

CHEMICAL ENGINEERING, B.S.E.

Degree Requirements (131-138 hours)

See College of Engineering and Computing (<https://academicbulletins.sc.edu/undergraduate/engineering-computing/>) for progression requirements and special academic opportunities.

Program of Study

Requirements	Credit Hours
1. Carolina Core	34-43
2. College Requirements	0
3. Program Requirements	64-65
4. Major Requirements	33

Founding Documents Requirement

All undergraduate students must take a 3-credit course or its equivalent with a passing grade in the subject areas of History, Political Science, or African American Studies that covers the founding documents including the United State Constitution, the Declaration of Independence, the Emancipation Proclamation and one or more documents that are foundational to the African American Freedom struggle, and a minimum of five essays from the Federalist papers. This course may count as a requirement in any part of the program of study including the Carolina Core, the major, minor or cognate, or as a general elective. Courses that meet this requirement are listed here (<https://academicbulletins.sc.edu/undergraduate/founding-document-courses/>).

1. Carolina Core Requirements (34-43 hours)

CMW – Effective, Engaged, and Persuasive Communication: Written (6 hours)

- ENGL 101 - *must be passed with a grade of C or higher*
- ENGL 102

ARP – Analytical Reasoning and Problem Solving (8 hours)

must be passed with a grade of C or higher

- MATH 141
- MATH 142

SCI – Scientific Literacy (8 hours)

must be passed with a grade of C or higher

- CHEM 111 & CHEM 111L
- PHYS 211 & PHYS 211L

GFL – Global Citizenship and Multicultural Understanding: Foreign Language (0-6 hours)

Score two or better on foreign language placement test; or complete the 109 and 110 courses in FREN, GERM, LATN or SPAN; or complete the 121 course in another foreign language.

- CC-GFL courses (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

GHS – Global Citizenship and Multicultural Understanding: Historical Thinking (3 hours)

- any CC-GHS course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

GSS – Global Citizenship and Multicultural Understanding: Social Sciences (3 hours)

- any CC-GSS course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

AIU – Aesthetic and Interpretive Understanding (3 hours)

- any CC-AIU course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

CMS – Effective, Engaged, and Persuasive Communication: Spoken Component ¹ (0-3 hours)

- PHIL 325 (CMS/VSR overlay)

INF – Information Literacy ¹ (0-3 hours)

- any overlay or stand-alone CC-INF course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

VSR – Values, Ethics, and Social Responsibility ¹ (0-3 hours)

- PHIL 325 (CMS/VSR overlay)

¹ **Carolina Core Stand Alone or Overlay Eligible Requirements** – Overlay-approved courses offer students the option of meeting two Carolina Core components in a single course. A maximum of two overlays is allowed. The total Carolina Core credit hours for this program must add up to a minimum of 34 hours.

2. College Requirements (0 hours)

No college-required courses for this program.

3. Program Requirements (64-65 hours)

Supporting Courses (64-65 hours)

Foundational Courses (20 hours)

Complete all of the following:

Course	Title	Credits
CHEM 112	General Chemistry II (must be passed with a grade of C or higher)	3
CHEM 112L	General Chemistry II Lab (must be passed with a grade of C or higher)	1
CHEM 333	Organic Chemistry I (must be passed with a grade of C or higher)	3
CHEM 334	Organic Chemistry II	3
MATH 241	Vector Calculus	3
MATH 242	Elementary Differential Equations (must be passed with a grade of C or higher)	3
PHYS 212	Essentials of Physics II	3

PHYS 212L	Essentials of Physics II Lab	1
Total Credit Hours		20

Chemistry Electives (6 hours)

A list of acceptable Chemistry Elective courses is maintained in the department office and on its website. These include the following:

