



## Program of Study

### Degree Requirements (131 hours)

#### 1. Carolina Core (34-46 hours)

- a. **CMW** (6 hours)
  - i. ENGL 101 - Critical Reading and Composition –*must be passed with a grade of C or higher*
  - ii. ENGL 102 - Rhetoric and Composition
- b. **ARP** (8 hours) –*must be passed with a grade of C or higher*
  - i. MATH 141 - Calculus I
  - ii. MATH 142 - Calculus II
- c. **SCI** (8 hours) –*must be passed with a grade of C or higher*
  - i. CHEM 111 - General Chemistry I
  - ii. CHEM 111L - General Chemistry I Laboratory
  - iii. PHYS 211 - Essentials of Physics I
  - iv. PHYS 211L - Essentials of Physics I Lab
- d. **GFL** (0-6 hours): Students in the College of Engineering and Computing are required to demonstrate proficiency in one foreign language equivalent to the 121 course by 1) a score of two or better on the foreign language placement test; or 2) completion of the 109 and 110 courses in FREN, GERM, LATN, or SPAN or completion of the 121 course in another foreign language.
- e. **GHS** (3 hours): any approved CC-GHS course
- f. **GSS** (3 hours): any approved CC-GSS course
- g. **AIU** (3 hours): any approved CC-AIU course

#### **Carolina Core Stand Alone or Overlay Eligible Requirements:**

Up to two of these requirements may be met in overlay courses. At least one of these requirements must be satisfied by a course not applied elsewhere in general education. (3-9 Hours)

- h. **CMS** (3 hours) Choose from:
  - i. PHIL 325 - Engineering Ethics (CMS/VSR overlay)
  - ii. SAEL 200 - Social Advocacy and Ethical Life (CMS/VSR overlay)
  - iii. any approved overlay or stand-alone CC-CMS course
- i. **INF** (0-3 hours): any approved overlay or stand-alone CC-VSR course
- j. **VSR** (0-3 hours) Choose from:
  - i. PHIL 325 - Engineering Ethics (CMS/VSR overlay)
  - ii. SAEL 200 - Social Advocacy and Ethical Life (CMS/VSR overlay)
  - iii. any approved overlay or stand-alone CC-VSR course

#### 2. College Requirements: No college-required courses for this program.

#### 3. Program Requirements (64-67 hours)

- a. **Supporting Courses** (64-67 hours)
  - i. CHEM 112 - General Chemistry II –*must be passed with a grade of C or higher*
  - ii. CHEM 112L - General Chemistry II Laboratory –*must be passed with a grade of C or higher*
  - iii. CHEM 333 - Organic Chemistry I –*must be passed with a grade of C or higher*
  - iv. CHEM 334 - Organic Chemistry II
  - v. MATH 241 - Vector Calculus
  - vi. MATH 242 - Elementary Differential Equations –*must be passed with a grade of C or higher*
  - vii. PHYS 212 - Essentials of Physics II
  - viii. PHYS 212L - Essentials of Physics II Lab

