CHEMICAL & BIOLOGICAL ENGINEERING

Bachelor of Science in Chemical Engineering (B.S.Ch.E.)
Department of Chemical & Biological Engineering
Catalog Year: 2019-2020

Minimum required credit hours required for graduation: 120
Recommended credit hours for graduation: 123 - Recommended credit hours are marked below with a caret (^).
A minimum grade of "C-" is required for all CBE courses. A minimum grade of "C" is required for all other courses (non-CBE courses).

FRESHMAN YEAR

FALL SEMESTER			SPRING SEMESTER		
CBE 101	Introduction to Chemical Engineering and Biological Engineering[1]	1	CHEM 1225 (or 132)	General Chemistry II for STEM Majors[1] (or Principles of Chemistry)	3
CHEM 1215 (or 131)	General Chemistry I for STEM Majors[1] (or Principles of Chemistry)	3	CHEM 1225L	General Chemistry II for STEM Majors Lab [1]	1
CHEM 1215L	General Chemistry I for STEM Majors Lab [1]	1	MATH 1522	Calculus II[1]	4
ENGL 1120	Composition II	3	PHYS 1310	Calculus-Based Physics I[1]	3
MATH 1512	Calculus I[1]	4	PHYS 1311	Problems in Calculus-Based Physics I	1^
GEN ED	Humanities[2][8]	3	GEN ED	Communication[2]	3
	Total Required Semester Hours:	15		Total Required Semester Hours:	14
				Total Recommended Semester Hours:	15

SOPHOMORE YEAR

FALL SEMESTER			SPRING SEMESTER		
CBE 251	Chemical Process Calculations[3]	3	CBE 253	Chemical & Biological Engineering Computing[3]	3
CHEM 301	Organic Chemistry	3	CBE 302	Chemical Engineering Thermodynamics[3]	3
CHEM 303L	Organic Chemistry Laboratory	1	MATH 316	Applied Ordinary Differential Equations	3
MATH 2530	Calculus III	4	CHEM 312	Physical Chemistry	3
PHYS 1320	Calculus-Based Physics II	3	CHEM 302	Organic Chemistry	3
PHYS 1321	Problems in Calculus-Based Physics II	1^		Total Required Semester Hours:	15
	Total Required Semester Hours:	14			
	Total Recommended Semester Hours:	15			

JUNIOR YEAR [4]

FALL SEMESTER			SPRING SEMESTER		
CBE 311	Introduction to Transport Phenomena[3]	3	CBE 312	Unit Operations[3]	3
CBE 317	Numerical Methods for Chemical and Biological Engineering[3]	3	CBE 319L	Chemical Engineering Laboratory II[3]	1
			CBE 321	Mass Transfer[3]	3
CBE 318L	Chemical Engineering Laboratory I: Introduction to Experimentation[3]	3	CBE 371	Introduction to Materials Engineering[3]	3
			CBE 213	Laboratory Electronics for NE & CBE[5]	3
BIOL 2110C	Principles of Biology: Cellular and Molecular Lecture & Laboratory	4	CE 350	Engineering Economy[5]	3
				Total Required Semester Hours:	16
GEN ED	Social & Behavioral Sciences[2][8]	3			
	Total Required Semester Hours:	16			

SENIOR YEAR [6]

FALL SEMESTER			SPRING SEMESTER		
CBE 418L	Chemical Engineering Laboratory III[3]	1	CBE 419L	Chemical Engineering Laboratory IV[3]	1
CBE 454	Process Dynamics and Control[3]	3	CBE 451	Senior Seminar[3]	1
CBE 461	Chemical Reactor Engineering[3]	3	CBE 494L	Advanced Chemical Engineering Design[3]	3
CBE 486	Introduction to Statistics and Design of Experiments[3]	3	ELECTIVE	Technical Elective [7]	3
			GEN ED	Arts & Design[2]	3
CBE 493L	Chemical Engineering Design[3]	3	GEN ED	Second Language[2][8]	3
ELECTIVE	Technical Elective[7]	3	CBE 491	Undergraduate Research	1^
	Total Required Semester Hours:	16		Total Required Semester Hours:	14
				Total Recommended Semester Hours:	15

(1) Admission to the BSCHE degree program requires completion of all math, science, and engineering courses listed in the freshman year with a grade of "C" or better and a minimum 2.5 GPA average in those courses, completion of ENGL 1110 or the equivalent with a "C" or better, and a minimum 2.30 cumulative UNM GPA.