Course	Title	Credits
CHEM 321	Quantitative Analysis	3
CHEM 322	Analytical Chemistry	3
CHEM 511	Inorganic Chemistry	3
CHEM 533	Comprehensive Organic Chemistry III	3
CHEM 541	Physical Chemistry	3
CHEM 542	Physical Chemistry	3
CHEM 545	Physical Biochemistry	3
CHEM 550	Biochemistry	3
CHEM 555	Biochemistry/Molecular Biology I	3
CHEM 556	Biochemistry/Molecular Biology II	3
CHEM 621	Instrumental Analysis	3
CHEM 622	Forensic Analytical Chemistry	3
CHEM 623	Introductory Environmental Chemistry	3
CHEM 624	Aquatic Chemistry	3
CHEM 633	Introduction to Polymer Synthesis	3
CHEM 643	Computational Chemistry	3
CHEM 644	Materials Chemistry	3
CHEM 655	Metabolic Biochemistry of Human Disease	3

Chemistry Laboratory Electives (2 hours)

A list of acceptable Chemical Laboratory Elective courses is maintained in the department office and on its website. These include the following:

Course	Title	Credits
CHEM 321L	Quantitative Analysis Laboratory	1
CHEM 322L	Analytical Chemistry Laboratory	1
CHEM 331L	Essentials of Organic Chemistry Laboratory I	1-2
or CHEM 333L	Comprehensive Organic Chemistry Laboratory I	
CHEM 332L	Essentials of Organic Chemistry Laboratory II	1-2
or CHEM 334L	Comprehensive Organic Chemistry Laboratory II	
CHEM 541L	Physical Chemistry Laboratory	2
CHEM 542L	Physical Chemistry Laboratory	2
CHEM 550L	Biochemistry Laboratory	1
CHEM 621L	Instrumental Analysis Lab	1

Computer Programming Elective (3-4 hours)

Course	Title	Credits
Select one of the following:		
CSCE 145	Algorithmic Design I	4
CSCE 206	Scientific Applications Programming	3

Lower Division Engineering (14 hours)

Complete all of the following:

Course	Title	Credits
ECHE 101	Introduction to Chemical Engineering	2-3
or ENCP 101	Introduction to Engineering I	

ECHE 300	Chemical Process Principles (must be passed with a grade of C or higher)	3
ECHE 310	Introductory Chemical Engineering Thermodynamics (must be passed with a grade of C or higher)	3
or ENCP 290	Thermodynamic Fundamentals	
ECHE 311	Chemical Engineering Thermodynamics (must be passed with a grade of C or higher)	3
ECHE 320	Chemical Engineering Fluid Mechanics (must be passed with a grade of C or higher)	3
or ENCP 360	Fluid Mechanics	

Professional Development Elective (1 hour)

A list of acceptable Professional Development Elective courses is maintained in the department office and on its website. The list includes the following:

Course	Title	Credits
ECHE 202	Exploring the Chemical Engineering Workplace	1
ECHE 203	Research in Chemical Engineering	1

Engineering Electives (6 hours)

A list of acceptable Engineering Elective courses is maintained in the department office and on its website. The list includes the following:

Course	Title	Credits
Select one of the following:		
ENCP 200	Statics	3
ECIV 200	Statics	
EMCH 200	Statics	
ENCP 201	Introduction to Applied Numerical Methods	3
or EMCH 201	Introduction to Applied Numerical Methods	
Select one of the following:		
ENCP 210	Dynamics	3
ECIV 210	Dynamics	
EMCH 310	Dynamics	
Select one of the following:		
ENCP 260	Introduction to the Mechanics of Solids	3
ECIV 220	Mechanics of Solids	
EMCH 260	Solid Mechanics	
ENCP 330	Introduction to Vibrations	3
or EMCH 330	Mechanical Vibrations	
ENCP 440	Sustainable Development in Engineering	3
ENCP 460	Special Topics in Engineering and Computing	1-6
ENCP 481	Project Management	1
ENCP 499	Interdisciplinary Technical Elective	1-3
ENCP 540	Environmentally Conscious Manufacturing	3
BMEN 240	Cellular and Molecular Biology with Engineering Applications	4
BMEN 271	Introduction to Biomaterials	3
BMEN 290	Thermodynamics of Biomolecular Systems	3
BMEN 300 and above, except BMEN 301 and BMEN 303		
CSCE 211	Digital Logic Design	3
CSCE 212	Introduction to Computer Architecture	3
CSCE 240	Advanced Programming Techniques	3
CSCE 274	Robotic Applications and Design	3

