Department of
CHEMICAL AND BIOMOLECULAR ENGINEERING
Clemson University

UNDERGRADUATE STUDENT HANDBOOK 2023-2024

Department of Chemical and Biomolecular Engineering

Clemson University

Clemson, South Carolina 29634–0909

(864) 656–3055

Student _____

Advisor _____

This handbook is available on the ChBE website:

https://www.clemson.edu/cecas/departments/chbe/documents/academics/undergrad_handbook.pdf

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INTRODUCTION

It is important that you acquaint yourself with the information in this handbook, which has been prepared to inform Chemical Engineering students about their program of study, and about the Chemical & Biomolecular Engineering Department. Most of the information presented is available in the Undergraduate Catalog or other sources, but it has been collected here for your convenience. If you have questions about anything regarding the curriculum, the department, or the chemical engineering profession, please talk to your advisor.

All colleges and departments establish certain academic requirements that must be met before a degree is granted. It is important for students to understand that university requirements will hold precedence over the requirements for graduation. For this reason, it is important for students to acquaint themselves with the appropriate University Catalog in order to fully understand all academic requirements throughout their college careers. Students are responsible for completing all requirements.

DEPARTMENT DIRECTORY

DEPARTMENTAL OFFICE:	127 Earle Hall (864) 656-3055 www.clemson.edu/cecas/departments/chbe
DEPARTMENT CHAIR:	Dr. David Bruce 125 Earle Hall dbruce@clemson.edu
UNDERGRADUATE COORDINATOR:	Dr. Amod Ogale 203 Earle Hall ogale@clemson.edu
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PROCUREMENT AND PAYROLL SUPPORT:	Tyler Cantrell 200 Earle Hall cantre9@clemson.edu
UNDERGRADUATE ADVISORS:	Each student is assigned an advisor upon entering the chemical engineering program. Check your CUNavigate account to identify your advisor.
AIChE STUDENT CHAPTER ADVISOR:	Dr. Chris Norfolk 209 Earle Hall cnorfol@clemson.edu

SELECTED INDEX – UNDERGRADUATE CATALOG

References below are from the latest Clemson University Catalog.

In general students are subject to the rules and regulations in place during the year in which they entered the University and to the curriculum requirements of the year of their most recent change of major.

University Announcements from prior years can be found online at: https://catalog.clemson.edu/

Academic Regulations
Admission
Center for Career and Professional Development (Placement)
Chemical Engineering Degree and Curricula
College of Engineering Computing and Applied Science Academic Policies
Cooperative Education
Health, Counseling & Psychological Services
Description of BMOL Courses
Description of CHE Courses
Disability Services
Financial Aid
Academic Integrity
General Education Requirements (A&H, SS, CCA, STS lists)
Minors
Transfer Students and Transfer Credits
Tuition and Fees

To access the **academic calendar**, please go to this link:
https://www.clemson.edu/registrar/academic-calendars/

CHEMICAL ENGINEERING PROGRAM

What is chemical engineering?
Chemical engineering is based on the sciences of chemistry, biology, physics and mathematics. The curriculum at Clemson emphasizes a broad range of fundamental principles in science and engineering as well as communication skills and humanities and social sciences. As a result, our graduates are sought avidly by industries in many areas of technology such as energy and fuels, commodity chemicals, specialty chemicals, pharmaceuticals, biotechnology, electronic and photonic devices, food and consumer goods, advanced materials, pulp and paper, and design engineering. Chemical engineers contribute to the prevention and remediation of environmental pollution, and many are involved in the application of engineering technology to the solution of medical and health-related problems.

Student Outcomes: What will I learn in the Clemson BS ChE Program?
The BS program in chemical engineering at Clemson consists of a blend of classroom instruction, laboratory practice, and project work designed to prepare graduates to accomplish our Program Educational Objectives. The program is designed to ensure that students achieve the following Student Outcomes by the time they graduate:

1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3) an ability to communicate effectively with a range of audiences
4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Program Educational Objectives: What can I achieve as a result of my Clemson education?
The undergraduate program in Chemical Engineering at Clemson University aims to produce graduates who within 3 to 5 years of graduation will

- Practice chemical engineering in a professional, ethical, and safe manner; and cultivate cross-disciplinary collaborations to solve contemporary challenges.
- Provide leadership in industry, government organizations, or higher education.
- Pursue life-long learning in chemical engineering, other engineering or science disciplines, medicine, law, or business.

Because of the broad, fundamental background, chemical engineering graduates are prepared for a wide variety of career paths. They can work in the operation and management of production facilities, conceptual engineering and design of new plants, technical marketing and sales, basic research and development, and a variety of other activities. The careers of many Clemson chemical engineers have led to top executive positions in established companies or to entrepreneurship in their own companies.

A Clemson chemical engineering student can tailor his/her education to a specific career objective. Many students use their Emphasis Area or Minor to prepare for a technical specialization such as energy, environmental control, or polymer processing. Others gravitate toward an emphasis in business. Some students prepare for entry into a graduate program in engineering or for advanced professional study in medicine, dentistry, or law.

CHEMICAL ENGINEERING CURRICULUM 2023-2024

Freshman Year			
Fall Semester		Spring Semester	
CH 1010 General Chemistry[1]	4	CH 1020 General Chemistry	4
ENGL 1030 Composition and Rhetoric[1]	3	CHE 1300 Introduction to Chemical Engineering[1]	3
ENGR 1020 Engineering Disciplines and Skills[1,2]	3	MATH 1080 Calculus of One Variable II[1]	4
MATH 1060 Calculus of One Variable I[1,3]	4	PHYS 1220 Physics with Calculus I[1]	3
Arts and Humanities/Social Science[4]	3	General Education Requirement[4]	3
Semester Totals:	17	*Semester Totals:*	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[5]	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[4]	3	MATH 2080 Introduction to Ordinary Differential Equations	4
Semester Totals:	17	*Semester Totals:*	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[6]	3
STAT 4110 Statistical Methods for Process Development and Control	3	General Education Requirement[4]	3
Emphasis Area Requirement[6]	3		
Semester Totals:	17	*Semester Totals:*	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[6]	3
Semester Totals:	15	Global Challenges Requirement[4,7]	3
		Semester Totals:	16
			Total: 130 Hours

Notes:

[1] Must be passed with a grade of *C* or better.

[2] The combination of **ENGR 1050** and **ENGR 1060** or the combination of **ENGR 1510** and **ENGR 1520** may be substituted for **ENGR 1020**.

[3] 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**.

[4] 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.

[5] **CH 2270** and **CH 2280** may be substituted for **CH 2290**.

[6] 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.

[7] 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.

CHEMICAL ENGINEERING CURRICULUM 2023-24 with BIOMOLECULAR ENGINEERING CONCENTRATION

Students also have the option of earning a Bachelor of Science degree in Chemical Engineering with a Biomolecular Concentration. The concentration is a modified version of the BSChE curriculum that devotes some credit hours to a stronger emphasis in biomolecular engineering and science.

Freshman Year			
Fall Semester		Spring Semester	
CH 1010 General Chemistry[1]	4	CH 1020 General Chemistry	4
ENGL 1030 Composition and Rhetoric[1]	3	CHE 1300 Introduction to Chemical Engineering[1]	3
ENGR 1020 Engineering Disciplines and Skills[1,2]	3	MATH 1080 Calculus of One Variable II[1]	4
MATH 1060 Calculus of One Variable I[1,3]	4	PHYS 1220 Physics with Calculus I[1]	3
Arts and Humanities/Social Science[4]	3	General Education Requirement[4]	3
Semester Totals:	17	*Semester Totals:*	17
Optional Summer Semester			
Consult with advisor for available course(s).			
Sophomore Year			
BIOL 1100 Principles of Biology I[5]	4	CH 2240 Organic Chemistry	3
CH 2230 Organic Chemistry	3	CH 2290 Organic Chemistry Laboratory[6]	1
CHE 2110 Mass and Energy Balances	4	CHE 2200 Chemical Engineering Thermodynamics I	3
MATH 2060 Calculus of Several Variables	4	CHE 2300 Fluids/Heat Transfer	4
Arts and Humanities/Social Science[1]	3	MATH 2080 Introduction to Ordinary Differential Equations	4
Semester Totals:	18	*Semester Totals:*	15
Junior Year			
BMOL 4250 Biomolecular Engineering	3	BIOE 3020 Biomaterials	3
CHE 3210 Chemical Engineering Thermodynamics II	3	BIOL 4340 Biological Chemistry Laboratory Techniques	2
CHE 3300 Mass Transfer and Separation Processes	4	CHE 3070 Unit Operations Laboratory I	3
PHYS 2210 Physics with Calculus II	3	CHE 3190 Engineering Materials	3
STAT 4110 Statistical Methods for Process Development and Control	3	Biochemistry Requirement[7]	3
		General Education Requirement	3
Semester Totals:	16	*Semester Totals:*	17
Optional Summer Semester			
Consult with advisor for available course(s).			
Senior Year			
BCHM 4310 Physical Biochemistry	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	Engineering Requirement[8]	3
Semester Totals:	15	Global Challenges Requirement[4,9]	3
		Semester Totals:	16
			Total: 131 Hours

Notes:

[1] Must be passed with a grade of *C* or better.

