE 3015, CHE 3044, CHE 3124, CHE 3134, CHE 3144, CHE 3184, *</i>	4 ^[F]		CHE 4186 Process & Plant Design <i>Pre: CHE 4185</i>	4 ^[S]
Elective (Pathways Concept 2, 3, or 7)	6		Technical Elective	3
CHE Elective	3		Elective (Pathways Concept 2, 3, or 7)	3
Technical Elective	3		Elective (Pathways Concept 6a)	3
TOTAL	16		TOTAL	13

General Information about Checksheet: Superscripted annotation (F, S, SI, SII) in credits column indicates terms when a course is expected to be offered. The (C-) indicates a graduation requirement of a C- or better. ¹Superscript and green color denote **CHE Common Degree Core Courses** and beige color denotes **Pathways Concept Courses**.

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

Pathways Concept 1: Discourse 1f-Foundational (6 credits). 1a Advanced/Applied (3 credits)	<i>Foundational:</i> ENGL 1105 (3) ENGL 1106 (3) <i>Advanced/Applied:</i> ENGL 3764 (3)
Pathways Concept 2: Critical Thinking in the Humanities (6 credits)	(3) (3)
Pathways Concept 3: Reasoning in the Social Sciences (6 credits)	(3) (3)
Pathways Concept 4: Reasoning in the Natural Sciences (8 credits)	PHYS 2305 (4) PHYS 2306 (4)
Pathways Concept 5: Quantitative and Computational Thinking (11 credits) 5f-Foundational (8 credits), 1a-Advanced/Applied (3 credits)	<i>Foundational:</i> MATH 1225 (4) MATH 1226 (4) <i>Advanced/Applied:</i> MATH 2214 (4)
Pathways Concept 6: Critique and Practice in Design and the Arts (7 credits): 6a-Arts (3 credits)6d- Design (4 credits)	<i>Arts:</i> (3) <i>Design:</i> ENGE 1215 + ENGE 1216 (4)
Pathways Concept 7: Critical Analysis of Identity and Equity in the United States (3 credits) Pathways 7 should be double counted with either Pathways 2, 3, or 6a to avoid taking any additional credit hours.	(3)

Electives: CHE majors must take 3 hrs of CHE Electives and 6 hrs of Technical Electives from the approved lists. Electives must be taken A-F, not P/F.

Change of Major Requirements: Please see: <https://eng.vt.edu/em>

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.

In-Major GPA: All CHE-prefix courses except CHE 4144: Bus & Mktg for Proc Industries are used to calculate in-major GPA.

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 CHE Department fully supports this policy. Specific expectations for satisfactory progress for Chemical 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 (under Academic Policies)
- Students must maintain a minimum in-major GPA of 2.0.
- If in-major GPA drops below 2.0, students will be placed on departmental probation.
- If an in-major GPA of 2.0 or better is not achieved after two semesters of departmental probation, the student is suspended from the department and prohibited from registering for CHE-prefix courses for at least one semester.
- Following suspension, permission of the department head is required for registration for CHE-prefix courses.

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 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.
- *Entry into CHE 4014 and 4185 is restricted to students who have an in-major GPA of 2.0 or better.

Graduation Requirements:

- Have a minimum in-major GPA of 2.0.
- Complete at least 130 semester credit hours with a minimum overall GPA of 2.0.

CHEMICAL ENGINEERING DEPARTMENT

Approved Elective Requirements for the BS in CHE
For students entering under UG Catalog 2022-2023

CHE students have several types of electives required in their program of study. Listed below are departmental, College and University requirements governing those electives.

PATHWAYS to GENERAL EDUCATION: Satisfaction of Pathways requirements is required of all students in the university. Engineering students satisfy this requirement in Concepts 1f (foundational), 4, 5, and 6d (design) through curricular engineering, math, science and English courses. Concept 1a (advanced/applied discourse) will be satisfied through the senior design and lab courses. Concepts 2, 3, 6a (arts), and 7 are satisfied through elective courses; six credits are required in Concepts 2 and 3, three credits in Concept 6, and three credits in Concept 7. The one course required for Concept 7 may, if carefully selected, simultaneously satisfy a Concept 2 or 3 requirement. Several courses appear on both the Concept 2 and Concept 6a (arts) lists, but they can be used to satisfy only one of these requirements. Concept 7 is the only concept in which a course may “double count.” **All Pathways requirements must be met with courses taken on an A/F basis unless a course is only offered on the P/F basis.** Each year, courses may be added to or removed from each Concept. A course may be used to satisfy a Concept, if it appears on the list of approved courses for that Concept during the year it was taken. A link to the Pathways to General Education Course Catalog guide is maintained at <https://www.pathways.prov.vt.edu/about/course-catalog.html>.