(2) A list of acceptable General Education (GEN ED) Humanities, Social & Behavioral Sciences, Arts & Design, and Second Language courses can be found here: http://gened.unm.edu/. These courses may be taken whenever convenient.

(3) CBE Core Courses must be taken in the order and semester in which they are listed on this sheet in order to avoid a delay in graduation.

(4) Students must file an application for the B.S.Ch.E. degree prior to the completion of 95 credit hours of applicable courses.

(5) CBE 213 and CE 350 may be taken in the fall or spring semester.

(6) Students are encouraged to take the Fundamentals of Engineering (FE) Examination during their senior year. This is the first formal step toward professional registration. www.ncees.org/fe/

(7) Technical electives are chosen with the consultation of the student's faculty advisor to ensure that they support the student's concentration as well as the student's individual academic, career, and/or research goals. A list of suggested technical electives based on concentration can be found on the back of this curriculum sheet.

(8) It is recommended that for either the GEN ED: Humanities course or GEN ED: Social & Behavioral Sciences course or GEN ED: Second Language course that students choose at least one course with a # next to it from the General Education webiste (http://gened.unm.edu/) so that it not only satisfies the General Education requirement but also satisfies the mandatory 3 credit hour U.S. Global Diversity & Inclusion Undergraduate Requirement. A comprehensive list of courses that will satisfy the U.S. Global Diversity & Inclusion Undergraduate Requirement can also be found at: http://diverse.unm.edu//about-dei/diversity-council/approved-courses.pdf

Concentrations

CHEMICAL PROCESS ENGINEERING (CHPE)

The Chemical Process Engineering concentration is designed to provide maximum flexibility for students to pursue career opportunities in a wide range of industries as a process engineer. Historically, many chemical process engineers have found employment in the petroleum or chemical industries, and many still do. However, chemical engineers with a strong process engineering foundation are in increasing demand in many other technology areas, including pharmaceuticals, semiconductors and electronic materials, and environmental or "green" engineering. This concentration builds on the traditional process engineering emphasis, allowing the technical electives to be chosen by the student in consultation with his adviser to fit the interests or professional goals of the student.

Complete 6 credit hours from the following list of Technical Electives or from any technical elective listed under any of the other concentrations.

MATH 311	Vector Analysis	3 hrs
MATH 312	Partial Differential Equations for Engineering	3 hrs
MATH 313	Complex Variables	3 hrs
MATH 314	Linear Algebra with Applications	3 hrs
STAT 345	Elements of Mathematical Statistics and Probability Theory	3 hrs

BIOENGINEERING (BIOE)

Since biological and medical systems involve complex chemical and physical processes, chemical engineering is a natural professional background for bioengineering applications. Bioengineering is an interdisciplinary field that combines the tools and methods of engineering to address challenges in the health sciences and in basic research. Bioengineers strive to understand biological systems, from molecules to whole organisms, from a quantitative and analytical perspective. Because of this in-depth study, bioengineers are uniquely qualified to work at the interface between living and non-living systems, enhancing our ability to measure, image, repair, or replace physiological substances or processes. Training in bioengineering prepares students for graduate school or industry, and is an excellent preparation for professional programs (medicine, dentistry, nursing, pharmacy). Career opportunities for bioengineers at the undergraduate level include the biosensor, pharmaceutical and medical device industries as well as positions in hospitals, federal labs, and environmental agencies.

Complete 6 credit hours from the following list of Technical Electives.