[2] The combination of **ENGR 1050** and **ENGR 1060** or the combination of **ENGR 1510** and **ENGR 1520** may be substituted for **ENGR 1020**.
[3] 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**.
[4] 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.
[5] **BIOL 1030**, **BIOL 1040**, **BIOL 1050**, and **BIOL 1060** may be substituted for **BIOL 1100**.
[6] **CH 2270** and **CH 2280** may be substituted for **CH 2290**.
[7] Select from **BCHM 3010**, **BCHM 3050**, **BCHM 4230** or **CH 3600**.
[8] Select from **BE 4280**, **BE 4350**, **BIOE 4400**, **BIOE 4490**, **BIOE 4760**, **BMOL 4030**, **BMOL 4270**, **CHE 4010** or **MICR 4130**.
[9] 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.

Department of
CHEMICAL AND BIOMOLECULAR ENGINEERING
Clemson University

ChBE Pre-Registration Advising Worksheet

Name: _____

CUID#: _____

Email: _____ @clemson.edu

Catalog Year: _____ Co-op Student: ☐

Plan Ahead: Indicate courses you plan to take NEXT semester. In the right-hand box, indicate courses you plan to take over the summer. *Leave the summer box blank if you do not plan to take any summer courses.*

☐ Fall ☐ Spring _____ Year

Course & Number (e.g., CHE 2110)	Credit Hours
Total Credits:	

☐ Summer _____ Year

Course & Number (e.g., CHE 3070)	Credit Hours
Total Credits:	

Comments to Advisor:

Required Courses Checklist: For listed courses, please indicate "C" if completed, "P" if in progress or "R" if re-taking. Enter your chosen Emphasis Area/Minor, and list the specific emphasis area/minor courses that are in progress or you have already taken.

CH 1020	CHE 1300	CHE 2110	CH 2230	MATH 2060	PHYS 2210	CH 2240	CH 2290	CHE 2200	CHE 2300	MATH 2080	CH 3390	CHE 3210	CHE 3300	STAT 4110
ECE 2070	**ECE 2080**	**BMOL[1] 4250**	**CH 3320**	**CH 3400**	**CHE 3070**	**CHE 3190**	**CHE 4070**	**CHE 4310**	**CHE 4430**	**CHE 4500**	**BMOL[1] 4290**	**CHE 4530**	**CHE 4330**	**CHE 4440**

Emphasis Area or Minor		Emphasis Area/Minor Courses Taken[3]				

General Education Checklist: Please indicate the specific course and number (e.g., ENGL 2120) attributed to each general education requirement that you have already taken. Do NOT simply list "C", "P", or "R" for these courses.

Hum. Lit[2]	Hum. Non-Lit[2]	Social Sci. #1[2]	Social Sci. #2[2]

Global Challenges[4]	

1 Depending on your curriculum year, this may have an alternate requirement.
2 Select from University approved Humanities and Social Science courses: see General Education in the Undergraduate Catalog at http://catalog.clemson.edu/
3 Select courses from the appropriate ChBE Undergraduate Student Handbook.
4 Global Challenge requirements may be satisfied by other courses as long as the student completes a total of 31 hours of Gen Ed (see Undergraduate Announcements for courses that may satisfy both requirements). One global challenges course must be at the 3000 level or higher.

Notes:

- Refer to the ChBE Undergraduate Handbook for a comprehensive description of Departmental Policies and curriculum information. www.clemson. edu/cecas/departments/chbe/documents/undergrad_handbook.pdf
- An engineering GPA of 2.0 or higher is required for graduation.
- **No student may exceed a maximum of two attempts to successfully complete any CHE course, including a "W" or academic forgiveness."**
- Students on co-op/intern (or others with approval of their advisor) may elect to not meet in person with their advisor.
- Please see the Academic Regulations section of the current Undergraduate Catalog (https://catalog.clemson.edu/) for information to satisfy the SC REACH Act graduation requirement.

Student Signature: _____ **Date:**
REQUIRED

Advisor Signature: _____ **Date:**
REQUIRED

Department of
CHEMICAL AND BIOMOLECULAR ENGINEERING
Clemson University

ChBE Pre-Registration Advising Worksheet
Biomolecular Concentration

Name: _____

CUID#: _____

Email: _____ @clemson.edu

Catalog Year: _____ **Co-op Student:** ☐

Plan Ahead: Indicate courses you plan to take NEXT semester. In the right-hand box, indicate courses you plan to take over the summer. *Leave the summer box blank if you do not plan to take any summer courses.*

☐ Fall ☐ Spring _____ Year ☐ Summer _____ Year

Course & Number (e.g., CHE 2110)	Credit Hours
Total Credits:	

Course & Number (e.g., CHE 3070)	Credit Hours
Total Credits:	

Comments to Advisor:

Required Courses Checklist: For listed courses, please indicate "C" if completed, "P" if in progress or "R" if re-taking. Enter your chosen Emphasis Area/Minor, and list the specific emphasis area/minor courses that are in progress or you have already taken.

CH 1020	CHE 1300	CHE 2110	CH 2230	MATH 2060	BIOL 1100	CH 2240	CH 2290	CHE 2200	CHE 2300	MATH 2080	PHYS 2210	BIO CHEM[5]	STAT 4110	CHE 3210
CHE 3300	**MICR 4130**	**BMOL[1] 4250**	**CH 3320**	**CHE 3070**	**CHE 3190**	**CHE 4070**	**CHE 4310**	**CHE 4430**	**CHE 4500**	**BCHM 4310**	**BMOL[1] 4290**	**CHE 4530**	**CHE 4330**	**CHE 4440**

ENG. REQ.[6]

General Education Checklist: Please indicate the specific course and number (e.g., ENGL 2120) attributed to each general education requirement that you have already taken. Do NOT simply list "C", "P", or "R" for these courses.

Hum. Lit[2]	Hum. Non-Lit[2]	Social Sci. #1[2]	Social Sci. #2[2]

Global Challenges	

1 Depending on your curriculum year, this may have an alternate requirement.
2 Select from University approved Humanities and Social Science courses: see General Education of the Undergraduate Catalog at http://catalog.clemson.edu/
3 Select courses from the appropriate ChBE Undergraduate Student Handbook.
4 Global Challenge requirements may be satisfied by other Gen Ed courses as long as the student completes a total of 31 hours of Gen Ed (see Undergraduate Announcements for courses that may satisfy both requirements). One global challenges course must be at the 3000 level or higher.
5 Biochem, select from BCHM 3010, BCHM 3050, BCHM 4230, or CH 3600.
6 Eng. Req., select from CHE 4010, BMOL 4030 or 4270, BE 4280 or 4350, BIO 4400, 4490, or 4730.

Notes:

- Refer to the ChBE Undergraduate Handbook for a comprehensive description of Departmental Policies and curriculum information. www.clemson. edu/cecas/departments/chbe/documents/undergrad_handbook.pdf
- An engineering GPA of 2.0 or higher is required for graduation.
- **No student may exceed a maximum of two attempts to successfully complete any CHE course, including a "W" or academic forgiveness."**
- Students on co-op/intern (or others with approval of their advisor) may elect to not meet in person with their advisor.
- Please see the Academic Regulations section of the current Undergraduate Catalog (https://catalog.clemson.edu/) for information to satisfy the SC REACH Act graduation requirement.

Student Signature: _____ **Date:**
REQUIRED

Advisor Signature: _____ **Date:**
REQUIRED

Contributions to Student Outcomes and Program Educational Objectives

Chemical Engineering Curriculum: Contributions to the Achievement of Student Outcomes

Course	Student Outcome						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CH 1010/1020/2230/2240/2290/3320/3390/3400			B			B	
MATH 1060/1080/2060/2080; STAT 4110							
PHYS 1220/2210; ECE 2070/2080	B				B	B	
BMOL 4250 Biomolecular Engineering; BMOL 4290 Bioprocess Engineering	A						
ENGL 1030, Arts/Humanities/Social Sciences			B				B
ENGR 1020 Engineering Disciplines & Skills	B						
CHE 1300 Introduction to Chemical Engineering	B						
CHE 2110 Mass and Energy Balances	A	B		B			
CHE 2200 Chemical Engineering Thermodynamics I	A						
CHE 2300 Fluids/Heat Transfer	A						
CHE 3070 Unit Operations Laboratory I	A	B	A	B	A	A	B
CHE 3190 Engineering Materials	A	B					
CHE 3210 Chemical Engineering Thermodynamics II	A						
CHE 3300 Mass Transfer/Separations	A	B					
CHE 4530 Process Dynamics & Control	A	B					
CHE 4070 Unit Operations Laboratory II	A	B	A	B	A	A	A
CHE 4310 Process Design I	A	A	B	A	B		B
CHE 4330 Process Design II	A	A	A	A	A		A
CHE 4430 Safety, Environmental, Professional Practice I	A			A			
CHE 4440 Safety, Environmental, Professional Practice II			A	A	B		A
CHE 4500 Kinetics & Reactor Design	A	B					

Notes: Courses shaded in blue are where outcomes are assessed.