CSCE 313	Embedded Systems	3
CSCE 317	Computer Systems Engineering	3
CSCE 520	Database System Design	3
CSCE 567	Visualization Tools	3
CSCE 582	Bayesian Networks and Decision Graphs	3
CSCE 587	Big Data Analytics	3
ECHE 202 or ECHE 203	Exploring the Chemical Engineering Workplace Research in Chemical Engineering	1
ECHE 372	Introduction to Materials	3
ECHE 389	Special Topics in Chemical Engineering	3
ECHE 456	Computational Methods for Engineering Applications	3
ECHE 497	Thesis Preparation	1-3
ECHE 499	Special Problems	1-3
ECHE 520	Chemical Engineering Fluid Mechanics	3
ECHE 521	Computational Fluid Dynamics for Engineering Applications	3
ECHE 571	Corrosion Engineering	3
ECHE 572	Polymer Processing	3
ECHE 573	Next Energy	3
ECHE 574	Combustion	3
ECHE 589	Special Advanced Topics in Chemical Engineering	3
ELCT 220	Electrical Engineering for Non-Majors	3
ELCT 221	Circuits	3
ELCT 222	Signals and Systems	3
ELCT 300 and above		
ECIV 300 and above, except ECIV 360 ¹		
EMCH 300 and above, except EMCH 354 and EMCH 360 ²		

¹ Except ECIV 360

² Except EMCH 354 and EMCH 360

Technical Electives (9 hours)

A list of acceptable Technical Elective courses is maintained in the department office and on its website. The list includes the following:

Course	Title	Credits
All Engineering Electives		
Chemistry Electives		
Chemistry Lab Electives		
ENCP 102 or EMCH 111	Introduction to Engineering II Introduction to Computer-Aided Design	3
MATH 374	Discrete Structures	3
MATH 500 and above		
STAT 500 and above, except STAT 541 and STAT 591		
BIOL 101	Biological Principles I	3
BIOL 101L	Biological Principles I Laboratory	1
BIOL 102	Biological Principles II	3
BIOL 102L	Biological Principles II Laboratory	1
BIOL 120	Human Biology	3
BIOL 120L	Laboratory in Human Biology	1
BIOL 200 and above		3
ENVR 231	Introduction to Sustainability Management and Leadership	3-4

ENVR 321	Environmental Pollution and Health	3
ENVR 331	Integrating Sustainability	3
GEOL 300 and above		
MSCI 300 and above		
PHYS 300 and above		
CSCE 145	Algorithmic Design I	4
CSCE 146	Algorithmic Design II	4
CSCE 210	Computer Hardware Foundations	3
CSCE 215	UNIX/Linux Fundamentals	1
CSCE 350	Data Structures and Algorithms	3

Liberal Arts Electives (3 hours)

At least one course used to satisfy the Liberal Arts Elective or a Carolina Core AIU, CMS, GHS, GSS, VSR requirement must be either at

1. the 300-level or above and in the same field of study as one of the other courses, or
2. 270 or above in the field of ENGL. Liberal Arts Electives include the following:

Course	Title	Credits
All approved Carolina Core Courses for AIU, CMS, GFL, GHS, GSS, and VSR		
AERO 401	National Security/Leadership Responsibilities/Commissioning Preparation (POC cadets only)	4
AERO 402	National Security / Leadership Responsibilities / Commissioning Preparation II (POC cadets only)	4
AFAM 201	Introduction to African American Studies: Social and Historical Foundations	3
AFAM 202	Introduction to African-American Studies	3
AFAM 335	The American Civil Rights Movement	3
ANTH 101	Primates, People, and Prehistory	3
ANTH 102	Understanding Other Cultures	3
ANTH 219	Great Discoveries in Archaeology	3
ANTH 300 and above except ANTH 399, ANTH 501		
ARTE 101	Introduction to Art	3
ARTH 105	History of Western Art I	3
ARTH 106	History of Western Art II	3
ARTH 300 and above except ARTH 399, ARTH 498, ARTH 499, ARTH 599		
ARMY 406	American Military Experience (Army cadets only)	3
CPLT any course; courses CPLT 270 and above count as 300-level		
DANC 101	Dance Appreciation	3
ECON 221	Principles of Microeconomics	3
ECON 222	Principles of Macroeconomics	3
ECON 224	Introduction to Economics	3
ECON 300 and above except ECON 399, ECON 421, ECON 499, ECON 524, ECON 595		
ENGL any course above 102, except 460 through 467		
Foreign languages 121 Elementary		
Foreign languages 300 and above except intensive reading courses or courses about teaching		
GEOG 103	Introduction to Geography	3
GEOG 121	Globalization and World Regions	3
GEOG 300 and above except GEOG 399, GEOG 595		