- ix. **Chemistry Electives** (6 hours): A list of acceptable Chemistry Elective courses is maintained in the department office and on its website. These include:
1. CHEM 321 - Quantitative Analysis
  2. CHEM 322 - Analytical Chemistry
  3. CHEM 511 - Inorganic Chemistry
  4. CHEM 533 - Comprehensive Organic Chemistry III
  5. CHEM 541 - Physical Chemistry
  6. CHEM 542 - Physical Chemistry
  7. CHEM 545 - Physical Biochemistry
  8. CHEM 550 - Biochemistry
  9. CHEM 555 - Biochemistry/Molecular Biology I
  10. CHEM 556 - Biochemistry/Molecular Biology II
  11. CHEM 621 - Instrumental Analysis
  12. CHEM 622 - Forensic Analytical Chemistry
  13. CHEM 623 - Introductory Environmental Chemistry
  14. CHEM 624 - Aquatic Chemistry
  15. CHEM 633 - Introduction to Polymer Synthesis
  16. CHEM 644 - Materials Chemistry
- x. **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:
1. CHEM 321L - Quantitative Analysis Laboratory
  2. CHEM 322L - Analytical Chemistry Laboratory
  3. CHEM 331L - Essentials of Organic Chemistry Laboratory I *or* CHEM 333L - Comprehensive Organic Chemistry Laboratory I
  4. CHEM 332L - Essentials of Organic Chemistry Laboratory II *or* CHEM 334L - Comprehensive Organic Chemistry Laboratory II
  5. CHEM 541L - Physical Chemistry Laboratory
  6. CHEM 542L - Physical Chemistry Laboratory
  7. CHEM 550L - Biochemistry Laboratory
  8. CHEM 591 - Advanced Experimental Chemistry I
  9. CHEM 592 - Advanced Experimental Chemistry II
  10. CHEM 621L - Instrumental Analysis Lab
- xi. **Lower Division Engineering** (14 hours):
1. ECHE 101 - Introduction to Chemical Engineering *or* ENCP 101 - Introduction to Engineering I
  2. ECHE 300 - Chemical Process Principles *—must be passed with a grade of C or higher*
  3. ECHE 310 - Introductory Chemical Engineering Thermodynamics *or* ENCP 290 - Thermodynamic Fundamentals
  4. ECHE 311 - Chemical Engineering Thermodynamics
  5. ECHE 320 - Chemical Engineering Fluid Mechanics *or* ENCP 360 - Fluid Mechanics
- xii. **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:
1. ECHE 202 - Exploring the Chemical Engineering Workplace
  2. BMEN 202 - Professional Development and Ethics in Biomedical Engineering II
- xiii. **Engineering Electives** (6 hours): A list of acceptable Engineering Elective courses is maintained in the department office and on its website. The list includes:
1. ENCP 200 - Statics *or* ECIV 200 - Statics *or* EMCH 200 - Statics
  2. ENCP 201 - Introduction to Applied Numerical Methods *or* EMCH 201 - Introduction to Applied Numerical Methods
  3. ENCP 210 - Dynamics *or* ECIV 210 - Dynamics *or* EMCH 310 - Dynamics
  4. ENCP 260 - Introduction to the Mechanics of Solids *or* ECIV 220 - Mechanics of Solids *or* EMCH 260 - Introduction to the Mechanics of Solids
  5. ENCP 330 - Introduction to Vibrations *or* EMCH 330 - Mechanical Vibrations
  6. ENCP 460 - Special Topics in Engineering and Computing
  7. ENCP 481 - Project Management
  8. ENCP 499 - Interdisciplinary Technical Elective

9. ENCP 540 - Environmentally Conscious Manufacturing
  10. BMEN 211 - Computational Tools for Modeling Biomedical Systems
  11. BMEN 260 - Introduction to Biomechanics
  12. BMEN 271 - Introduction to Biomaterials
  13. BMEN 290 - Thermodynamics of Biomolecular Systems
  14. BMEN 300 and above, except BMEN 301 and BMEN 303
  15. CSCE 211 - Digital Logic Design
  16. CSCE 212 - Introduction to Computer Architecture
  17. CSCE 240 - Introduction to Software Engineering
  18. CSCE 313 - Embedded Systems
  19. CSCE 317 - Computer Systems Engineering
  20. CSCE 274 - Robotic Applications and Design
  21. ECHE 372 - Introduction to Materials
  22. ECHE 389 - Special Topics in Chemical Engineering
  23. ECHE 456 - Computational Methods for Engineering Applications
  24. ECHE 497 - Thesis Preparation
  25. ECHE 499 - Special Problems
  26. ECHE 520 - Chemical Engineering Fluid Mechanics
  27. ECHE 571 - Corrosion Engineering
  28. ECHE 572 - Polymer Processing
  29. ECHE 573 - Next Energy
  30. ECHE 574 - Combustion
  31. ECHE 589 - Special Advanced Topics in Chemical Engineering
  32. ELCT 220 - Electrical Engineering for Non-Majors
  33. ELCT 221 - Circuits
  34. ELCT 222 - Signals and Systems
  35. ELCT 300 and above
  36. ECIV 300 - Civil Engineering Measurements and above, except ECIV 360
  37. EMCH 300 and above, except EMCH 354 and EMCH 360
- xiv. **Technical Electives** (12 hours): A list of acceptable Technical Elective courses is maintained in the department office and on its website. The list includes:
1. All Engineering Electives
  2. Chemistry Electives
  3. Chemistry Lab Electives
  4. ENCP 102 - Introduction to Engineering II *or* EMCH 111 - Introduction to Engineering Graphics and Visualization
  5. MATH 374 - Discrete Structures
  6. MATH 500 and above
  7. STAT 500 and above, except STAT 541 and STAT 591
  8. BIOL 101 - Biological Principles I
  9. BIOL 101L - Biological Principles I Laboratory
  10. BIOL 102 - Biological Principles II
  11. BIOL 102L - Biological Principles II Laboratory
  12. BIOL 120 - Human Biology
  13. BIOL 120L - Laboratory in Human Biology
  14. BIOL 200 - Plant Science and above
  15. GEOL any course
  16. MSCI any course
  17. PHYS 300 and above
  18. CSCE 145 - Algorithmic Design I
  19. CSCE 146 - Algorithmic Design II
  20. CSCE 206 - Scientific Applications Programming
  21. CSCE 210 - Computer Hardware Foundations
  22. CSCE 215 - UNIX/Linux Fundamentals