BIOC 423	Introductory Biochemistry	3 hrs
BIOL 2305	Microbiology for Health Sciences	4 hrs
BIOL 2410C	Principles of Biology: Genetics Lecture & Lab	4 hrs
BIOL 492/592	Introductory Mathematical Biology	3 hrs
BME 558	Methods of Analysis in Bioengineering	3 hrs
BME 575	Biomechanics	3 hrs
BME 581	Colloidal Nanocrystals for Biomedical Applications	3 hrs
CBE 417/517	Applied Biology for Biomedical Engineers	3 hrs
CBE 472/572	Biomaterials Engineering	3 hrs
CBE 479/579	Tissue Engineering	3 hrs
CBE 499	Sel T: Protein and Nucleic Acid Engineering	3 hrs
CBE 499	Sel T: Thermodynamics of Biological Systems	3 hrs

Note: Seniors in the BSCHE degree program are eligible to take 500-level courses but must complete a Level Restriction Authorization Form through the Registrar's Office.

ENVIRONMENTAL ENGINEERING (ENEN)

The chemical engineer with a concentration in Environmental Engineering is prepared to enter a field of growing importance. This field deals with treatment of waste to reduce its volume, to recover recyclable resources and to prepare appropriately for long-term disposal. Interesting applications exist in atmospheric discharge control and clean-up, bio-treatable water decontamination, soil remediation, and nuclear byproduct handling. Increasingly, chemical engineers are required to develop new processes to minimize byproduct and waste generation, and achieve higher energy efficiencies.

Complete 6 credit hours from the following list of Technical Electives.

CE 335	Environmental and Water Resources Engineering	3 hrs
CE 431/531	Physical-Chemical Water and Wastewater	3 hrs
CE 433/533	Environmental Microbiology	3 hrs
CE 436/536	Biological Wastewater Treatment	3 hrs
CE 438/538	Sustainable Engineering	3 hrs
EPS 333	Environmental Geology	3 hrs
EPS 415/515	Geochemistry of Natural Waters	3 hrs
EPS 462/562	Hydrogeology	3 hrs

MATERIALS PROCESSING (MAPR)

The Materials Processing concentration is designed to add additional emphasis in inorganic materials, polymeric, or biological materials, depending on the students interest. Students who are interested in working in the realm of high technology materials, biomedical materials, or nanotechnology should choose this concentration. These rapidly developing fields are expected to provide many job opportunities in the next decade. New materials are currently being developed whose properties depend strongly on their microstructure, nanostructure and processing history. Materials included in this category are advanced ceramics, polymers, composites, photonics, superconductors, semiconductors, and recording media.
This concentration provides flexibility for students interested in inorganic or organic materials technology.

Complete 6 credit hours from the following list of Technical Electives.

CBE 412/512	Characterization Methods for Nanostructures	3 hrs
CBE 477/577	Electrochemical Engineering	3 hrs
CHEM 431	Advanced Inorganic Chemistry	3 hrs
CE 302	Mechanics of Materials	3 hrs
EPS 301	Mineralogy/Earth & Planetary Materials	3 hrs
EPS 302L	Mineralogy Laboratory	2 hrs
ME 419/519	Theory, Fabrication, and Characterization of Nano and Microelectromechanical Systems (NEMS/MEMS)	4 hrs

SEMICONDUCTOR MANUFACTURING (SCMF)

There is an increasing demand for chemical engineers in high technology oriented semiconductor manufacturing companies like Intel, Motorola, IBM, etc. This concentration is designed to prepare the student in the fundamental unit operations used in semiconductor manufacturing (oxidation, diffusion, lithography, plasma etch, CVD, ion implant and metalization) and statistical methods used extensively in the industry to optimize the performance of these unit operations. The continuing revolution occurring in computer technology virtually insures there is a strong future demand for engineers with the background needed for semiconductor manufacturing. The goal of this concentration is to introduce students to the specific chemical engineering tools used in micro-chip fabrication.

Complete the 6 hrs of Technical Electives listed below.

CHEM 311	Physical Chemistry	3	ECE 371	Materials and Devices	3

NOTE: SCMF students may take ECE 371 with an override after earning a "C" or better in CHEM 311 and MATH 316. See Sarah for the override.