A -- denotes a primary contributor B -- denotes a secondary contributor

(1) ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
(2) ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
(3) ability to communicate effectively with a range of audiences
(4) ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
(5) ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
(6) ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
(7) ability to acquire and apply new knowledge as needed, using appropriate learning strategies

BMOL Concentration: Contributions to the Achievement of Student Outcomes

Course	Student Outcome						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CH 1010/1020/2230/2240/2290/; BIOL 1100			B			B	
MATH 1060/1080/2060/2080; STAT 4110							
PHYS 1220/2210							
Biochemistry Requirement; BCHM 4310; BIOL 4340						B	
ENGL 1030, Arts/Humanities/Social Sciences			B				B
ENGR 1020 Engineering Disciplines & Skills	B						
CHE 1300 Introduction to Chemical Engineering	B						
CHE 2110 Mass and Energy Balances	A	B		B			
CHE 2200 Chemical Engineering Thermodynamics I	A						
CHE 2300 Fluids/Heat Transfer	A						
CHE 3070 Unit Operations Laboratory I	A	B	A	B	A	A	B
CHE 3190 Engineering Materials	A	B					
CHE 3210 Chemical Engineering Thermodynamics II	A						
CHE 3300 Mass Transfer/Separations	A	B					
CHE 4530 Process Dynamics & Control	A	B					
CHE 4070 Unit Operations Laboratory II	A	B	A	B	A	A	A
CHE 4310 Process Design I	A	A	B	A	B		B
CHE 4330 Process Design II	A	A	A	A	A		A
CHE 4430 Safety, Environmental, Professional Practice I	A			A			
CHE 4440 Safety, Environmental, Professional Practice II			A	A	B		A
CHE 4500 Kinetics & Reactor Design	A	B					
BIOE 3020 Biomaterials; BMOL 4250 Biomolecular Engineering; BMOL 4290 Bioprocess Engineering	A						

Notes: Courses shaded in blue are where outcomes are assessed.

A -- denotes a primary contributor B -- denotes a secondary contributor

(1) ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
(2) ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
(3) ability to communicate effectively with a range of audiences
(4) ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
(5) ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
(6) ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
(7) ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Chemical Engineering Curriculum: Contributions to Program Educational Objectives

Course	Program Educational Objective		
	PEO1	PEO2	PEO3
CH 1010/1020/2230/2240/2290/3320/3390/3400	B		
MATH 1060/1080/2060/2080; STAT 4110	B		
PHYS 1220/2210; ECE 2070/2080	B		
BMOL 4250 Biomolecular Engineering; BMOL 4290 Bioprocess Engineering	B		
ENGL 1030, Arts/Humanities/Social Sciences	B		B
ENGR 1020 Engineering Disciplines & Skills	B		
CHE 1300 Introduction to Chemical Engineering	B		
CHE 2110 Mass and Energy Balances	A		
CHE 2200 Chemical Engineering Thermodynamics I	A		
CHE 2300 Fluids/Heat Transfer	A		
CHE 3070 Unit Operations Laboratory I	A	B	A
CHE 3190 Engineering Materials	A		
CHE 3210 Chemical Engineering Thermodynamics II	A		
CHE 3300 Mass Transfer/Separations	A		
CHE 4530 Process Dynamics & Control	A		
CHE 4070 Unit Operations Laboratory II	A	A	A
CHE 4310 Process Design I	A	B	B
CHE 4330 Process Design II	A	A	A
CHE 4430 Safety, Environmental, Professional Practice I	A	B	B
CHE 4440 Safety, Environmental, Professional Practice II	B	B	B
CHE 4500 Kinetics & Reactor Design	A		

Notes:

A -- denotes a primary contributor B -- denotes a secondary contributor

PEO1 Practice chemical engineering in a professional, ethical, and safe manner; and cultivate cross-disciplinary collaborations to solve contemporary challenges

PEO2 Provide leadership in industry, government organizations, or higher education

PEO3 Pursue life-long learning in chemical engineering, other engineering or science disciplines, medicine, law, or business

BMOL Concentration: Contributions to Program Educational Objectives

Course	Program Educational Objective		
	PEO1	PEO2	PEO3
CH 1010/1020/2230/2240/2290/; BIOL 1100	B		
MATH 1060/1080/2060/2080; STAT 4110	B		
PHYS 1220/2210	B		
Biochemistry Requirement; BCHM 4310; BIOL 4340	B		
ENGL 1030, Arts/Humanities/Social Sciences	B		B
ENGR 1020 Engineering Disciplines & Skills	B		
CHE 1300 Introduction to Chemical Engineering	B		
CHE 2110 Mass and Energy Balances	A		
CHE 2200 Chemical Engineering Thermodynamics I	A		
CHE 2300 Fluids/Heat Transfer	A		
CHE 3070 Unit Operations Laboratory I	A	B	A
CHE 3190 Engineering Materials	A		
CHE 3210 Chemical Engineering Thermodynamics II	A		
CHE 3300 Mass Transfer/Separations	A		
CHE 4530 Process Dynamics & Control	A		
CHE 4070 Unit Operations Laboratory II	A	A	A
CHE 4310 Process Design I	A	B	B
CHE 4330 Process Design II	A	A	A
CHE 4430 Safety, Environmental, Professional Practice I	A	B	B
CHE 4440 Safety, Environmental, Professional Practice II	B	B	B
CHE 4500 Kinetics & Reactor Design	A		
BIOE 3020 Biomaterials; BMOL 4250 Biomolecular Engineering; BMOL 4290 Bioprocess Engineering	A		B

Notes:

A -- denotes a primary contributor B -- denotes a secondary contributor

PEO1 Practice chemical engineering in a professional, ethical, and safe manner; and cultivate cross-disciplinary collaborations to solve contemporary challenges

PEO2 Provide leadership in industry, government organizations, or higher education

PEO3 Pursue life-long learning in chemical engineering, other engineering or science disciplines, medicine, law, or business

DEPARTMENTAL POLICIES

CHBE UNDERGRADUATE PREREQUISITE POLICY

Prerequisites to chemical engineering courses are established by the faculty to ensure that students are properly prepared for the courses in the curriculum. The objectives are to prevent students from doing serious harm to their own academic records by attempting courses they are not prepared for, to insure that students are able to do their fair share of team work, and to ensure that the pace and scope of courses are not impeded by poorly prepared students.

Generally, the faculty are reluctant to waive prerequisites, but mitigating circumstances sometimes arise. Any student who wishes to enroll in a course for which they do not meet all prerequisites must submit a written request in the form of a memo document via email to the ChBE Departmental Undergraduate Coordinator or the ChBE Student Services Coordinator. The memo should contain an explanation of the circumstances, be addressed to the Undergraduate Curriculum Committee, contain any supporting documentation, and be received AT LEAST 2 days before the start of classes. Earlier submittal is encouraged.

When the Undergraduate Committee deliberates on such requests, the primary factors considered are the reasons for the prerequisite deficiency and the student's academic record to date, with particular emphasis on engineering GPA and prior performance in chemical engineering courses. Students who enroll in a course without meeting all prerequisites or receiving a written Departmental waiver will be dropped from the course.

Things for students to consider regarding Prerequisite Waivers

- DO NOT DROP OR STOP ATTENDING A CLASS WITHOUT CONSULTING YOUR ADVISOR.
- Waivers are not automatically or routinely granted.
- The chemical engineering curriculum is highly structured, with many courses being prerequisites to others.
- Many classes are offered only once a year. Before you drop any course, you must consider the consequences to your academic schedule and progress toward graduation.

FOR MORE INFORMATION, SEE YOUR ADVISOR AND THE PREREQUISITE GUIDE IN THIS HANDBOOK.

Guide to Course Prerequisites: 2023/24 Chemical Engineering Curriculum

WARNING: Prerequisites are subject to change. Consult the Undergraduate Catalog, which contains the most recent information. To use this guide, begin with key course of interest in the center column. These courses are listed in order of the semester in which they are normally taken. The left column gives the prerequisites for the key course, and the right column lists subsequent courses which require the key course as a prerequisite.

Prerequisites →	* Key Course * →	Prerequisite for
	CH 1010	CH 1020, CHE 1300
A score of 680 or higher on the SAT Math section, or a score of 29 or higher on the ACT Math section, or a score of 80 or higher on the Clemson Mathematics Placement Test (CMPT)	**MATH 1060**	MATH 1080, ENGR 1020 (coreq) PHYS 1220 (coreq)
	ENGL 1030	
Score of 65 or higher on the CMPT; or a score of 640 or higher on SAT Math section; or a score of 27 or higher on ACT Math section; or one of the following MATH courses (concurrent enrollment is allowed): MATH 1040 or MATH 1060 or MATH 1080 or MATH 2060 or MATH 2080 with a C or better	**ENGR 1020**	CHE 1300
CH 1010 with C or better	**CH 1020**	CHE 2110, CH 2230
MATH 1060 with a C or better or MATH 1070 with a C or better	**MATH 1080**	MATH 2060, PHYS 2210, CHE 2110
MATH 1060 or MATH 1070 (concurrent enrollment is allowed)	**PHYS 1220**	CHE 2110
CH 1010 with a C or better and either ENGR 1020 or ENGR 1060 with a C or better	**CHE 1300**	CHE 2110
CH 1020	**CH 2230**	CH 2240, CH 2290, CHE 3190 (coreq)
MATH 1080 with a C or better or MATH 1110 with a C or better	**MATH 2060**	MATH 2080, CHE 2200, ECE 3070, CHE 2300 (coreq), STAT 4110
CH 1020, MATH 1080, PHYS 1220, CHE 1300 with a C or higher	**CHE 2110**	CHE 2200, 2300, 3190
MATH 1080 or MATH 1110 (concurrent enrollment is allowed)	**PHYS 2210**	ECE 3070
CH 2230	**CH 2240**	BMOL 4250
CH 2230	**CH 2290**	
MATH 2060 with a C or better	**MATH 2080**	CHE 3210, 4530
CHE 2110, MATH 2060	**CHE 2200**	CHE 3210, CHE 3070, CH 3320, CH 3390, CHE 2300 (coreq), CHE 3190 (coreq), CCHE 3300, BMOL 4250