23. CSCE 350 - Data Structures and Algorithms
- xv. **Liberal Arts Electives** (3-6 hours): A total of 6 courses (18 hours) of Carolina Core/Liberal Arts Electives are required. These must include courses that satisfy Carolina Core requirements for AIU, CMS, GHS, GSS, and VSR. If an overlay course is used to satisfy two components of the Carolina Core, then two Liberal Arts Electives are needed in addition to those courses fulfilling the Carolina Core requirements. If five stand-alone courses are used to satisfy the five Carolina Core requirements (AIU, CMS, GHS, GSS, and VSR), then one additional Liberal Arts Elective is needed. At least one of the six courses used to satisfy a Carolina Core/Liberal Arts Elective requirement must be at the 300-level or above and in the same field of study as one of the other five courses. A list of acceptable Liberal Arts Elective courses is maintained in the department office and the Bulletin. The list includes:
1. All approved Carolina Core Courses for AIU, CMS, GFL, GHS, GSS, and VSR
  2. AERO 401 (POC cadets only) - National Security Affairs
  3. AERO 402 (POC Cadets only) - Preparation for Active Duty
  4. AFAM 201 - Introduction to African American Studies: Social and Historical Foundations
  5. AFAM 202 - Introduction to African-American Studies: Arts and Cultural Foundations
  6. AFAM 335 - The American Civil Rights Movement
  7. ANTH 101 - Primates, People, and Prehistory
  8. ANTH 102 - Understanding Other Cultures
  9. ANTH 219 - Great Discoveries in Archaeology
  10. ANTH 300- and above except 399, 501
  11. ARTE 101 - Introduction to Art
  12. ARTH 105 - History of Western Art I
  13. ARTH 106 - History of Western Art II
  14. ARTH 300 and above except 399, 498, 499, 599
  15. ARMY 406 (Army cadets only) - American Military Experience
  16. ARMY 407 (Army cadets only) - Evolution of Warfare
  17. CPLT Any course; courses 270 and above count as 300 - level
  18. DANC 101 - Dance Appreciation
  19. ECON 221 - Principles of Microeconomics
  20. ECON 222 - Principles of Macroeconomics
  21. ECON 224 - Introduction to Economics
  22. ECON 300 and above except 399, 421, 499, 524, 595
  23. ENGL Any course above 102 (\*\*) except 460 through 467
  24. Foreign languages 121 Elementary
  25. Foreign languages 300 and above except intensive reading courses or courses about teaching
  26. GEOG 103 - Introduction to Geography
  27. GEOG 121 - Globalization and World Regions
  28. GEOG 300 and above except 399, 595
  29. HIST Any course
  30. LASP 301 - Interdisciplinary Study of Latin America
  31. LASP 311 - Latin American Cultures
  32. LASP 315 - South American Indian Cultures
  33. LASP 322 - Mesoamerican Prehistory
  34. LASP 331 - Geography of Latin America
  35. LASP 351 - Politics and Governments of Latin America
  36. LASP 398 - Special Topics in Latin American Studies
  37. LASP 425 - Prehistoric Archaeology of South America
  38. LASP 451 - International Relations of Latin America
  39. LING 300 - Introduction to Language Sciences
  40. LING 340 - Language, Culture, and Society
  41. LING 405 - Topics in Linguistics
  42. LING 505 - Interdisciplinary Topics in Linguistics
  43. LING 540 - Topics in Language and Culture
  44. LING 541 - Language and Gender
  45. LING 542 - Research in Language Conflict and Language Rights
  46. LING 543 - Discourse, Gender, and Politics of Emotion
  47. LING 545 - Anthropological Approaches to Narrative and Performance

48. LING 567 - Psychology of Language
49. LING 600 - Survey of Linguistics
50. MUSC 110 - Introduction to Music
51. MUSC 140 - Jazz and American Popular Music
52. MUSC 145 - Introduction to Music Literature
53. MUSC any music history course at or above 300 level
54. NAVY 303 (Midshipmen only) - Evolution of the Art of War
55. PHIL 102 - Introduction to Philosophy
56. PHIL 300 and above
57. PSYC 101 - Introduction to Psychology
58. PSYC 103 - Psychology of Adjustment
59. PSYC 300 and above except 570 to 599
60. POLI Any course except 379, 399
61. RELG Any course
62. SOCY 101 - Introductory Sociology
63. SOCY 300 and above except 399
64. THEA 200 - Understanding and Appreciation of Theatre
65. THEA 561 - History of the Theatre I
66. THEA 562 - History of the Theatre II
67. WGST 111 - Women in Culture
68. WGST 112 - Women in Society
69. WGST 113 - Women's Health
70. WGST 300 - Sex and Gender
71. WGST 301 - Psychology of Marriage
72. WGST 304 - Race, Class, Gender, and Sexuality
73. WGST 305 - Sociology of Families
74. WGST 307 - Feminist Theory
75. WGST 308 - African-American Feminist Theory
76. WGST 310 - Psychology of Women
77. WGST 351 - The Family in Cross-Cultural Perspective
78. WGST 352 - Gender and Politics
79. WGST 358 - Gender and Culture
80. WGST 430 - Topics in Women's Studies
81. WGST 454 - Women and the Law
82. WGST 525 - The Psychology of the Midlife Woman
83. WGST 554 - Women and Crime
84. WGST 555 - Language and Gender

