

# CHEMICAL ENGINEERING CURRICULUM 2023-2024

Freshman Year			
Fall Semester		Spring Semester	
CH 1010 General Chemistry <sup>1</sup>	4	CH 1020 General Chemistry	4
ENGL 1030 Composition and Rhetoric <sup>1</sup>	3	CHE 1300 Introduction to Chemical Engineering <sup>1</sup>	3
ENGR 1020 Engineering Disciplines and Skills <sup>1,2</sup>	3	MATH 1080 Calculus of One Variable II <sup>1</sup>	4
MATH 1060 Calculus of One Variable I <sup>1,3</sup>	4	PHYS 1220 Physics with Calculus I <sup>1</sup>	3
Arts and Humanities/Social Science <sup>4</sup>	3	General Education Requirement <sup>4</sup>	3
<i>Semester Totals:</i>	17	<i>Semester Totals:</i>	17
Optional Summer Semester			
Consult with advisor for available course(s).			
Sophomore Year			
CH 2230 Organic Chemistry	3	CH 2240 Organic Chemistry	3
CHE 2110 Mass and Energy Balances	4	CH 2290 Organic Chemistry Laboratory <sup>5</sup>	1
MATH 2060 Calculus of Several Variables	4	CHE 2200 Chemical Engineering Thermodynamics I	3
PHYS 2210 Physics with Calculus II	3	CHE 2300 Fluids/Heat Transfer	4
General Education Requirement <sup>4</sup>	3	MATH 2080 Introduction to Ordinary Differential Equations	4
<i>Semester Totals:</i>	17	<i>Semester Totals:</i>	15
Junior Year			
CH 3390 Physical Chemistry Laboratory	1	CH 3320 Physical Chemistry	3
CHE 3210 Chemical Engineering Thermodynamics II	3	CH 3400 Physical Chemistry Laboratory	1
CHE 3300 Mass Transfer and Separation Processes	4	CHE 3070 Unit Operations Laboratory I	3
ECE 2070 Basic Electrical Engineering	2	CHE 3190 Engineering Materials	3
ECE 2080 Basic Electrical Engineering Laboratory	1	Emphasis Area Requirement <sup>6</sup>	3
STAT 4110 Statistical Methods for Process Development and Control	3	General Education Requirement <sup>4</sup>	3
Emphasis Area Requirement <sup>6</sup>	3		
<i>Semester Totals:</i>	17	<i>Semester Totals:</i>	16
Optional Summer Semester			
Consult with advisor for available course(s).			
Senior Year			
BMOL 4250 Biomolecular Engineering	3	BMOL 4290 Bioprocess Engineering	3
CHE 4070 Unit Operations Laboratory II	3	CHE 4530 Process Dynamics and Control	3
CHE 4310 Chemical Process Design I	3	CHE 4330 Process Design II	3
CHE 4430 Safety, Environmental and Professional Practice I	3	CHE 4440 Safety, Environmental and Professional Practice II	1
CHE 4500 Chemical Reaction Engineering	3	Emphasis Area Requirement <sup>6</sup>	3
<i>Semester Totals:</i>	15	Global Challenges Requirement <sup>4,7</sup>	3
		<i>Semester Totals:</i>	16
			<b>Total: 130 Hours</b>

Notes:

<sup>1</sup> Must be passed with a grade of C or better.

<sup>2</sup> The combination of [ENGR 1050](#) and [ENGR 1060](#) or the combination of [ENGR 1510](#) and [ENGR 1520](#) may be substituted for [ENGR 1020](#).

<sup>3</sup> Depending on a student's Clemson Mathematics Placement Test score, [MATH 1040](#) and [MATH 1070](#) may be substituted for [MATH 1060](#); or the student may be required to take [MATH 1050](#) before enrolling in [MATH 1060](#).

<sup>4</sup> See [General Education Requirements](#). Three General Education credits must also satisfy the South Carolina REACH Act Requirement. See the South Carolina REACH Act Requirement in the [Academic Regulations](#) section.