Prerequisites →	* Key Course * →	Prerequisite for
CHE 2110, CHE 2200 (coreq), MATH 2060 (coreq)	**CHE 2300**	CHE 3300, CHE 3070, CHE 3190 (coreq)
CHE 2110, CHE 2230 (coreq), CHE 2200 (coreq)	**CHE 3190**	
CHE 2200, CHE 2300	**CH 3070**	CHE 4070, 4310
MATH 2060	**STAT 4110**	
MATH 2060 and PHYS 2210	**ECE 2070**	ECE 2080 (coreq)
ECE 2070 (concurrent enrollment is allowed)	**ECE 2080**	
CH 3310 or CHE 2200 (concurrent enrollment is allowed)	**CH 3390**	
CH 2240; and one of CH 3300 or CH 3301 or CHE 2200	**BMOL 4250**	
CHE 2200, MATH 2080	**CHE 3210**	CHE 4500, CHE 4310, CHE 3300 (coreq)
CHE 2200, CHE 2300, CHE 3210 (coreq)	**CHE 3300**	CHE 4530, 4070, 4310, 4330, 4500, BMOL 4290
CH 3310 or CHE 2200	**CH 3320**	CH 3400 (coreq)
CH 3320 (coreq)	**CH 3400**	
CHE 3070, CHE 3300	**CHE 4070**	CHE 4330
CHE 3070, CHE 3210, CHE 3300, CHE 4500 (coreq)	**CHE 4310**	CHE 4430 (coreq), CHE 4330
CHE 4310 (coreq)	**CHE 4430**	CHE 4440
CHE 3300, CHE 3210	**CHE 4500**	CHE 4310 (coreq), CHE 4330
MATH 2080, CHE 2300 and CHE 3300 (coreq)	**CHE 4530**	
CHE 3300, 4070, 4310, 4500	**CHE 4330**	
CHE 4430, CHE 4330 (coreq)	**CHE 4440**	
CHE 3300, CHE 4500	**BMOL 4290**	

Notes: coreq denotes corequisite

Guide to Course Prerequisites: 2023/24 Chemical Engineering Curriculum, Biomolecular Engineering Concentration

WARNING: Prerequisites are subject to change. Consult the Undergraduate Catalog, which contains the most recent information. To use this guide, begin with key course of interest in the center column. These are listed in order of the semester in which they are normally taken. The left column gives the prerequisites for the key course, and the right column lists subsequent courses which require the key course as a prerequisite.

Prerequisites →	* Key Course * →	Prerequisite for
	CH 1010	CH 1020, CHE 1300
A score of 680 or higher on the SAT Math section, or a score of 29 or higher on the ACT Math section, or a score of 80 or higher on the Clemson Mathematics Placement Test (CMPT)	**MATH 1060**	MATH 1080, ENGR 1020 (coreq) PHYS 1220 (coreq)
	ENGL 1030	
Score of 65 or higher on the CMPT; or a score of 640 or higher on SAT Math section; or a score of 27 or higher on ACT Math section; or one of the following MATH courses (concurrent enrollment is allowed): MATH 1040 or MATH 1060 or MATH 1080 or MATH 2060 or MATH 2080 with a C or better	**ENGR 1020**	CHE 1300
CH 1010 with C or better	**CH 1020**	CHE 2110, CH 2230
MATH 1060 with a C or better or MATH 1070 with a C or better	**MATH 1080**	MATH 2060, PHYS 2210, CHE 2110
MATH 1060 or MATH 1070 (concurrent enrollment is allowed)	**PHYS 1220**	CHE 2110
CH 1010 with a C or better and either ENGR 1020 or ENGR 1060 with a C or better	**CHE 1300**	CHE 2110
CH 1020	**CH 2230**	CH 2240, CH 2290, CHE 3190 (coreq)
MATH 1080 with a C or better or MATH 1110 with a C or better	**MATH 2060**	MATH 2080, CHE 2200, ECE 3070, CHE 2300 (coreq), STAT 4110
CH 1020, MATH 1080, PHYS 1220, CHE 1300 with a C or higher	**CHE 2110**	CHE 2200, 2300, 3190
MATH 1080 or MATH 1110 (concurrent enrollment is allowed)	**PHYS 2210**	ECE 3070
CH 2230	**CH 2240**	BMOL 4250
CH 2230	**CH 2290**	
MATH 2060 with a C or better	**MATH 2080**	CHE 3210, 4530

Prerequisites →	* Key Course * →	Prerequisite for
CHE 2110, MATH 2060	**CHE 2200**	CHE 3210, CHE 3070, CH 3320, CH 3390, CHE 2300 (coreq), CHE 3190 (coreq), CCHE 3300, BMOL 4250
CHE 2110, CHE 2200 (coreq), MATH 2060 (coreq)	**CHE 2300**	CHE 3300, CHE 3070, CHE 3190 (coreq)
CHE 2110, CHE 2230 (coreq), CHE 2200 (coreq)	**CHE 3190**	
CHE 2200, CHE 2300	**CH 3070**	CHE 4070, 4310
	BIOL 1100	BCHM 3010 (Biochemistry requirement)
MATH 2060	**STAT 4110**	
CH 2240; and one of CH 3300 or CH 3301 or CHE 2200	**BMOL 4250**	
One of the two following combinations: (1) BIOE 2010 and MSE 2100; and either both CH 2010 and CH 2020, or both CH 2230 and CH 2270; or (2) CHE 2110 and CH 2230; and either CH 2270 or CH 2290	**BIOE 3020**	
BIOL 1100 with a C or better; CH 2230 (coreq)	**BCHM 3010 (Biochemistry requirement)**	BCHM 4310
CHE 2200, MATH 2080	**CHE 3210**	CHE 4500, CHE 4310, CHE 3300 (coreq)
CHE 2200, CHE 2300, CHE 3210 (coreq)	**CHE 3300**	CHE 4530, 4070, 4310, 4330, 4500, BMOL 4290
BCHM 3010 with C or better or CH 3300 (coreq)	**BCHM 4310**	
BCHM 3010 or BCHM 3050	**BIOL 4340**	
CHE 3070, CHE 3300	**CHE 4070**	CHE 4330
CHE 3070, CHE 3210, CHE 3300, CHE 4500 (coreq)	**CHE 4310**	CHE 4430 (coreq), CHE 4330
CHE 4310 (coreq)	**CHE 4430**	CHE 4440
CHE 3300, CHE 3210	**CHE 4500**	CHE 4310 (coreq), CHE 4330
MATH 2080, CHE 2300 and CHE 3300 (coreq)	**CHE 4530**	
CHE 3300, 4070, 4310, 4500	**CHE 4330**	
CHE 4430, CHE 4330 (coreq)	**CHE 4440**	
CHE 3300, CHE 4500	**BMOL 4290**	

Note: coreq denotes corequisite

COURSE SUBSTITUTIONS AND COURSES TAKEN ELSEWHERE

Substitution for Required Courses

The Faculty of Chemical & Biomolecular Engineering has designed the curriculum carefully to ensure that our graduates are well prepared to undertake their professional careers, and to ensure that all accreditation requirements and university requirements are met. Thus, substitution for a required course in the curriculum is not approved without close scrutiny. Nevertheless, there are occasionally circumstances in which such substitution is justified and will be permitted with the necessary approvals. Such circumstances include substitution of an equivalent or higher-level course in the same subject matter or substitution that permits a student to take advantage of a change made in a later curriculum. In all cases, the proposed substitution must be such that it does not cause any violation of accreditation or university requirements. If a student wishes to substitute an alternative course, whether a Clemson course or a transfer course, for a required course, a course substitution form must be completed and approved. The form entitled "Request Substitution for an Academic Requirement" is available in iROAR.

Courses Taken Elsewhere

In the summer, or during terms away from campus (e.g., on co-op or study abroad), it is sometimes advantageous for students to take one or more courses at another institution. For such course transfers to be accepted, the department that offers the equivalent course at Clemson must certify its equivalency. Thus, for example, the Chemistry Department must certify an organic chemistry course as equivalent to CH 2230 or 2240 at Clemson for it to be accepted in our curriculum. This certification should be obtained in advance of taking the course. Many courses offered at nearby schools have already been certified and included on the University's Transfer Credit Equivalency List (TCEL) so that their approval requires only verification that they are on the list and the signature of your advisor. If a student wishes to transfer an equivalent course from another institution for credit, an "Approval of Credits To Be Earned at Another School" form must be completed in iROAR.

There are several university policies concerning course transfer; some of these are listed on the following page. Additionally, three notes on course transfer are called especially to your attention:

1. You must earn at least a grade C for any transfer to be accepted.

2. Transfer of any chemical engineering course not on the University's Transfer Credit Equivalency List (TCEL) requires signatures of your academic advisor and the Chemical Engineering Department Chair.

