

CHEMICAL ENGINEERING MAJOR

Program Curriculum

Code	Title	Credits
Degree Core Requirements		
CHE 2114	Mass and Energy Balances (C-)	3
CHE 2164	Chemical Engineering Thermodynamics	3
CHE 3015	Process Measurement & Control	3
CHE 3114	Fluid Transport	3
CHE 3134	Separation Processes	3
CHE 3144	Mass Transfer	3
CHE 3154	Heat Transfer Analysis	3
CHE 3185	Chemical Reactor Analysis and Design	2
Subtotal		23
Major Requirements		
CHE 2004	Chemical Engineering Sophomore Seminar	1
CHE 3124	Chemical Engineering Simulations and Process Modeling	3
CHE 3186	Chemical Reactor Analysis and Design	2
CHE 4014	Chemical Engineering Laboratory ¹	4
CHE 4185	Process and Plant Design ¹	4
CHE 4186	Process and Plant Design	4
CHEM 1035	General Chemistry	3
CHEM 1045	General Chemistry Laboratory	1
CHEM 1036	General Chemistry	3
CHEM 1046	General Chemistry Laboratory	1
CHEM 2535	Organic Chemistry	3
or CHEM 2565	Principles of Organic Chemistry	
CHEM 2536	Organic Chemistry	3
or CHEM 2566	Principles of Organic Chemistry	
CHEM 2545	Organic Chemistry Laboratory	1
CHEM 3625	Physical Chemistry Laboratory	1
MATH 2114	Introduction to Linear Algebra	3
MATH 2204	Introduction to Multivariable Calculus	3
MATH 2214	Introduction to Differential Equations	3
STAT 4604	Statistical Methods for Engineers	3
or STAT 4705	Probability and Statistics for Engineers	
Major Electives		
CHE Electives		6
Technical Electives		6
Career Bridge Experience ²		
ENGE 3900	Bridge Experience ²	
Subtotal		55
Pathways to General Education		
<i>Pathways Concept 1 - Discourse</i>		
ENGL 1105	First-Year Writing (1F)	3
ENGL 1106	First-Year Writing (1F)	3
ENGL 3764	Technical Writing (1A)	3
<i>Pathways Concept 2 - Critical Thinking in the Humanities</i>		

Select six hours in Pathway 2 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G02)		6
Pathways Concept 3 - Reasoning in the Social Sciences		
Select six hours in Pathway 3 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G03)		6
Pathways Concept 4 - Reasoning in the Natural Sciences		
PHYS 2305	Foundations of Physics	4
PHYS 2306	Foundations of Physics	4
Pathways Concept 5 - Quantitative and Computational Thinking		
MATH 1225	Calculus of a Single Variable (5F)	4
MATH 1226	Calculus of a Single Variable (5F)	4
MATH 2214	Introduction to Differential Equations (5A)	3
Pathways Concept 6 - Critique and Practice in Design and the Arts		
Select 3 hours in Pathway 6a (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06A)		3
ENGE 1215 & ENGE 1216 or ENGE 1414	Foundations of Engineering and Foundations of Engineering Foundations of Engineering Practice	4
Pathways Concept 7 - Critical Analysis of Identity and Equity in the United States		
Pathways 7		3
Subtotal		50
Total Credits		128

¹ Entry into CHE 4014 Chemical Engineering Laboratory and CHE 4185 Process and Plant Design is restricted to students who have an in-major GPA of 2.0 or better.

² Career Bridge Experiences help prepare students for post-graduation life and develop a professional identity. Internships, Co-ops, and Undergraduate Research are examples of possible Career Bridge Experiences. Students must participate in a Career Bridge Experience to complete the BS CHE degree. Because some of these experiences are not credit bearing, the **ENGE 3900** course is used to track and assess student participation in a Career Bridge Experience and to record fulfillment of this degree requirement on the transcript. Students should enroll in ENGE 3900 during the semester (or one of the semesters) that they undertake the Career Bridge Experience. Enrollment in ENGE 3900 requires approval of a Career Bridge Plan. Further information about acceptable Career Bridge Experiences and the process for submitting a Career Bridge Plan are explained in **CHE 2004**.

CHE Electives

A total of 6 hours of CHE elective are required from the following list. If you take more than six 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.

Code	Title	Credits
CHE 4104	Process Materials	3
CHE 4114	Energy and Climate Change Solutions	3
CHE 4214	Introduction to Polymer Materials	3
CHE 4224	Introduction to Polymer Processing	3
CHE 4304	Biological Transport Phenomena	3
CHE 4334	Introduction to Colloidal and Interfacial Science	3

CHE 4404	Machine Learning in Chemical Sciences and Engineering	3
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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. 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.