CHE Electives. A total of 3 hours of CHE elective are required from the following list. If you take more than three hours, the excess hours will count toward Technical Electives. All CHE Electives must be taken A-F. Students are responsible for the satisfaction of prerequisites required for their chosen electives.

CHE 4104	Process Materials <i>Pre: 2164, (CHEM 2535 or CHEM 2565)</i>	3
CHE 4114	Energy and Climate Change Solutions <i>Pre: 3144, 3184</i>	3
CHE 4214	Introduction to Polymer Materials <i>Pre: 2164, CHEM 2536</i>	3
CHE 4224	Introduction to Polymer Processing <i>Pre: 3144, 3044</i>	3
CHE 4304	Biological Transport Phenomena <i>Pre: 3044, 3114, 3144</i>	3
CHE 4334	Introduction to Colloidal Interface Science <i>Pre: CHEM 3615</i>	3
CHE 4404	Data Analytics in Chemical Engineering <i>Pre: 3124</i>	3

Technical Electives. A total of 6 hours of technical electives are required from the following list. All Technical Electives must be taken A-F. No courses may double-count as both CHE elective and technical elective. Students are responsible for the satisfaction of prerequisites required for their chosen electives.

Biochemistry		Credits
BCHM 2024	Concepts of Biochemistry <i>Pre: CHEM 2514 or CHEM 2535</i>	3

BCHM 3114	Biochemistry for Biotechnology & the Life Sciences <i>CHEM 2566</i>	<i>Pre: CHEM 2536 or</i>	3
BCHM 4115	General Biochemistry	<i>Pre: (CHEM 2536 or CHEM 2566), (BCHM 2114 or CHEM 2154)</i>	4
BCHM 4116	General Biochemistry	<i>Pre: BCHM 4115</i>	3
Biomedical Engineering			
BMES 2104	Introduction to Biomedical Engineering	<i>Pre: ENGE 1216 or ENGE 1414; Co: MATH 2214</i>	3
BMES 4064	Introduction to Medical Physiology		3
Chemical Engineering			
CHE 4104	Process Materials	<i>Pre: CHE 2164, (CHEM 2535 or CHEM 2565)</i>	3
CHE 4114	Energy and Climate Change Solutions	<i>Pre: CHE 3144, CHE 3184</i>	3
CHE 4214	Introduction to Polymer Materials	<i>Pre: CHEM 2536, CHE 2164</i>	3
CHE 4224	Introduction to Polymer Processing	<i>Pre: 3144, 3044</i>	3
CHE 4304/ ME 4344	Biological Transport Phenomena	<i>Pre: (CHE 3114, CHE 3044, CHE 3144) or (ME 3304, ME 3404) or (CHE 3114, CHE 3044, CHE 3144) or (ME 3304, ME 3404)</i>	3
CHE 4334	Introduction to Colloidal Interface Science	<i>Pre: CHEM 3615</i>	3
CHE 4404	Data Analytics in Chemical Engineering	<i>Pre: CHE 3124</i>	3
CHE 4544/ BSE 4544	Protein Separation Engineering	<i>Pre: BSE 3504 or CHE 3144</i>	3
CHE 4994 4974*	Independent Study/Undergraduate Research		1-3
Chemistry			
CHEM 2114	Analytical Chemistry	<i>Pre: 1036 or 1056 or 1056H; Co: CHEM 2124</i>	3
CHEM 3616	Physical Chemistry	<i>Pre: MATH 2214, (CHEM 3615 or CHEM 3615H), (CHEM 3615, MATH 2214 or CHEM 3615H)</i>	3
CHEM 3626	Physical Chemistry Laboratory	<i>Pre: (CHEM 3616 or CHEM 3616H or CHEM 4616), CHEM 3625, CHEM 4014</i>	1
CHEM 4074/ MSE 4544	Laboratory in Polymer Science	<i>Pre: CHEM 3616, CHEM 4534</i>	2
CHEM 4114	Instrumental Analysis	<i>Pre: (CHEM 3615 or CHEM 3615H), CHEM 2154; "Co: CHEM 4124</i>	3
CHEM 4124	Instrumental Analysis Laboratory	<i>Co: CHEM 4114</i>	1
CHEM 4404	Physical Inorganic Chemistry	<i>Pre: (CHEM 3616 or CHEM 3616H), CHEM 2424</i>	3
CHEM 4414	Inorganic Chemistry Laboratory	<i>Pre: CHEM 2424, (CHEM 3616 or CHEM 3616H), CHEM 4404; Co: CHEM 4424, CHEM 3616</i>	3
CHEM 4514	Green Chemistry	<i>Pre: CHEM 2536 or CHEM 2566</i>	3
CHEM 4524	Identification of Organic Compounds	<i>Pre: (CHEM 2536 or CHEM 2566), (CHEM 3616 or CHEM 3616H or CHEM 4616)</i>	3
CHEM 4534	Organic Chemistry of Polymers	<i>Pre: CHEM 2536 or CHEM 2566</i>	3
CHEM 4554	Drug Chemistry	<i>Pre: CHEM 2536 or CHEM 2566</i>	3
CHEM 4616	Physical Chemistry for the Life Sciences	<i>Pre: CHEM 4615</i>	3
CHEM 4634	Polymer and Surface Chemistry	<i>Pre: CHEM 3615 or CHEM 4615</i>	3
CHEM 4994	Undergraduate Research		1-3