3. No more than 13 hours of chemical engineering credits from another university will be accepted for required course credits at Clemson.

See https://www.clemson.edu/admissions/undergraduate-admissions/course-transfer-information.html for transfer evaluation equivalency information for specific colleges and universities.

CHEMICAL ENGINEERING DEPARTMENTAL ACADEMIC ADVISING

Prior to registering for each semester, it is the student's responsibility to seek out their academic advisor to consult on their academic status and progress towards graduation. Each student who enters the major is assigned to a Student Services Coordinator for academic advising. Each student must consult his or her advisor at least once each semester to review academic plans and progress and to be cleared for registration for the next semester. Prior to an advising meeting, students complete a pre-advising worksheet and a general education worksheet for a student's particular degree plan and academic year that dictates what degree requirements have been completed, what courses are planned for the upcoming semester, and a plan of courses to complete the degree.

The primary purpose of the required advising meetings is to select courses for the coming semester. The student is expected to actively participate in preparing a schedule that follows the academic policies of the Department, including meeting all prerequisites. Students are instructed to come to their advising meeting with a projected schedule for the coming semester. The roles of advisors are to review the student's plan of courses, to confirm that the plan is appropriate or to advise them on necessary corrections, and to make sure that the student is on a correct path towards graduation. A student's advising appointment is an opportunity to ask questions regarding the Chemical Engineering curriculum and requirements for completing the Chemical Engineering degree. Students may also take this opportunity to ask their advisor about other questions regarding other opportunities in the department (e.g., research, cooperative education, internship, study abroad, graduate school, etc.). Students are redirected to the Departmental Undergraduate Coordinator for additional information as needed, and referrals are made to other resources if necessary. After the advisor approves a plan of study for the coming semester, the advisor provides the student with a PIN that they enter when registering.

Students should consult their advisor before making other decisions regarding their academic progress. Examples of these may include:

- Dropping a required CHE course after the drop date, which could have implications with prerequisites or the departmental two strike policy. **Students may not attempt any CHE course more than two times, which includes a W and the use of an academic forgiveness.**
- Use of academic forgiveness. Academic forgiveness can be used at any point but is irreversible. Students may prefer to save their academic forgiveness to apply towards courses with more credit hours or for engineering courses that contribute to **the Departmental 2.0 engineering GPA requirement for graduation.**
- In addition to satisfying the curriculum requirements, the student must also satisfy the following requirements to graduate:
    1. The student's cumulative GPA must be 2.00 or higher.
    2. The student must complete through instruction from Clemson a minimum of 37 of the last 43 credits presented for the degree.
    3. All undergraduate students who enter the university during Summer 2021 or afterward must pass one course that has been approved as meeting the South Carolina REACH Act requirement. This course may count as a requirement in any part of the program of study. Successful completion of coursework in compliance with the REACH Act is required for graduation.
    4. 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 (i.e., engineering GPA or eGPA). Courses taught in the following rubrics are used in the calculation of a student's eGPA: AMFG (Advanced Manufacturing), AUE (Automotive Engineering), BE (Biosystems Engineering), BIOE (Bioengineering), BMOL (Biomolecular Engineering), CE (Civil Engineering), CHE (Chemical Engineering), ECAS (College of Engineering, Computing and Applied Sciences), ECE (Electrical and Computer Engineering), EES (Environmental Engineering and Science), EM (Engineering Mechanics), ENGR (Engineering), ESED (Engineering and Science Education), IE (Industrial Engineering), ME (Mechanical Engineering), and MSE (Materials Science and Engineering). All attempts of these courses with grades of *A, B, C, D, F,* and *I* are included in the calculation.

- Should a student not meet the minimum eGPA (2.0) requirement, the student may request a waiver for extenuating circumstances provided that the student meets certain other requirements. The student shall submit a memo to the Department Undergraduate Studies Coordinator explaining the extenuating circumstances, have an eGPA of at least 1.9, and passed the FE exam.

CHEMICAL ENGINEERING DEPARTMENTAL APPEAL PROCESS

In the event that a student believes extenuating circumstances exist that have directly or indirectly resulted in a student's inability to meet any of the chemical engineering degree requirements, the student may submit a formal appeal to the Departmental Undergraduate Studies Committee for evaluation. The appeal should be made in the form of a written memo and submitted via email to the Departmental Undergraduate Coordinator with a copy to your academic advisor. The memo should contain an explanation of the circumstances and include any supporting documentation. For example, in the event of an unforeseen personal tragedy, a letter from a medical doctor or registered grief counselor may be included as an attachment. All submitted documentation will be held confidential within the department.

All appeals will be evaluated by the Departmental Undergraduate Studies Committee and the Department Chair. For cases requiring further deliberation, the Departmental Undergraduate Studies Committee will gain insight from other members of the Departmental Faculty.

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

Information about General Education requirements can be found in the Undergraduate Catalog at https://catalog.clemson.edu/. Each undergraduate student must fulfill the General Education requirements stipulated in the Undergraduate Catalog in the year of initial enrollment at Clemson or in the year of re-enrollment if the student withdraws from the university and returns. Any exception to curricular or general education requirements must the approved via the course substitution procedure.

The Clemson University undergraduate curriculum is designed such that arts and humanities, mathematics, natural sciences, social sciences, and written and oral communication contribute to the holistic development of its students. The General Education program includes 31 total credit hours in the following:

COMMUNICATIONS

- Communication (minimum of 6 credit hours)
    - English Composition (3 credit hours)
    - Oral Communication (3 credit hours)

WAYS OF KNOWING

- Mathematics (minimum of 3 credit hours)
- Natural Sciences with Lab (minimum of 4 credit hours)
- Arts and Humanities (minimum of 6 credit hours)
    - Literature (3 credit hours)
    - Non-Literature (3 credit hours)
- Social Sciences (minimum of 6 credit hours selected from two different fields)

GLOBAL CHALLENGES

- Global Challenges (minimum of 6 credit hours, must be selected from two different fields unless identified in the Undergraduate Catalog as interdisciplinary)
- At least three credit hours must be selected from a course(s) at the 3000-level or higher
- 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.

Communications: Students in Chemical Engineering complete English composition by taking ENGL 1030 (Composition and Rhetoric). They satisfy the university requirement for oral communication by taking a University-approved cluster of courses as discussed below.

Oral communications are developed in a three-course sequence. Though earlier courses may include oral presentations, formal instruction begins in the first unit operations laboratory course (CHE 3070). Instruction is provided on oral presentations of laboratory plans and reports of experimental results. In CHE 3070 each student makes and receives constructive feedback and a grade on two oral presentations. Much of this work is done by students working in teams, but individual work is graded so that the skills of each student can be developed and evaluated. In the second unit operations laboratory course (CHE 4070), communication skills are developed further through additional instruction and practice with respect to laboratory work. Two oral presentations are required. In the capstone design course (CHE 4330), the context changes to chemical process design projects. Each student must contribute to a final presentation. A panel of faculty and professional practitioners evaluates the final project presentation.

Ways of knowing: Clemson University's General Education requirements in mathematics and natural sciences with lab are far surpassed in the Chemical Engineering Program. Chemical Engineering students must take at least one literature course, at least one non-literature course in the arts or humanities, and at least two social science courses in different disciplines.

Global Challenges: Chemical Engineering students complete the first three credits of Global Challenges by taking ENGR 1020 (Engineering Disciplines and Skills). In addition, they must take at least one 3000-level or higher Global Challenges course in a different discipline.

SC REACH ACT (SC. 38 as amended) Graduation Requirements

To comply with the South Carolina REACH ACT, all undergraduate students who enter the university during summer 2021 or afterward must pass one of the following courses. This course may count as a requirement in any part of the program of study including the major, minor, general education or as a free elective.

- **HIST 1010 – History of the United States 3 Credits (3 Contact Hours)**
- **POSC 1010 – American National Government 3 Credits (3 Contact Hours)**
- **POSC 1030 – Introduction to Political Theory 3 Credits (3 Contact Hours)**

Students with AP, IB, or dual enrollment credit for these courses do not need to repeat them. Additional courses may be approved which can satisfy this requirement. Successful completion of coursework in compliance with the REACH ACT is required for graduation.

ENRICHMENT OPPORTUNITIES

Cooperative Education Program

The Cooperative Education Program at Clemson is recognized as one of the leading co-op programs in the country. Many engineering students prefer the Co-op Program because of the depth and rigor of the experience. Students appreciate the formal structure of the program as well as the convenience and ease of the matching process. The Co-op Program is the only engaged-learning program in which students are able to interview with 6-8 companies in a four-day period.

Cooperative Education is an engaged-learning program designed to provide the student with an opportunity to learn and develop under a mentor engineer over multiple rotations. Students are employed full-time, with pay, by a company that partners with the program.

Semesters of co-op rotations typically alternate with semesters of classes and result in significant full-time professional experience for each student. Engineering students do a minimum of 3 rotations (two regular semesters and one summer) to complete the program and receive the ***Cooperative Education Certificate***. Studies show that **co-op graduates earn higher starting salaries** and are making higher salaries five years into their careers than their peers who do not participate.