Code	Title	Credits
Biochemistry		
BCHM 2024	Concepts of Biochemistry	3
BCHM 3114	Biochemistry for Biotechnology and the Life Sciences	3
BCHM 4115	General Biochemistry	4
BCHM 4116	General Biochemistry	3
Biomedical Engineering		
BMES 2104	Introduction to Biomedical Engineering	3
BMES 4064	Introduction to Medical Physiology	3
Chemical Engineering		
CHE 4104	Process Materials	3
CHE 4114	Energy and Climate Change Solutions	3
CHE 4214	Introduction to Polymer Materials	3
CHE 4224	Introduction to Polymer Processing	3
CHE 4304	Biological Transport Phenomena	3
CHE 4334	Introduction to Colloidal and Interfacial Science	3
CHE 4404	Machine Learning in Chemical Sciences and Engineering	3
CHE 4544	Protein Separation Engineering	3
CHE 4974	Independent Study ³	1-3
CHE 4994	Undergraduate Research ³	1-3
Chemistry		
CHEM 2114	Analytical Chemistry	3
CHEM 3615	Physical Chemistry	3
CHEM 3626	Physical Chemistry Laboratory	1
CHEM 4074	Laboratory in Polymer Science	2
CHEM 4114	Instrumental Analysis	3
CHEM 4124	Instrumental Analysis Laboratory	1
CHEM 4404	Physical Inorganic Chemistry	3
CHEM 4414	Inorganic Chemistry Lab	2
CHEM 4514	Green Chemistry	3
CHEM 4524	Identification of Organic Compounds	3
CHEM 4534	Organic Chemistry of Polymers	3
CHEM 4554	Drug Chemistry	3
CHEM 4616	Physical Chemistry for the Life Sciences	3
CHEM 4624	Materials Chemistry in Energy Sciences	3
CHEM 4634	Polymer and Surface Chemistry	3
CHEM 4734	Environmental Soil Chemistry	3
CHEM 4994	Undergraduate Research ³	1-19
Civil and Environmental Engineering		
CEE 5104	Environmental Chemistry	3
Computer Science		

CS 3114	Data Structures and Algorithms	3
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Engineering		
ENGR 3124	Introduction to Green Engineering	3
Food Science and Technology		
FST 4104	Applied Brewing Science and Engineering	3
FST 4504	Food Chemistry	3
Mathematics		
MATH 4564	Operational Methods for Engineers	3
Materials Science and Engineering		
MSE 3204	Fundamentals of Electronic Materials	3
MSE 4394	Introduction to Molecular Dynamics Simulation	3
MSE 4544	Laboratory In Polymer Science	2
MSE 4574	Biomaterials	3
Nuclear Science and Engineering		
NSEG 3145	Fundamentals of Nuclear Engr	3
Physics		
PHYS 3324	Modern Physics	4
PHYS 4564	Polymer Physics	3
Sustainable Biomaterials		
SBIO 3434	Chemistry and Conversion of Sustainable Biomaterials	3
SBIO 3444	Sustainable Biomaterials and Bioenergy	3
SBIO 3454	Society, Sustainability Biomaterials and Energy	3

³ **4974** Independent Study and **4994** Undergraduate Research cannot be requested through online course request. Interested students are encouraged to contact potential research mentors, who will initiate the process. Contact Drs Martin and Bortner for more information about ChemE Car and ChemE Cube Teams, respectively.

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. Undergraduate research must be in a topic closely related to track and no more than 3 credits of approved research may be applied toward a track. 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.

Code	Title	Credits
CHE 4114	Energy and Climate Change Solutions	3
Select a minimum of 6 credit hours from the following:		
CEE 4134	Environmental Sustainability - A Systems Approach	3
CHE 4994	Undergraduate Research	1-19
CHEM 4514	Green Chemistry	3
CHEM 4624	Materials Chemistry in Energy Sciences	3
ECE 4364	Alternate Energy for Climate Sustainability	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		3
ME 4324	Energy Systems: Theory and Applications	3
S BIO 2504	Circular Economy Analytics for Sustainable Systems	3
S BIO 3444	Sustainable Biomaterials and Bioenergy	3
S BIO 3454	Society, Sustainability Biomaterials and Energy	3

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.

Code	Title	Credits
CHE 4404	Machine Learning in Chemical Sciences and Engineering	3
Select a minimum of 6 credit hours from the following:		
AOE 4024	An Introduction to the Finite Element Method	3
CHE 4994	Undergraduate Research	1-19
CMDA 4654	Intermediate Data Analytics and Machine Learning	3
CS 4884	Computational Biology and Bioinformatics Capstone	3
MSE 4394	Introduction to Molecular Dynamics Simulation	3

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.