<sup>5</sup> [CH 2270](#) and [CH 2280](#) may be substituted for [CH 2290](#).

<sup>6</sup> Nine credit hours devoted to the completion of an emphasis area or approved minor are required. Emphasis Area courses may not be used to satisfy other degree requirements. Select from the following Emphasis Areas:

**Applied Engineering, Mathematics and Science Emphasis Area**-Select from the following lists. At least one course must be selected from the Engineering courses list.

*Engineering Courses*-[CHE 4010](#), [CHE 4140](#), [CE 2010](#), [IE 3600](#), [IE 3610](#), [IE 4620](#), [ME 2040](#)

*Mathematics Courses*-[MATH 4340](#) or [MATH 4500](#)

*Science Courses*-[CH 3130](#), [CH 4020](#), [CH 4110](#), [CH 4130](#), [CH 4210](#), [CH 4270](#), [CH 4350](#), [PHYS 2220](#), [PHYS 4200](#), [PHYS 4320](#), [PHYS 4410](#), [PHYS 4450](#)

**Biomolecular Science and Engineering Emphasis Area**-Select from the following lists. At least one course must be selected from the Engineering courses list and Science courses list.

*Engineering Courses*-[BE 4280](#), [BIOE 3020](#), [BIOE 4010](#), [BIOE 4020](#), [BIOE 4400](#), [BIOE 4480](#), [BIOE 4490](#), [BMOL 4260](#), [BMOL 4270](#)

*Science Courses*-[BCHM 3050](#), [BCHM 4060](#), [BCHM 4310](#), [BCHM 4330](#), [BCHM 4360](#), [BIOL 4340](#), [CH 3600](#), [CH 4040](#), [CH 4140](#), [CH 4250](#), [GEN 4400](#), [MICR 3050](#)/[MICR 3060](#), [MICR 4070](#), [MICR 4130](#), [PHYS 4170](#)

**Business Management Emphasis Area**-[MGT 2010](#) is required. Select two additional courses from [ACCT 2010](#), [ECON 3060](#), [ECON 3100](#), [ECON 3210](#), [ELE 3010](#), [ELE 4010](#), [ELE 4070](#), [MGT 3900](#), [MGT 4110](#), [MGT 4230](#), [MKT 3140](#)

**Energy Studies Emphasis Area**-Select from [AGRB 4570](#), [BE 4400](#), [CE 4370](#), [CE 4400](#), [CE 4430](#), [CE 4910](#), [CHE 4140](#), [CHE 4150](#), [ECE 4200](#), [ECE 4570](#), [ECE 4610](#), [ECE 4710](#), [ECON 4570](#), [EES 3100](#), [EES 4100](#), [EES 4120](#), [GEOL 4090](#), [ME 4200](#), [ME 4220](#), [ME 4260](#), [ME 4570](#)

**Environmental Engineering and Science Emphasis Area**-Select two engineering courses and one science or policy course from the following lists:

*Engineering Courses*-[BE 4240](#), [BE 4400](#), [BMOL 4030](#), [CHE 4010](#), [CHE 4140](#), [CHE 4150](#), [EES 4010](#), [EES 4020](#), [EES 4100](#), [EES 4300](#), [EES 4800](#), [EES 4850](#), [EES 4860](#), [ETOX 4210](#), [ETOX 4460](#)

*Science/Policy Courses*-[CH 4110](#), [CH 4130](#), [ENR 3120](#), [ENSP 4000](#), [PHYS 2450](#), [PHYS 4200](#)

**Polymeric Materials Emphasis Area**-Select from [BIOE 3020](#), [CH 4650](#), [CHE 4120](#), [CHE 4130](#), [CHE 4450](#), [MSE 4150](#), [MSE 4610](#), [PKSC 4160](#). Students may not use both [CHE 4120](#) and [MSE 4150](#) to satisfy this requirement.

<sup>7</sup> Select a three-credit 3000- or 4000-level course that satisfies the Global Challenges General Education Requirement.