The program is a robust educational experience. While on rotations, the students' experiences are closely monitored by the program's academic staff to ensure that they are learning and developing as engineers.

Eligibility:
Chemical Engineering students must be in the second semester of their sophomore year before entering the program.

Students must have a minimum Clemson University GPA of 2.5 and be enrolled in a full time (minimum 12 credit hours) course load at the time they enter the program. Transfer students must have an established Clemson University GPA before entering the program.

Participation:
Students interested in seeking a co-op assignment should contact the Co-op Program office the first week of classes in either the fall or spring semester, depending on when they want to begin their first rotation. The fall semester is the time to interview for 1st rotations that begin in January and the spring semester is the time to interview for 1st rotations that begin in May or August.

ChemE Department Advising:
For department specific advising, please see one of the ChE academic advisors.

Contact Information:
Cooperative Education Program
Maria Torres, Co-op Advisor for Chemical, Civil, and Environmental Engineering
mariam@clemson.edu

Dr. Jeff Neal, Director and Instructor of Record for the Co-op Courses
Suite 316, Hendrix Student Center
864-656-3150
Website: https://career.sites.clemson.edu/cooperative_education/

Cooperative Education Curriculum Maps

CHEMICAL ENGINEERING CURRICULUM CO-OP "A"

Refer to the Undergraduate Catalog or curriculum map provided earlier for specific courses.

YEAR	FALL SEMESTER	SPRING SEMESTER	SUMMER
1	Freshman year fall courses	Freshman year spring courses	
2	Sophomore year fall courses	Sophomore year spring courses	COOP Semester (1)
3	Junior year fall courses	COOP Semester (2)	
4	COOP Semester (3)	Junior year spring courses	
5	Senior year fall courses	Senior year spring courses	

CHEMICAL ENGINEERING CURRICULUM CO-OP "B"

Refer to the Undergraduate Catalog or curriculum map provided earlier for specific courses.

YEAR	FALL SEMESTER	SPRING SEMESTER	SUMMER
1	Freshman year fall courses	Freshman year spring courses	
2	Sophomore year fall courses	Sophomore year spring courses	
3	COOP Semester (1)	Junior year spring courses	
4	Junior year fall courses	COOP Semester (2)	COOP Semester (3)
5	Senior year fall courses	Senior year spring courses	

CHEMICAL ENGINEERING CURRICULUM CO-OP "A" with BIOMOLECULAR ENGINEERING CONCENTRATION

Refer to the Undergraduate Catalog or curriculum map provided earlier for specific courses.

YEAR	FALL SEMESTER	SPRING SEMESTER	SUMMER
1	Freshman year fall courses	Freshman year spring courses	
2	Sophomore year fall courses	Sophomore year spring courses	COOP Semester (1)
3	Junior year fall courses	COOP Semester (2)	
4	COOP Semester (3)	Junior year spring courses	
5	Senior year fall courses	Senior year spring courses	

CHEMICAL ENGINEERING CURRICULUM CO-OP "B" with BIOMOLECULAR ENGINEERING CONCENTRATION

Refer to the Undergraduate Catalog or curriculum map provided earlier for specific courses.

YEAR	FALL SEMESTER	SPRING SEMESTER	SUMMER
1	Freshman year fall courses	Freshman year spring courses	
2	Sophomore year fall courses	Sophomore year spring courses	
3	COOP Semester (1)	Junior year spring courses	
4	Junior year fall courses	COOP Semester (2)	COOP Semester (3)
5	Senior year fall courses	Senior year spring courses	

Internship Opportunities

Internships provide similar experience with industry, business, and government organizations but are limited to a single term and particularly over a summer term. Many students will prefer an internship opportunity based on the ability to gain multiple internship opportunities with different organizations, the fact that it does not delay graduation, or based upon the availability of positions offered by different organizations. Some companies may only provide opportunities for internships or Co-ops. The internship program does not have an extended contract with the student and University, but students may have the opportunity to complete multiple internship rotations if desired. Some students will opt to participate in both co-op and internships before they graduate.

Internships are less restrictive and are available to undergraduate and graduate students. Eligibility for internships is dictated by the internship position advertised by the sponsoring organization.

Advantages for Students

Students who elect to participate in the co-op and internship programs realize several benefits:

1. Co-op and internships provide valuable on-the-job learning experiences that cannot be acquired in the classroom.
2. Co-op and internships provide students opportunities to evaluate their initial career path choice.
3. Often students are offered permanent employment with their co-op or internship employer after graduation.
4. Career-related, on-the-job experiences enhance classroom academic work through increased motivation and conceptual understanding.
5. Co-op and internships provide students additional opportunities to develop professionally with respect to confidence, maturity, responsibility, and skill in human relations.
6. Co-op and internships allow students to earn substantial wages and salary that can be used to finance a portion of college expenses.
7. More and more employers are requiring that new hires have prior relevant work experience.

Special Notes:

1. If you have a scholarship and you decide to co-op, be sure to talk with the Financial Aid Office about how your scholarship should be administered. Some scholarships require that you complete a minimum of hours in a 12-month period, and this can influence your course scheduling. See your advisor if you need to depart from the suggested schedule.

Pay careful attention to the suggested schedule you choose to follow and consult with your academic advisor each semester. This will ensure that you can get the courses you need when you plan to take them and that you will have all the prerequisites for each course.

THE HONORS PROGRAM

(Clemson University Honors College)

The Honors Program of Clemson University is known as Calhoun Honors College, and students enrolled in honors work are called Calhoun Scholars. To enter or to remain in Calhoun Honors College a student must have a cumulative grade-point ratio of 3.4. Admission to Calhoun Honors College for incoming freshmen is by invitation, based primarily on SAT scores and high school academic records. Calhoun College is operated under the guidelines of the Honors Program Committee, a group comprised of faculty members from each college, and chaired by the Director of the Honors Program. The Calhoun Honors College Student Handbook is available in the Honors Program Office, 105 Tillman Hall.

Students graduating with Senior Departmental Honors will receive the Senior Departmental Honors Medallion at an honors ceremony shortly before graduation. The medallion is worn during the graduate exercises. Students' diplomas also reflect the honors graduation designation.

SENIOR DEPARTMENTAL HONORS PROGRAM

Department of Chemical & Biomolecular Engineering

Administration

The Senior Departmental Honors Program is administered by the Honors Program Chair. The Honors Coordinator who chairs this committee is appointed by the Department Chair and the current Departmental Honors Coordinator.

Admission

Students who wish to participate in the Senior Departmental Honors Program must meet the eligibility requirements set by Calhoun College and the ChBE Department, which include:

- Students applying for admission to the Senior Departmental Honors Program must have completed or be about to complete the sophomore courses of the chemical engineering curriculum and must have at least three (and preferably four) semesters remaining to complete their degree program.
- To enter and to remain in the Senior Departmental Honors Program a student must have a cumulative grade-point ratio of 3.4.
- To enter the program students must have a minimum cumulative GPR of 3.0 in their major courses. They must maintain this standard (exclusive of grades earned in CHE 3950, 4950, and 4970) to graduate with Senior Departmental Honors.
- The faculty intends for the Honors Program to be an enriching experience beyond that normally provided undergraduate students. Therefore, Chemical Engineering honors courses will not be used to replace any courses for earning the B.S. degree in Chemical Engineering.
- Students in the program must earn at least a B in one honors course in Chemical Engineering each semester of the junior and senior years (or, equivalently, a Pass in CHE 3000). The program is a research-focused effort centered around four courses, for a total of 8 hours of honors credit. The courses are described below. The exact timing of these courses is flexible, at the discretion of the Honors Program Committee and the student's research advisor. During the last half of the

spring semester of their senior year, senior honors students will make oral presentation on their work.

Chemical & Biomolecular Engineering Honors Courses

(1) ***CHE 3000, Honors Seminar*** (1 hour credit, P/F). New honors students will take this course during the fall semester of the junior year. The purpose is to provide opportunities for students to learn about research projects. Honors students will attend the weekly graduate seminar, and interested faculty may also present separate talks describing projects to honors students. Students will be given the opportunity to earn credit for CHE 3000 during a spring semester if their schedules preclude enrollment in the fall.

Student Responsibilities: Honors student attendance at each seminar will be mandatory. Students accumulating more than one unexcused absence will receive an F in 3000 and will be dismissed from the program.

No later than two weeks before the end of the semester, each honors student will identify three projects for which they would like to work and will submit the selected list to the Honors Program Coordinator.

(2) ***CHE 3950 and 4950***, Honors Research (3 hours credit, each graded). During the spring semester, junior year, and fall, senior year, students will perform their research under the guidance of faculty advisors. Each student is expected to work 10 hours per week on the project. With the concurrence of a faculty advisor, co-op students may substitute 3 hours of CHE 4910 (Special Projects) earned over the course of an entire summer (2 hours for one session and 1 hour for the other) for CHE 3950 or CHE 4950.

Student Responsibilities: Two weeks before the end of the first research term, students enrolled in CHE 3950 will submit to the Honors Program Committee a written report of progress on the project. In general, the requirements and expectations of this report are set by the student's research faculty advisor.

Two weeks before the end of the second research term, each student will submit to the Honors Program Committee a thesis outline.