#### 4. **Major Requirements (30 hours)**

##### a. **Major Courses** (30 hours)

- i. ECHE 321 - Heat-Flow Analysis
- ii. ECHE 322 - Mass Transfer
- iii. ECHE 430 - Chemical Engineering Kinetics
- iv. ECHE 440 - Separation Process Design
- v. ECHE 460 - Chemical Engineering Laboratory I
- vi. ECHE 461 - Chemical Engineering Laboratory II
- vii. ECHE 465 - Chemical-Process Analysis and Design I
- viii. ECHE 466 - Chemical-Process Analysis and Design II
- ix. ECHE 550 - Chemical-Process Dynamics and Control
- x. ECHE 567 - Process Safety, Health, and Loss Prevention

##### b. **Concentrations** -*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.

**i. Concentration in Biomolecular Engineering (15 hours)**

- Required: BIOL 302\* and CHEM 550.
- Required: one course from the following list: BMEN 271, BMEN 391.
- Required: two courses from the following list: BIOL 303, BIOL 460, BIOL 505, BIOL 530, BIOL 665, BMEN 271, BMEN 342, BMEN 389, BMEN 391, BMEN 392, BMEN 499 (3 credit hours), BMEN 572, BMEN 589. Multiple distinct 389/589 courses may be counted.

\*Note: BIOL 101 and 102 are prerequisites for BIOL 302.

**ii. Concentration in Energy (15 hours)**

- Required: ECHE 573.
- Four courses from the following list: ECHE 372, ECHE 389 (designated energy electives), ECHE 499 (approved energy-related research project, up to 3 credit hours), ECHE 571, ECHE 574, ELCT 363, ELCT 510, ELCT 563, EMCH 551, EMCH 552, EMCH 553, EMCH 576, ECHE 589 (designated energy electives), EMCH 592, EMCH 594. Multiple distinct 389/589 courses may be counted.

**iii. Concentration in Interdisciplinary Engineering (15 hours)**

- Required: five courses from the following list: EMCH 200 (or ECIV 200 or ENCP 200), EMCH 220, EMCH 260, EMCH 310, MATH 526, STAT 509, CSCE 206 or ECHE 456, ELCT 220 or ELCT 221, ECHE 372 or EMCH 371, CHEM 621.

**iv. Concentration in Materials (15 hours)**

- Required: ECHE 372.
- Required: One course from the following list: ECHE 389 (designated materials courses), ECHE 571, ECHE 572, ECHE 589 (designated materials courses).
- Three courses from the following list: CHEM 511, CHEM 633, CHEM 644, ELCT 363, (ELCT 563 or ELCT 581), EMCH 573, ECHE 389 (designated materials electives), ECHE 499 (approved materials-related research project, up to 3 credit hours), ECHE 571, ECHE 572, ECHE 589 (designated materials electives). Multiple distinct 389/589 courses may be counted.

**v. Concentration in Environmental Engineering (15 hours)**

- Required: ECIV 350, ECIV 362, ECIV 558
- One course from the following list: CHEM 623, CHEM 624
- One course from the following list: ENVR 231, ENVR 321, ENVR 322, ENVR 331

**vi. Concentration in Numerical Methods and Computing (15 hours)**

- Required: BMEN 211 or EMCH 201 or ENCP 201
- Four courses from the following list: CSCE 145, CSCE 146, MATH 374 or 574, MATH (500 level or higher), GEOL 575, EMCH 501, ECHE 589 (depending on topic coverage, multiple versions possible).

### **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 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, 466, 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 - Special Problems 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 - Thesis Preparation, 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.

### **Program GPA**

Program GPA requirement policies are described in the College of Engineering and Computing section of this bulletin. For the purpose of these policies, the following courses are used to determine the Program GPA for the Chemical Engineering B.S.E. program: all Lower Division Engineering courses, all Chemical Engineering Major courses, and all Engineering Electives.