Civil and Environmental Engineering

CEE 5104 Environmental Chemistry 3

Computer Science

CS 3114 Data Structures & Algorithms *Pre: CS 2114, CS 2505, (MATH 2534 or MATH 3034)*

Engineering

ENGR 3124 Introduction to Green Engineering *Pre: (CHEM 1035 or CHEM 1074), (ENGE 1216 or ENGE 1104 or ENGE 1114), PHYS 2306* 3

Environmental Science

CSES 4734/
CHEM 4734 Environmental Soil Chemistry *Pre: CSES 3114, CSES 3124, CHEM 2514 or CHEM 2535, CHEM 3114, (MATH 2015 or MATH 1026)* 3

Food Science and Technology

FST 4104 Applied Malting and Brewing Science *Pre: FST 3124, 4504* 3

FST 4504 Food Chemistry *Pre: FST 3604, FST 4304* 3

Materials Science and Engineering

MSE 3204 Fundamentals of Electronic Materials *Pre: MSE 2054, PHYS 2306* 3

MSE 4394 Introduction to Molecular Dynamics Simulation *Pre MSE 2034 or 2044* 3

MSE 4544/
CHEM 4074 Laboratory in Polymer Science *Pre: CHEM 3616, CHEM 4534* 2

MSE 4574 Biomaterials *Pre MSE 3054* 3

Nuclear Science and Engineering

NSEG 3145 Fundamentals of Nuclear Engineering *Pre: MATH 2214 or MATH 2214H* 3

Physics

PHYS 3324 Modern Physics *Pre: PHYS 2306 Co: MATH 2214, MATH 2504* 4

PHYS 4564 Polymer Physics *Pre: Phys 2306* 3

Sustainable Biomaterials

SBIO 3434 Chemical & Conversion of Sustainable Biomaterials *Pre: CHEM 1036* 3

SBIO 3444 Sustainable Biomaterials & Bioenergy *Pre: (CHEM 2514 or CHEM 2535), (CHEM 3615 or CHEM 4615)* 3

SBIO 3454 Society, Sustainability Biomaterials and Energy

*CHE 4994/Undergraduate Research (UR) and CHE 4974/ Independent Study (IS) cannot be added through online request. Instead, the student should talk with a faculty member about a research project, and complete and submit the requisite paperwork by the third day of classes. To be eligible to take 4974 or 4994, your overall and in-major GPA must be at least 2.0.

If there is a course you are interested in taking and it is not on the approved list, talk to Dr. Goldstein for approval to substitute a course.

Tracks in Chemical Engineering

Students who complete 9 credits from any of the following sets of courses will have completed a “Track.” While this will not be acknowledged on the student’s transcript or diploma, the student is welcome to identify the completion of the Track on their resume/curriculum vitae. Completion of a track is not required for the BS degree in CHE.