(3) ***CHE 4970, Honors Thesis*** (1 hour credit, graded). During the spring of the senior year, each Honors student will write a thesis. A complete draft of the thesis will be submitted to the faculty advisor no later than the date set by the by the student and their faculty advisor. Generally, the body of the thesis will constitute no more than 50 type-written pages (excluding appendices), and it will follow a format established by the student's faculty advisor. This draft will be critiqued by the faculty advisor and revised by the student for final submittal to the Honors Program Coordinator no later than April 15.

STUDY ABROAD OPPORTUNITIES

In collaboration with the Department of Chemical and Biochemical Engineering at the Technical University of Denmark (DTU), the Department of Chemical and Biomolecular Engineering at Clemson University invite rising seniors to participate in a 4-week long unit operations experimental course. This course is held on DTU's campus in Kongens Lyngby, Denmark, in a large, modern pilot plant facility, which houses over 30 different large-scale chemical and process technologies.

This unique course not only exposes students to the theoretical and practical engineering aspects of various unit operations but also provides the students with an opportunity to discover the wonders of Copenhagen and the beautiful Danish countryside. The course is specifically designed for international, non-DTU students with the intention to provide the students with experiences as close as possible to those they will encounter in industry.

Note, this course can be taken in place of CHE 4070 (Unit Ops II).

Contact Information:
Dr. Eric Davis, Associate Professor, Chemical & Biomolecular Engineering
ericd@clemson.edu

CECAS Global Engagement
engagement@clemson.edu

UNDERGRADUATE RESEARCH OPPORTUNITIES

The faculty in the Department of Chemical and Biomolecular Engineering conduct research in many exciting areas. The faculty listing that appears later in this handbook indicates the broad range of research activities available. These research projects often offer the opportunity for undergraduates to participate in one of several ways:

(a) Part-time work as a Laboratory Assistant during the academic year
(b) Part-time or full-time work as a Lab Assistant during the summer
(c) Summer Research Fellowships
(d) Creative inquiry course credit through CHE 1990, 2990, 3990, 4990
(e) Research for course credit through CHE 4910/4910.
(f) Participation in the Departmental Honors Program.

Undergraduates have made meaningful contributions to our research in the past, and many students have begun to work as Lab Assistants as early as their sophomore year. It is an excellent way to earn money or academic credits. You can also get insight into whether you may be interested in graduate study after your B.S. since most research jobs in industry and government require advanced degrees.

Finally, whether you continue to do research in graduate school or in industry, research experience as an undergraduate is a plus when seeking employment after graduation. If you are interested in becoming involved, talk directly to a faculty member whose research area you think looks interesting.

Note: Students will not be provided an opportunity to enroll in CHE 4910 as a means to raise a low engineering grade point average.

GRADUATE STUDY IN CHEMICAL ENGINEERING

What is graduate school?
You may attend graduate school in chemical engineering to earn an M.S. degree, a Ph.D. degree, or both. The M.S. degree typically requires 2 years, while the Ph.D. degree typically requires 4-5 years beyond the B.S. degree. You will take advanced courses during the first one or two years, and then will focus on a thesis research project in a research area of your interest.

Who should attend graduate school?
For research and development, technical work, or teaching, a graduate degree is a definite advantage, if not a requirement. If your GPR is greater than 3.5/4.0, then your chances of being accepted into a Ph.D. program with financial aid are excellent. If your GPR is between 3.0/4.0 and 3.5/4.0, then you can probably gain admission to graduate school with financial aid, but your choices may be more limited.

Why does one attend graduate school?
If you are like many others, you may be tired of taking courses and living the student lifestyle when your undergraduate program is completed. It may at first seem out of the question to go through four more years of school in order to obtain a Ph.D. degree. However, there are three very important reasons for doing so:

- Graduate school is challenging and fun - Most of your graduate courses will be in areas that interest you and will offer considerable interaction with the professor and the other students. Moreover, the majority of your time spent on a Ph.D. degree will be in research on a challenging problem that is of interest to you. You will have opportunity to develop close-knit relationships with other members of your entering class and research group.

- Graduate school is a wise investment - Although there is a short-term financial sacrifice in not taking a professional job with a B.S. degree, those who obtain advanced degrees generally receive higher starting salaries and come out ahead financially in the long-term. More important, though, is the job satisfaction that is made possible with an advanced degree. There are many exciting areas that are opening up to chemical engineers, including biotechnology, electronic devices, advanced materials, novel energy processing, and hazardous waste management. Advanced knowledge is needed to work in these so-called "frontiers of chemical engineering." In addition, a Ph.D. degree may be a distinct advantage for upper- level management jobs and is a requirement for an academic position.

- Graduate students are paid to go to school - Most full-time graduate students have their tuition paid and they receive a stipend that is sufficient to live on. Many fellowships also exist that pay even higher stipends.

When is the best time to attend graduate school?
It is generally best to attend graduate school shortly after completing a B.S. degree. A small percentage of graduate students work a few years in industry first and then return to school with a clearer vision of how an advanced degree can improve career opportunities. However, the interruption of a career in this way is difficult and requires some sacrifice.

Where does one attend graduate school?
We do recommend that you consider going to a different school than Clemson. It is important that you apply to schools that have active research programs in one or more areas that interest you. Directories, such as the "Graduate Education Issue" published each Fall by Chemical Engineering Education (an ASEE journal) and the AIChE Graduate School Directory published each year, give information on faculty, students, research grants, and research publications. Discuss your desire to attend graduate school with faculty members at Clemson. Ask them for advice on schools that are well-suited for you and that have faculty members with active research programs in areas that interest you.

Of course, Clemson has active research programs in several areas, and a strong graduate program of study. We have found that Clemson undergraduates are some of our best graduate students, and certainly encourage you to consider study here.

How does one apply for graduate school?
First, talk to the Department Graduate Coordinator. If you are interested in applying at Clemson, they can supply you with the necessary forms. They can also counsel you on other graduate schools to consider, and suggest other Clemson faculty to talk with about particular research areas. In general though, early in the fall term of your senior year you should contact departments that you are interested in requesting information about the program and details on how to apply. It is probably best to apply to schools that you are seriously interested in. The applications should be submitted in the fall, or early in the winter.

When a school accepts you for graduate study, it will specify a decision date. An important element in making your decision will be the financial aid available. If you are interested in a Ph.D. and have good qualifications, then most schools will offer you a fellowship, teaching assistantship, or research assistantship that will cover tuition and provide a monthly stipend that is adequate for living expenses. Also, it is a good idea to visit the one or two schools that you are most interested in. Often, the school will pay for part of your visit.

What is the combined BS/MS plan?
Undergraduate Chemical Engineering majors who have completed at least 90 credit hours with a grade point ratio of 3.4 can begin work toward an MS (Master of Science) in Chemical Engineering or an MS or MENGR (Master of Engineering) in Environmental Engineering and Science by selecting approved graduate courses for their emphasis area. See details in the Emphasis Area descriptions for Advanced Engineering, Math, and Science and Environmental Engineering and Science.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS STUDENT CHAPTER

It is traditional that professionals band together to promote their profession and to disseminate professional information. Medical doctors join the American Medical Association, lawyers belong to the American Bar Association, and chemical engineers affiliate themselves with the American Institute of Chemical Engineers (AIChE). As a chemical engineering student at Clemson you are invited to join our outstanding Student Chapter of the American Institute of Chemical Engineers (AIChE), which has won the National Award of Excellence over 10 times in its history.

The Student Chapter of AICHE is active at the national, regional, and local levels. At the national level, there are many benefits for the Chem E student. Joining the national organization is FREE! You can become a member and learn about student membership benefits here: https://www.aiche.org/students/membership

At the regional level, a student convention is held each year at one of the member universities. The Southern Region, of which Clemson is a member, includes the University of Puerto Rico as well as universities in the states of Kentucky, Virginia, Tennessee, North Carolina, South Carolina, Louisiana, Mississippi, Alabama, Georgia and Florida. At the Regional Convention held each year at one of the member universities, we socialize with Chem Es from other schools, visit chemical plants, and hold a technical paper contest. In addition, each year a national convention is held, and Clemson usually sends 2-4 representatives.

The AIChE Student Chapter is most active at the local level. Each year the Clemson student organization hosts many professional development events designed to acquaint students with types of situations that they can expect to find themselves in after graduation. This is accomplished through guest speakers (usually about 8 per year), plant trips, and two dinners with chemical engineers who work in the area and are members of Greenville's Western Section. The AIChE Student Chapter also sponsors social events to help students get to know each other and the faculty on a personal basis. Traditionally these include a Welcome Back Picnic in August, a Shrimp Boil later in the fall, and a Pig Roast in the spring.

In summary, there are many excellent reasons to join AIChE. As a freshman or sophomore, it is often difficult to know whether the major you have chosen is really right for you. By joining AIChE, you can get exposure to the wide variety of jobs that will be available to you after graduation, and thus feel certain that you have chosen the right path. Membership dues are inexpensive. **For more information, contact the AIChE Student Chapter Advisor.**

OTHER IMPORTANT INFORMATION AND ADVICE FOR CHEMICAL ENGINEERING STUDENTS

Why Are You In College?

You are here for one overriding reason, and that is to learn. You will and should do other things while here. You will meet a lot of people, make new friends and have a lot of fun. You should participate in some extra- curricula activities, take time out for personal participation sports (golf, tennis, etc.) and allow some time to simply have fun. However, all of these activities are secondary to your main purpose - learning the subject matter and intellectual discipline of your future profession. Keep that in mind.