#### ADDITIONAL NOTES:

1. If a student has completed all of the courses listed in the General Engineering core, in order to register for a complete schedule, they may need to consider registering for courses required in the engineering degree program they intend to pursue. Students should see the list of possible courses in the Major Specific Coursework section of the [General Engineering Program](#) entry. Major specific coursework is coursework outside the General Engineering core that will count towards an engineering major once a student has officially changed their major. *Note that not all courses will count towards every engineering major. The courses listed in the Major Specific Coursework should not be considered alternatives or substitutes for the courses listed in the General Engineering core. If a student takes one of these other courses in place of the courses specifically listed in the General Engineering core, they could delay their eligibility to transfer from General Engineering into one of the degree-granting programs in engineering.*
2. No student may exceed a maximum of two attempts, including a *W*, to complete successfully any BMOL or CHE course.
3. In addition to institutional requirements, candidates for a BS degree in Chemical Engineering are required to have a cumulative grade-point average of 2.00 or higher in all engineering courses taken at Clemson. Undergraduate and graduate courses taught in the following rubrics are used in the calculation of a student's engineering GPA (eGPA): AMFG, AUE, BE, BIOE, BMOL, CE, CES, CHE, CME, ECAS, ECE, EES, EG, EM, ENGR, ESED, IE, ME, and MSE. All attempts of these courses with grades of *A*, *B*, *C*, *D*, *F*, and *I* are included in the calculation. Grades of *CE*, *CR*, *FGD*, *FGF*, *NP*, *P*, *SCD*, *SCN*, *SCP*, *TR*, and *W* are NOT included in the calculation.
4. Depending on a student's math placement, they may be invited to take part in the General Engineering Learning Community where they complete the following courses: [ENGR 1000](#), [ENGR 1010](#), [ENGR 1100](#), [ENGR 1110](#), [ENGR 1510](#), and [ENGR 1520](#). The combination of [ENGR 1510](#) and [ENGR 1520](#) may be substituted for [ENGR 1020](#).
5. A transfer course may not be used to satisfy the General Education Global Challenges Requirement. While a transfer course may fulfill other degree requirements, students must enroll in a Clemson course(s) on the Global Challenges list to fulfill the Global Challenges Requirement.

## Emphasis Areas

The Chemical Engineering curriculum includes Emphasis Areas to allow students flexibility in selecting courses and planning their future careers. Students in this curriculum must declare an area of interest and plan a sequence of Emphasis Area courses in the fall semester of the sophomore year. These initial plans can be modified later in consultation with an academic advisor. Before graduation each student in the regular Chemical Engineering curriculum must complete 9 credit hours of approved courses in one of the following Emphasis Areas:

- Applied Engineering, Mathematics, and Science
- Biomolecular Science and Engineering
- Business Management
- Energy Studies
- Environmental Engineering and Science
- Polymeric Materials

Alternatively, students in the Chemical Engineering curriculum may apply the 9-hours set aside for completion of an Emphasis Area toward the completion of any minor or second major offered by Clemson, except the Chemistry Minor and the Cluster Minor. (You can earn a minor in Chemistry if you wish, but you will also have to complete an Emphasis Area.) Minor requirements are set by the department granting the minor. Details of each minor are available in the Undergraduate Catalog. Students who enter the program having already earned a baccalaureate degree from an accredited institution may apply 9 approved hours of required junior or senior-level courses from the previous degree program to satisfy the Emphasis Area requirement.

### **REQUIREMENTS FOR EMPHASIS AREAS**

**Important note to students:** It is **your responsibility** to insure that the Emphasis Area courses you select will be offered when you want to take them **and** that you will meet the prerequisites and other registration criteria stipulated by the offering department. Course schedules change frequently, and many of the Emphasis Area courses have prerequisites that are not part of the ChE curriculum.