HIST any course		
LASP 301	Interdisciplinary Study of Latin America	3
LASP 311	Latin American Cultures	3
LASP 315	South American Indian Cultures	3
LASP 322	Mesoamerican Prehistory	3
LASP 331	Geography of Latin America	3
LASP 351	Politics and Governments of Latin America	3
LASP 398	Special Topics in Latin American Studies	3
LASP 425	Prehistoric Archaeology of South America	3
LASP 451	International Relations of Latin America	3
LING 300	Introduction to Language Sciences	3
LING 340	Language, Culture, and Society	3
LING 405	Topics in Linguistics	3
LING 540	Topics in Language and Culture	3
LING 541	Language and Gender	3
LING 542	Research in Language Conflict and Language Rights	3
LING 543	Discourse, Gender, and Politics of Emotion	3
LING 545	Anthropological Approaches to Narrative and Performance	3
LING 567	Psychology of Language	3
LING 600	Survey of Linguistics	3
MUSC 110	Introduction to Music	3
MUSC 140	Jazz and American Popular Music	3
MUSC 145	Introduction to Music Literature	3
MUSC any music history course at or above 300-level		
NAVY 303	Evolution of the Art of War (Midshipmen only)	3
PHIL 102	Introduction to Philosophy	3
PHIL 300 and above		
PSYC 101	Introduction to Psychology	3
PSYC 103	Psychology of Adjustment	3
PSYC 300 and above except PSYC 570 to PSYC 599		
POLI any course except POLI 379, POLI 399		
RELG any course		
SOCY 101	Introductory Sociology	3
SOCY 300 and above except 399		
THEA 200	Understanding and Appreciation of Theatre	3
THEA 561	History of the Theatre I	3
THEA 562	History of the Theatre II	3
WGST 112	Introduction to Women's and Gender Studies	3
WGST 113	Women's Health	3
WGST 207	Gender and Culture	3
WGST 300	Sex and Gender	3
WGST 301	Psychology of Marriage	3
WGST 304	Race, Class, Gender, and Sexuality	3
WGST 305	Sociology of Families	3
WGST 307	Feminist Theory	3
WGST 308	African-American Feminist Theory	3
WGST 310	Psychology of Women	3
WGST 351	The Family in Cross-Cultural Perspective	3
WGST 352	Gender and Politics	3
WGST 430	Topics in Women's Studies	1-3

WGST 454	Women and the Law	3
WGST 525	The Psychology of the Midlife Woman	3
WGST 554	Women and Crime	3
WGST 555	Language and Gender	3

4. Major Requirements (33 hours)

Major Courses (33 hours)

Course	Title	Credits
ECHE 321	Heat-Flow Analysis	3
ECHE 322	Mass Transfer	3
ECHE 430	Chemical Engineering Kinetics	3
ECHE 440	Separation Process Design	3
ECHE 456	Computational Methods for Engineering Applications	3
ECHE 460	Chemical Engineering Laboratory I	3
ECHE 461	Chemical Engineering Laboratory II	3
ECHE 465	Chemical-Process Analysis and Design I	3
ECHE 466	Chemical-Process Analysis and Design II	3
ECHE 550	Chemical-Process Dynamics and Control	3
ECHE 567	Process Safety, Health and Loss Prevention	3
Total Credit Hours		33

Concentrations (15 hours) *optional*

Students may pursue any of the following concentrations by choosing specified engineering, technical, and chemistry elective courses to fulfill degree requirements:

- Concentration in Biomolecular Engineering
- Concentration in Energy
- Concentration in Interdisciplinary Engineering
- Concentration in Materials
- Concentration in Environmental Engineering
- Concentration in Numerical Methods and Computing

To fulfill the requirements for any concentration, a student must complete five courses (15 credit hours) in one area. Consult the department website or advising handbook for the most up to date list of approved concentration courses. Although these courses are designated as electives in the B.S.E. curriculum in chemical engineering, certain courses in the lists are designated as "required" with respect to fulfilling concentration requirements. Also note that the lists may not include all of the prerequisites for some of the listed courses.