Professionalism

The work of a professional person differs from that of others in the crafts and trades industry by virtue of the fact that it is intellectual and of a non-routine nature. In general a professional works with their brain and a craftsman with their hands. Your future employer will be interested in having you solve "new" problems. If all the problems had been solved, there would be no need for engineers. Your future work will be non-routine and non-repetitive; new, unusual, and challenging problems will be the rule rather than the exception. The reason for our emphasis on understanding basic concepts should now be apparent. You will find that in chemical engineering education we stick to concepts and fundamentals, and that we will not teach you, except incidentally, how to make any specific product such as nylon, sulfuric acid, rocket fuel, etc. Processes for making things change almost daily, but the fundamentals on which processes are created endure.

How To Study

Many students fail in college because they don't know how to study; and indeed, many students have never had to study. To succeed in college, particularly in engineering, you must develop good study habits and stick to them. There are many approaches to this; for further help, see the Academic Success Center, or ask your advisor for help.

To illustrate one method of study, let us assume that you are studying for an engineering course.

1. Find a quiet place to study. If your dorm or apartment is not suitable, go to the University Library or one of the academic buildings such as Earle Hall. Have a reasonable size desk and a straight chair. Sit with your feet on the floor, not on the desk.

2. Check your assignment or estimate how many pages of text the professor will cover in the next class. As you read the material, make yourself a set of notes on the material. Derive and understand the key equations in your notes, always bearing in mind the individual assumptions and previous equations used in the derivation; the final result is often not as important as the concepts it embodies. Although writing down a derivation that is in the book may seem unnecessary, most people learn much better by virtue of this "active" studying rather than simply "passively" reading the material.

3. Don't be afraid to underline or highlight important passages in a book, or to make notes in the margin. When you run across something that you don't understand or are unsure of, make a note in the margin. These notes form the basis for questions at the next lecture.

4. At the lecture, make a new set of notes. An effective professor will give you more on a subject than is in your text and will bring out variations on the text material. Be sure to ask questions on points that are not clear to you.

5. The night after a lecture you should combine the two sets of notes you have taken into a final set. By this time you will have covered the material three times and if you have been diligent in note taking and listening to the lecturer, you should have a solid understanding of the material. You will usually have an opportunity to test your knowledge by working homework problems. If you do not have a firm grasp on the material, seek help from your instructor at your earliest opportunity.

6. Never depend on "cramming" for a quiz or examination. If you follow this recommended reviewing, your quizzes will be easy.

Understanding Concepts

In four years of college the faculty can only hope to sharpen your thinking processes along the lines of your chosen field of study. You are not here to be taught "how" to do something, but rather you are here to absorb the concepts of "why" things happen the way they do. You should strive to gain an understanding of overall concepts; for example, in chemistry you will be taught the molar concept for calculating yields from chemical reactions, and in the calculus you will be taught the concept of a differential operator. If you firmly grasp the concepts, you will be able to apply them in other classes, and in your future profession long after the present-day “hows” are obsolete.

Keep Your Books

Don't succumb to the temptation to sell your books at the end of a semester for a little ready cash. Keep your books, especially the technical ones, for they will form the basis of your professional library after graduation. As a professional engineer you will live with books and you never know which one you may have to consult. Be smart; keep your books.

Scholastic Regulations

Become familiar with the Scholastic Regulations of Clemson University as written in the University Catalog. The University accepts no excuses for ignorance of these regulations. Be sure that you know to compute your overall GPR and your engineering GPR, and be sure that you know the prerequisites for the courses you must take.

If You Fall Behind In A Course

If you become aware that you are falling behind in a course, you should immediately see your instructor for advice on catching up. All faculty members maintain office hours so as to be available to students, but you must take the initiative to ask for help. Please discard any thoughts that you may have retained from high school regarding "playing up" to a teacher. You are now in a professional course of study and you have a responsibility to yourself to get the best education you possibly can. Don't worry an instructor with trivial things, but don’t hesitate to ask if you need help in a course. You will surely fall behind in the course if you "cut class" or sleep in class. You (or your parents or your scholarship provider) are paying good $$$ for each credit hour of class you have scheduled. You should seriously consider whether or not you can afford to throw away money like that.

Your Advisor

Each chemical engineering student is assigned to a Student Services Coordinators for advising. Get to know your advisor and don't hesitate to ask them for help with scheduling course, etc. In addition, you should seek guidance for studying, career plans, or anything else related to chemical engineering from the Undergraduate Studies Coordinator or other faculty mentors. Each semester during registration, you must make out a schedule courses. that you want to take in the following semester, and this schedule must be approved by your advisor. You will not be able to register for courses without meeting with your advisor to receive your registration pin.

DOS AND DON'TS TO BE A SUCCESSFUL CHEMICAL ENGINEERING STUDENT

DO

1. Be independent. Gather needed information and make your own decisions.
2. Be active in your education; i.e. participate, check your emails communicate to faculty, etc.
3. Memorize the important principles.
4. Learn to separate important principles from less important details. Don't highlight the entire textbook.
5. Learn to distinguish between causes and effects.
6. Read written instructions carefully and interpret them appropriately.
7. Look for analogies and use them to interpret new ideas.
8. Use knowledge and methods from previous courses and experiences.
9. Try to connect textbook and lecture material with "the real world" examples.
10. Develop systematic procedures to solve problems.
11. Learn to analyze data for consistency, reliability, and meaning.
12. Learn to ascribe physical meaning to equations.
13. Learn to use fundamental logic to reach a conclusion.
14. Try to judge the reasonableness of your answers.
15. Learn to write coherent paragraphs. Scientific writing is probably different than what you're used to.
16. Present your work in a neat and orderly fashion.
17. Exercise and stay healthy.
18. Anticipate the consequences of your actions and realize that you alone are responsible for them
19. Do everything you do ethically and with respect for others.

DON'T

1. Accept all authoritative statements as truths. No one has all the answers.
2. Expect instructors to give cookbook procedures for everything.
3. Copy homework.
4. Expect to find all the answers in one place.
5. Expect all problems to have closed-form solutions; some require iteration, i.e., trial & error.
6. Expect all problems to have a single solution (or any solution).
7. Expect quizzes to be exactly like old homework problems.
8. Submit reports that look good but contain inappropriate or inaccurate information.

CHEMICAL ENGINEERING FACULTY

Ana. C. Alba-Rubio, Associate Professor, Ph.D. – Autonomous University of Madrid (2011): Heterogeneous Catalysis, Nanomaterials, Rational Design and Synthesis, Control of Catalyst Deactivation, Sustainable Processes

Marc R. Birtwistle, Associate Professor, PhD. – University of Delaware (2008). Cancer systems biology and pharmacology

David A. Bruce, Professor and Chair, Ph.D. – Georgia Institute of Technology (1994): Catalyst development for the petrochemical and pharmaceutical industries and molecular modeling, chiral zeolites, mesophase materials and polymeric templating.

Eric M. Davis, Associate Professor &Associate Chair, Graduate Coordinator , Ph.D. – Drexel University (2013): Polymer Membranes, Transport Phenomena, Poromechanics

Scott M. Husson, William B. "Bill" Sturgis '57 & Martha Elizabeth "Martha Beth" Blackmon Sturgis Distinguished Professor in Chemical and Biomolecular Engineering, Ph.D. – University of California, Berkeley (1998): Advanced Separation Materials, Membrane Science and Engineering, Bioseparations, Water-Energy Nexus, Nuclear Separations.

Jessica M. Larsen, Carol and John Cromer Family '63 Endowed Associate Professor, Ph.D. – Auburn University (2017): Drug delivery and advanced materials with a focus on application in treatment of neurodegenerative disease and other brain disorders.

Elizabeth Melvin, Lecturer, Ph.D. – North Carolina State University (2011)

Adam Melvin, Associate Professor, Ph.D. – North Carolina State University (2010): Biomolecular Engineering, Point of Care diagnostics, Microfluids, Single Cell Analysis, Chemical Biology, Algai chemotaxis and Growth Dynamics

Christopher W. Norfolk, Principal Lecturer, Ph.D., P.E. – University of Notre Dame (2005): RiSE Faculty Fellow. Composite materials, defense industry, prosthetic technology.

Amod A. Ogale, Dow Chemical Professor and Undergraduate Coordinator, Ph.D. – University of Delaware (1986): Director, Center for Advanced Engineering Fibers and Films. Polymer processing; composite formation, characterization; experimental and modeling issues related to advanced engineering fibers and films.

Suzanne Roat, Professor of Practice, Ph.D. – University of Tennessee (1991): Energy, Sustainability, Process Design, and Process Control

Mark. E. Roberts, Associate Professor, Ph.D. – Stanford University (2008): Organic and nano-materials; electrical energy storage; chemical and biological sensors.

Mark C. Thies, Dow Chemical Professor, Ph.D. – University of Delaware (1985): Thermodynamics and supercritical fluids, separation processes, materials processing, phase behavior of complex mixtures, environmental applications.

Ming Yang, Assistant Professor, Ph.D. – Tufts University (2015): Catalysis, Advanced Materials,

Reaction Engineering for Energy and Environmental Applications