**The Undergraduate Catalog lists prerequisites for every course offered by Clemson.** In some cases a department may waive a prerequisite or accept a reasonable alternative for a well-qualified student. If you believe that you have reasonable alternatives to the listed prerequisites, then you should request a prerequisite waiver from the offering department. In other cases, even though you have the prerequisites, you may be unable to get into a course due to other registration restrictions such as space limitations, majors who are given priority, or the course is not offered on a regular schedule.

**The department that offers a particular course is the only reliable source** that can tell you when a course will be offered and what requirements must be met prior to registration. Plan ahead and contact the offering department if there is any doubt about the availability of courses you select. ***It is highly advisable to plan ahead and coordinate the emphasis area prerequisites with your General Education requirements.***

Note also that not all courses listed in the Emphasis Areas have 3 credits. Therefore, depending on the set of courses you select, you might need to complete more than 3 courses to satisfy the 9 credit hour minimum.

Below are the approved Emphasis Area Courses for the 2023-24 curriculum year.

**a) Applied Engineering, Mathematics, and Science Emphasis Area**

Select from the following lists. At least one course must be selected from the Engineering course list.

*Engineering Courses*

- CHE 4010 (Transport Phenomena)
- CHE 4140 (Green Engineering)
- CE 2010 (Statics)
- IE 3600 (Industrial Applications of Probability and Statistics I)
- IE 3610 (Industrial Applications of Probability and Statistics II)
- IE 4620 (Six Sigma Quality)
- ME 2040 (Mechanics of Materials)

*Mathematics Courses*

- MATH 4340 (Advanced Engineering Mathematics)
- MATH 4500 (Introduction to Mathematical Models)

*Science Courses*

- CH 3130 (Quantitative Analysis, 3150 or 3170 must be taken concurrently)
- CH 4020 (Inorganic Chemistry)
- CH 4110 (Instrumental Analysis)
- CH 4130 (Chemistry of Aqueous Systems)
- CH 4210 (Advanced Organic Chemistry)
- CH 4270/4271 (Organic Spectroscopy)
- CH 4350 (Atomic and Molecular Structure)
- PHYS 2220 (Physics with Calculus III)
- PHYS 4200 (Atmospheric Physics)
- PHYS 4320 (Optics)
- PHYS 4410 (Electromagnetics I)
- PHYS 4450 (Solid State Physics I)

**b) Biomolecular Science and Engineering Emphasis Area**

Select from the following lists. At least one course must be selected from the Engineering course list and Science course list.

*Engineering Courses*

- BE 4280 (Biochemical Engineering)
- BIOE 3020 (Biomaterials)
- BIOE 4010 (Bioengineering Design Theory)
- BIOE 4020 (Biocompatibility)
- BIOE 4400 (Biopharmaceutical Engineering)
- BIOE 4480 (Tissue Engineering)
- BIOE 4490 (Drug Delivery)
- BMOL 4260 (Biosensors and Bioelectronic Devices)
- BMOL 4270 (Membranes for Biotechnology and Biomedicine)

*Science Courses*

BCHM 3050 (Essential Elements of Biochemistry)  
BCHM 4060 (Physiological Chemistry)  
BCHM 4310 (Physical Approach to Biochemistry)  
BCHM 4330 (Physical Approach to Biochemistry Laboratory)  
BCHM 4360 (Molecular Biology: Genes to Proteins)  
BIOL 4340 (Biological Chemistry Laboratory Techniques)  
CH 3600 (Chemical Biology)  
CH 4040 (Bioinorganic Chemistry)  
CH 4140 (Bioanalytical Chemistry)  
CH 4250 (Medicinal Chemistry)  
GEN 4400 (Bioinformatics)  
MICR 3050 (General Microbiology)  
MICR 4070/4071 (Food and Dairy Microbiology)  
MICR 4130/4131 (Industrial Microbiology)  
PHYS 4170 (Introduction to Molecular Biophysics)

**c) Business Management Emphasis Area**

MGT 2010 (Principles of Management) is required. Select two additional courses from