Concentration in Biomolecular Engineering (15 hours)

Course	Title	Credits
BIOL 302	Cell and Molecular Biology ¹	3
or BMEN 240	Cellular and Molecular Biology with Engineering Applications	
CHEM 550	Biochemistry	3
Select one of the following:		3
BMEN 271	Introduction to Biomaterials	
BMEN 391	Kinetics in Biomolecular Systems	
Select two of the following:		6
BIOL 303	Fundamental Genetics	
BIOL 460	Advanced Human Physiology	

BIOL 505	Developmental Biology
BIOL 530	Histology
BIOL 665	Human Molecular Genetics
BMEN 271	Introduction to Biomaterials
BMEN 321	Biomonitoring and Electrophysiology
BMEN 342	Infectious Disease & Immunology for Biomedical Engineers
BMEN 345	Human Anatomy and Physiology for Biomedical Engineers
BMEN 346	Medical Microbiology for Biomedical Engineers
BMEN 389	Special Topics in Biomedical Engineering for Undergraduates
BMEN 391	Kinetics in Biomolecular Systems
BMEN 392	Fundamentals of Biochemical Engineering
BMEN 499	Independent Research
BMEN 546	Delivery of Bioactive Agents
BMEN 547	Immunoengineering
BMEN 548	Cardiovascular System: From Development to Disease
BMEN 565	Advanced Biomechanics
BMEN 572	Tissue Engineering
BMEN 589	Special Topics in Biomedical Engineering ¹
Total Credit Hours	15

¹ BIOL 101 and BIOL 102 are prerequisites for BIOL 302. Multiple distinct 389/589 courses may be counted.

Concentration in Energy (15 hours)

Course	Title	Credits
ECH 573	Next Energy	3
Select four of the following:		12
ECH 372	Introduction to Materials	
ECH 389	Special Topics in Chemical Engineering (designated energy electives) ¹	
ECH 499	Special Problems (approved energy-related research project, up to 3 credit hours)	
ECH 571	Corrosion Engineering	
ECH 574	Combustion	
ELCT 363	Introduction to Microelectronics	
ELCT 510	Photovoltaic Materials and Devices	
ELCT 563	Semiconductor Electronic Devices	
EMCH 551	Nuclear Energy in the Hydrogen Economy	
EMCH 552	Introduction to Nuclear Engineering	
EMCH 553	Nuclear Fuel Cycles	
EMCH 576	Fundamentals and Applications of Fuel Cells	
ECH 589	Special Advanced Topics in Chemical Engineering (designated energy electives) ¹	
EMCH 592	Introduction to Combustion	
EMCH 594	Solar Heating	
Total Credit Hours		15

¹ Multiple distinct 389/589 courses may be counted.

Concentration in Interdisciplinary Engineering (15 hours)

Course	Title	Credits
Select five courses from the following:		15
EMCH 200	Statics or ECIV 200 Statics or ENCP 200 Statics	
EMCH 220	Mechanical Engineering Fundamentals for Non-Majors	
EMCH 260	Solid Mechanics	
EMCH 310	Dynamics	
MATH 526	Numerical Linear Algebra	
STAT 509	Statistics for Engineers	
CSC 206	Scientific Applications Programming or ECHE 456 Computational Methods for Engineering Applications	
ELCT 220	Electrical Engineering for Non-Majors or ELCT 221 Circuits	
ECHE 372	Introduction to Materials or EMCH 371 Materials	
CHEM 621	Instrumental Analysis	
Total Credit Hours		15

Concentration in Materials (15 hours)