Code	Title	Credits
CHE 4304	Biological Transport Phenomena	3
Select a minimum of 6 credit hours from the following:		
BMES 4064	Introduction to Medical Physiology	3
CHE 4544	Protein Separation Engineering	3
CHE 4994	Undergraduate Research	1-19
CHEM 4554	Drug Chemistry	3
CS 4884	Computational Biology and Bioinformatics Capstone	3
ESM 4105	Engineering Analysis of Physiologic Systems	3
MSE 4574	Biomaterials	3

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 courses for at least one semester.
- Following suspension, permission of the department head is required for registration in CHE-prefix courses.

Graduation Requirements

- Have a minimum in-major GPA of 2.0.
- Complete at least 128 semester credit hours with a minimum overall GPA of 2.0.

In-Major GPA

All CHE-prefix courses except CHE 4144 Business and Marketing Strategies for the Process Industries are used to calculate in-major GPA.

Acceptable Substitutions

1. MATH 2405H (5 cr) may be substituted for MATH 2114 (3 cr)
2. MATH 2405H (5 cr) + MATH 2406H (5 cr) may be substituted for MATH 2114 (3 cr) + MATH 2204 (3 cr) + MATH 2214 (3 cr)
3. CHE 4015 (2 cr) + CHE 4016 (2 cr) may be substituted for CHE 4014 (4 cr)
4. CHEM 1055 (4 cr) may be substituted for CHEM 1035 (3 cr)
5. CHEM 1056 (4 cr) may be substituted for CHEM 1036 (3 cr)
6. CHEM 1065 (1 cr) may be substituted for CHEM 1045 (1 cr)
7. CHEM 1066 (1 cr) may be substituted for CHEM 1046 (1 cr)
8. CHEM 2555 (2 cr) may be substituted for CHEM 2545 (1 cr)

Foreign Language Requirement

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.

Roadmap

First Year

Fall Semester		Credits
CHEM 1035	General Chemistry	3
CHEM 1045	General Chemistry Laboratory	1
ENGL 1105	First-Year Writing	3
MATH 1225	Calculus of a Single Variable	4
ENGE 1215	Foundations of Engineering	2
Elective (Pathways Concept 2, 3, or 7)		3
Credits		16

Spring Semester

CHEM 1036	General Chemistry	3
CHEM 1046	General Chemistry Laboratory	1
ENGL 1106	First-Year Writing	3
MATH 1226	Calculus of a Single Variable	4
PHYS 2305	Foundations of Physics	4
ENGE 1216	Foundations of Engineering	2
Credits		17

Second Year

Fall Semester

CHEM 2535 or CHEM 2565	Organic Chemistry or Principles of Organic Chemistry	3
CHEM 2545	Organic Chemistry Laboratory	1
CHE 2114	Mass and Energy Balances (C-)	3
PHYS 2306	Foundations of Physics	4
MATH 2114	Introduction to Linear Algebra	3
MATH 2204	Introduction to Multivariable Calculus	3
Credits		17

Spring Semester

CHEM 2536 or CHEM 2566	Organic Chemistry or Principles of Organic Chemistry	3
CHE 2004	Chemical Engineering Sophomore Seminar	1
CHE 2164	Chemical Engineering Thermodynamics	3
CHE 3134	Separation Processes	3
MATH 2214	Introduction to Differential Equations	3
Elective (Pathways Concept 2, 3, or 7)		3
Credits		16

Third Year

Fall Semester

CHE 3114	Fluid Transport	3
CHE 3124	Chemical Engineering Simulations and Process Modeling	3
CHE 3185	Chemical Reactor Analysis and Design	2
ENGL 3764	Technical Writing	3
Elective (Pathways Concept 2, 3, or 7)		3
Credits		14

Spring Semester

CHEM 3625	Physical Chemistry Laboratory	1
CHE 3015	Process Measurement & Control	3
CHE 3154	Heat Transfer Analysis	3
CHE 3144	Mass Transfer	3
Select one of the following:		3
STAT 4604	Statistical Methods for Engineers	
STAT 4705	Probability and Statistics for Engineers	
Credits		13

Summer Semester		
CHE 4014	Chemical Engineering Laboratory	4
Credits		4
Fourth Year		
Fall Semester		
CHE 3186	Chemical Reactor Analysis and Design	2
CHE 4185	Process and Plant Design	4
ENGE 3900	Bridge Experience	0
Elective (Pathways Concept 2, 3, or 7)		3
CHE Elective		3
Technical Elective		3
Credits		15
Spring Semester		
CHE 4186	Process and Plant Design	4
CHE Elective		3
Technical Elective		3
Elective (Pathways Concept 2, 3, or 7)		3
Elective (Pathways Concept 6a)		3
Credits		16
Total Credits		128