ACCT 2010 (Financial Accounting Concepts)  
ECON (MGT) 3060 (Managerial Economics)  
ECON 3100 (International Economy)  
ECON (ELE) 3210 (Economics of Innovation)  
ELE 3010 (Entrepreneurial Foundations)  
ELE 4010 (Venture Concept Testing)  
ELE 4070 (Technology Entrepreneurship)  
MGT 3900 (Operations Management)  
MGT 4110 (Project Management)  
MGT 4230 (International Business Management)  
MKT 3140 (New Venture Creation I)

**d) Energy Studies Emphasis Area**

Select from

AGRB 4570 (Natural Resource Use, Technology, and Policy)  
BE 4400/4401 (Sustainable Energy Engineering)  
CE 4370 (Sustainable Energy Project Design and Analysis)  
CE 4400/4401 (Sustainable Energy Engineering)  
CE 4430 (Water Resources Engineering)  
CE 4910 (Selected Topics in Civil Engineering, Energy Related)  
CHE 4140 (Green Engineering)  
CHE 4150 (Alternative Energy)  
ECE 4200 (Renewable Energy Penetration on the Power Grid)  
ECE 4570 (Fundamentals of Wind Power)  
ECE 4610 (Fundamentals of Solar Energy)  
ECE 4710 (Electrification of Transportation)  
ECON 4570 (Natural Resource Use, Technology, and Policy)  
EES 3100 (Introduction to Nuclear Engineering)  
EES 4100 (Environmental Radiation Protection I)  
EES 4120 (Nuclear Fuel Cycle and Radioactive Waste Management)

GEOL 4090/4091 (Environmental and Exploration Geophysics)  
ME 4200 (Energy Sources and Their Utilization)  
ME 4220 (Design of Gas Turbines)  
ME 4260 (Nuclear Energy)  
ME 4570 (Fundamentals of Wind Power)

**e) Environmental Engineering and Science Emphasis Area**

Select two engineering courses and one science or policy course from the following lists:

*Engineering Courses*

BE 4240 (Ecological Engineering)  
BE 4400 (Sustainable Energy Engineering)  
BMOL 4030 (Biotransport Phenomena)  
CHE 4010 (Transport Phenomena)  
CHE 4140 (Green Engineering)  
CHE 4150 (Alternative Energy)  
EES 4010 (Environmental Engineering)  
EES 4020 (Water and Waste Treatment Systems)  
EES 4100 (Environmental Radiation Protection I)  
EES 4300 (Air Pollution Engineering)  
EES 4800 (Environmental Risk Assessment)  
EES 4850 (Hazardous Waste Management)  
EES 4860 (Environmental Sustainability)  
ETOX 4210 (Chemical Sources and Fate in Environmental Systems)  
ETOX 4460 (Soil and Water Quality: Fundamentals)

*Science/Policy Courses*

CH 4110 (Instrumental Analysis)  
CH 4130 (Chemistry of Aqueous Systems)  
ENR 3120 (Environmental Risks and Society)  
ENSP 4000 (Studies in Environmental Science)  
PHYS 2450 (Physics of Global Climate Change)  
PHYS 4200 (Atmospheric Physics)

**f) Polymeric Materials Emphasis Area**

Select from

BIOE 3020/3021 (Biomaterials)  
CH 4650 (Frontiers in Polymer Chemistry)  
CHE 4120 (Polymer Engineering)  
CHE 4130 (Polymer Composite Engineering)  
CHE 4450 (Special Topics, Polymer related)  
MSE 4150 (Polymer Science and Engineering)  
MSE 4610/4611 (Polymer Fiber Engineering)  
PKSC 4160/4161 (Application of Polymers in Packaging)

Students may not use both CHE 4120 and MSE 4150 to satisfy this requirement.

**g) Selected Minor in lieu of an Emphasis Area**

Students may use the 9 hours devoted to the Emphasis Area requirement to select and complete any Minor, except the Chemistry Minor or the Cluster Minor. See the Undergraduate Catalog for requirements in the Minor of your choice.