Climate and Energy Solutions Track

Chemical Engineers design and operate many industrial and power plants and can influence the output of CO₂ and other greenhouse gases, as well as other chemicals and materials that can negatively impact the environment. Chemical Engineers can positively impact climate change through process design, selection of appropriate materials, and careful control of process operating conditions, and through the implementation of decarbonization and climate change mitigation strategies. “Climate and Energy Solutions” is a track within the Chemical Engineering major where students will receive additional training in areas such as sustainable and renewable energy production, increased efficiency, decarbonization, green and sustainable materials, planning for low energy and low environmental impacts, and other strategies for mitigating climate change and environmental effects. By judicious selection of courses, students may complete the Green Engineering minor and Climate and Engineering Solutions track.

Required Course:

CHE 4114	Energy and Climate Change Solutions	(3)
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¹Choose a minimum of 6 credit hours from the following courses.

CEE 4134	Environmental Sustainability – A Systems Approach	(3)
² CHE 4994	Undergraduate Research	(var)
CHEM 4514	Green Chemistry	(3)
ECE 4364	Alternate Energy Systems	(3)
ENGR 3124	Introduction to Green Engineering	(3)
ENGR 4134	Environmental Life Cycle Assessment	(3)
ESM 4194	Sustainable Energy Solutions for a Global Society	(3)
ME 4154	Industrial Energy Systems	(3)
ME 4324	Energy Systems: Theory and Applications	(3)
SBIO 2504	Circular Economy Analytics for Sustainable Systems	(3)
SBIO 3444	Sustainable Biomaterials & Bioenergy	(3)
SBIO 3454	Society, Sustainability Biomaterials and Energy	(3)

¹Prerequisites may apply. See your advisor.

²Undergraduate research must be in a topic closely related to Energy and Climate Solutions. No more than 3 credits of approved research may be applied toward this track.

Computational and Data Sciences Track

Large-scale numerical simulations and autonomous experimentation have revolutionized many disciplines in science and engineering. To meet the growing workforce demand for tackling massive amounts of data in chemical industries, the “Computational and Data Sciences” track offers a uniquely interdisciplinary set of courses teaching the basic methodologies and applied tools of data analytics with domain-specific examples. The

track prepares students for a broad variety of career paths that leverage computation and data for solving urgent societal problems: from energy and biomedical materials design, to advanced manufacturing, to intelligent chemical processes with on-the-fly diagnosis, forecasting, and optimization, to opportunities not yet foreseen.

Required Course:

CHE 4404	Data Analytics in Chemical Engineering	(3)
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Choose a minimum of 6 credit hours from the following courses¹

AOE 4024	Introduction to the Finite Element Method	(3)
² CHE 4994	Undergraduate Research	(var)
CMDA 4654	Intermediate Data Analytics and Machine Learning	(3)
CS 4884	Computational Biology and Bioinformatics	(3)
MSE 4394	Introduction to Molecular Dynamics Simulation	(3)

¹Prerequisites may apply. See your advisor.

²Undergraduate research must be in a topic closely related to Data Analytics. No more than 3 credits of approved research may be applied toward this track.

Healthcare Technologies Track

Chemical Engineering principles are central to a broad range of bioengineering solutions to health and medicine problems, including protein and pharmaceutical engineering, tissue engineering, fermentation, wastewater treatment, and the development of novel bioreactors for product synthesis. The “Healthcare Technologies” track will allow students with a particular interest in one or more of these topics to focus their technical electives in that area. By judicious selection of courses, students may complete the Biomedical Engineering minor and Healthcare Technologies track.

Required Course:

CHE 4304	Biological Transport Phenomena	(3)
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¹Choose a minimum of 6 credit hours from the following courses¹.

BMES 4064	Intro to Medical Physiology	(3)
CHE 4544	Protein Separation Engineering	(3)
² CHE 4994	Undergraduate Research	(var)
CHEM 4554	Drug Chemistry	(3)
CS 4884	Computational Biology and Bioinformatics	(3)
ESM 4105	Engineering Analysis of Physiologic Systems	(3)
MSE 4574	Biomaterials	(3)

¹Prerequisites may apply. See your advisor.

²Undergraduate research must be in a topic closely related to Health and Medicine. No more than 3 credits of approved research may be applied toward this track.