



## Concentration Descriptions

### Technical Electives List

### 2019-2020 Catalog Year

Students must select one (only one) of the following concentrations for the Bachelor of Science in Chemical Engineering (B.S.Ch.E.) degree program: Chemical Process Engineering (CHPE), Bioengineering (BIOE), Environmental Engineering (ENEN), Materials Processing (MAPR), or Semiconductor Manufacturing (SCMF).

Each concentration for the B.S.Ch.E. requires 6 credit hours total of technical electives. Together, you and your faculty advisor will select the most appropriate technical electives for your concentration from this document to support your individual academic and career goals.

The Director of Undergraduate Studies may allow up to 6 credit hours of technical electives for students taking required ROTC courses in aerospace or naval science.

Students are encouraged to sign up for *CBE 491: Undergraduate Research* which provides academic credit for doing research under the supervision of a CBE faculty member. In order to be used as a technical elective CBE 491 must be taken for 3 credit hours and a CBE 491 Waiver Form must be submitted and approved by the CBE Director of Undergraduate Programs prior to taking CBE 491 for technical elective credit. Only 3 credit hours of CBE 491 may be applied toward the technical elective requirement. Please contact the CBE Program Advisement Coordinator, Sarah E. Dominguez at [skieltyk@unm.edu](mailto:skieltyk@unm.edu), for more information.

#### 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.**

Course	Title	Hours	Prerequisites
MATH 311	Vector Analysis	3	MATH 264
MATH 312	Partial Differential Equations for Engineering	3	MATH 264 & MATH 316
MATH 313	Complex Variables	3	MATH 264 & one 300-level MATH
MATH 314	Linear Algebra with Applications	3	MATH 163, Pre/Corequisite: CS 151L or CS 152L or ECE 131 or PHYC 290
STAT 345	Elements of Mathematical Statistics and Probability Theory	3	MATH 163 or 181

## 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.**

Course	Title	Hours	Prerequisites
BIOC 423	Introductory Biochemistry	3	CHEM 302
BIOL 202L	Genetics	3	BIOL 201L & CHEM 121 (or 131) & CHEM 123L, Pre/Corequisite: CHEM 122 (or 132)/124L
BIOL 239	Microbiology for Health Sciences and Non-Majors	3	BIOL 201L
BIOL 492/592	Introductory Mathematical Biology	3	MATH 163
BME 575	Biomechanics	3	
BME 581	Colloidal Nanocrystals for Biomedical Applications	3	
BME 558	Methods of Analysis in Bioengineering	3	
CBE 417/517	Applied Biology for Biomedical Engineers	3	CBE 361 and BIOL 201L
CBE 472/572	Biomaterials Engineering	3	
CBE 479/579	Tissue Engineering	3	
CBE 499	Sel T: Protein and Nucleic Acid Engineering	3	
CBE 499	Sel T: Thermodynamics of Biological Systems	3	

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.**

Course	Title	Hours	Prerequisites
CE 335	Environmental and Water Resources Engineering	3	CE 331 and (CHEM 121 or 131) and CHEM 123L
CE 431/531	Physical-Chemical Water and Wastewater Treatment (3 hrs)	3	CE 335
CE 433/533	Environmental Microbiology	3	
CE 436/536	Biological Wastewater Treatment	3	CE 335
CE 438/538	Sustainable Engineering	3	
EPS 333	Environmental Geology	3	(EPS 101 or ENVS 101) and (MATH 121 or 123 or 150 or 153 or 162)
EPS 415/515	Geochemistry of Natural Waters	3	EPS 304L or ((CHEM 121 or 132) and CHEM 123L)
EPS 462/562	Hydrogeology	3	(CHEM 121 or 131) and CHEM 123L and MATH 163 and PHYC 160

### 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.**

Course	Title	Hours	Prerequisites
CBE 412/512	Characterization Methods for Nanostructures	3	
CBE 477/577	Electrochemical Engineering	3	CBE 302
CHEM 431	Advanced Inorganic Chemistry	3	CHEM 311 or 315
CE 302	Mechanics of Materials	3	CE 202, Pre/Corequisite: MATH 316
EPS 301	Mineralogy/Earth & Planetary Materials	3	(CHEM 121 or 131) and CHEM 123L
EPS 302L	Mineralogy Laboratory	2	
ME 419/519	Theory, Fabrication, and Characterization of Nano and Microelectromechanical Systems (NEMS/MEMS)	4	

### 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.**

Course	Title	Hours	Prerequisites
CHEM 311	Physical Chemistry	3	(CHEM 122 or 132) & CHEM 124L & MATH 163 & PHYC 161, Pre/Coreq: MATH 264
ECE 371	Materials and Devices	3	CHEM 311 and MATH 316*

\*Note: The CHEM 311 and MATH 316 pre-reqs for ECE 371 apply to BSCHE students only. You will need an override to take this course using those pre-reqs. You must request the override from the CBE Program Advisement Coordinator, Sarah E. Dominguez.