Course	Title	Credits
ECHE 372	Introduction to Materials	3
Select one of the following:		3
ECHE 389	Special Topics in Chemical Engineering (designated materials courses)	
ECHE 571	Corrosion Engineering	
ECHE 572	Polymer Processing	
ECHE 589	Special Advanced Topics in Chemical Engineering (designated materials courses)	
Select three of the following:		9
CHEM 511	Inorganic Chemistry	
CHEM 633	Introduction to Polymer Synthesis	
CHEM 644	Materials Chemistry	
ELCT 363	Introduction to Microelectronics	
ELCT 563	Semiconductor Electronic Devices	
EMCH 573	Introduction to Nuclear Materials	
ECHE 389	Special Topics in Chemical Engineering (designated materials electives) ¹	
ECHE 499	Special Problems (approved materials-related research project, up to 3 credit hours)	
ECHE 571	Corrosion Engineering	
ECHE 572	Polymer Processing	
ECHE 589	Special Advanced Topics in Chemical Engineering (designated materials electives) ¹	
Total Credit Hours		15

¹ Multiple distinct 389/589 courses may be counted.

Concentration in Environmental Engineering (15 hours)

Course	Title	Credits
ECIV 350	Introduction to Environmental Engineering	3
ECIV 362	Introduction to Water Resources Engineering	3

ECIV 558	Environmental Engineering Process Modeling	3
CHEM 623 or CHEM 624	Introductory Environmental Chemistry Aquatic Chemistry	3
Select one of the following:		3
ENVR 231	Introduction to Sustainability Management and Leadership	
ENVR 321	Environmental Pollution and Health	
ENVR 322	Environmental Ethics	
ENVR 331	Integrating Sustainability	
Total Credit Hours		15

Concentration in Numerical Methods and Computing (15 hours)

Course	Title	Credits
Select one of the following:		3
EMCH 201	Introduction to Applied Numerical Methods	
ENCP 201	Introduction to Applied Numerical Methods	
Select four of the following:		12
CSCE 145	Algorithmic Design I	
CSCE 146	Algorithmic Design II	
MATH 374 or MATH 574	Discrete Structures Discrete Mathematics I	
MATH (500-level or higher)		
GEOL 575	Numerical Modeling for Earth Science Applications	
EMCH 501	Engineering Analysis I	
ECHE 589	Special Advanced Topics in Chemical Engineering (depending on topic coverage, multiple versions possible)	
Total Credit Hours		15

B.S.E. with Distinction

The B.S.E. with Distinction is available to students majoring in chemical engineering who wish to participate in significant research and/or design activities in chemical engineering with a faculty mentor.

A minimum GPA of 3.50 in major courses, 3.50 in all engineering courses, and 3.50 overall is required at the time the student applies to enter the departmental undergraduate research track.

The student should apply to enter the departmental undergraduate research track and choose the members of the thesis committee as early as possible but in all cases at least one year before submitting and defending the thesis. The thesis committee will consist of a thesis advisor, who must be a tenure-track faculty member in chemical engineering, and two other tenure-track or research faculty members in chemical engineering or in any other department.

By the end of the semester in which the student is admitted into the research track, a short description of the research must be agreed upon by the thesis committee and the student, and filed in the college office. Projects involving research and/or design are acceptable. The design projects or research projects for ECHE 465, ECHE 466, ECHE 567, or other courses are not acceptable as the thesis. The student must also choose three credit hours of engineering or technical elective courses related to the thesis topic. The course(s) must be approved by the thesis committee and completed by the student at least one semester before the thesis is submitted and defended.

Before submitting and defending the thesis, the student must have completed three credit hours of ECHE 499 under the thesis advisor,

preferably one credit hour per semester. During the semester in which the thesis is submitted and defended the student must also complete three credit hours of ECHE 497, one credit hour under each of the three members of the thesis committee. At least two months before submitting and defending the thesis, the student must present a progress report to the thesis committee orally and in writing.

By the end of his/her last semester, the student must have presented the research at a national meeting of a professional society (such as AIChE, ACS, ECS, etc.), at Discovery Day at USC, or at a comparable venue. The student must also submit a written thesis describing the research and defend it orally before the thesis committee. The defense must be announced at least one week in advance and be open to the general public.

Students who successfully fulfill all of these requirements with a GPA of at least 3.50 in the three hours of ECHE 497, 3.50 in all major courses, 3.50 in all engineering courses, and 3.50 overall, will be awarded their degree with "Distinction in Chemical Engineering" upon graduation.