

# Chemical Engineering, B.S.

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## About

- Bachelor of Science in Chemical Engineering
- Bachelor of Science in Chemical Engineering, Honors.

The chemical engineer typically uses the principles of mathematics, chemistry, biology, physics and engineering sciences to creatively solve technical and commercial problems arising in the design and operation of industrial scale processes. These solutions must respond to economic constraints and address social, ethical, environmental and safety implications. Industrial scale processes can include fuels, bulk chemicals, polymers, foods and pharmaceuticals (including protein, gene and cell-based therapies). Graduates are prepared to think critically and apply their skills in chemical and biological engineering to fields such as sustainability, entrepreneurship, manufacturing, research and development, finance, management and patent law.

## Mission Statement

The Chemical and Biological Engineering Department is committed to providing undergraduate and graduate students innovative and effective educational experiences that will prepare them for the technological, professional, and societal challenges of their careers. Through research that advances engineering and scientific knowledge, the department inspires students and brings value to the university and broader community.

## Program Educational Objectives

Consistent with the University's Augustinian Mission that values broadly-educated, and well-rounded individuals, graduates of the Chemical Engineering Program are able to pursue the following career objectives:

- Conduct themselves in a manner that recognizes their professional responsibilities to society in areas such as sustainability, safety, ethics, and environmental protection.
- Apply the underlying scientific principles and technical capabilities needed to succeed in both the traditional and emerging fields of the chemical engineering profession.
- Continue to learn and grow by leveraging professional opportunities that facilitate the effective practice of their chosen profession.

## Curricular Philosophy

The early years of the chemical engineering curriculum includes a strong humanities component while emphasizing the basic principles of natural and engineering sciences. Later courses relate these skills to chemical engineering applications including the solution of open-ended problems constrained by requirements such as economics, safety, and sustainability. Courses develop students' abilities with the complexity of design experiences systematically increasing throughout the courses in chemical and biological engineering; culminating in the senior process design and process controls courses.

The curriculum includes several engineering, science, and humanities/social science electives, providing flexibility for a student to pursue individual educational and career goals. Chemical and biological engineering electives include opportunities for specialization in traditional and emerging fields of chemical engineering as well as biochemical and biological engineering. Seniors may conduct research for academic credit or complete a six-month co-op. Students develop their academic plan with guidance from a faculty member designated as the student's academic advisor.

**Program:** [Engineering](#)

**Type:** Bachelor of Science

## Freshman Year

### First Semester

Course	Title	Credits
ACS 1000	Ancients	3
THL 1000	Faith, Reason, and Culture	3
MAT 1500	Calculus I	4
CHM 1103	General Chemistry Lab I	1
CHM 1151	General Chemistry I	4
EGR 1200	Egr. Interdisciplinary Proj. I	3
EGR 1001	Career Compass First Yr A	0.5

### Second Semester

Course	Title	Credits
ACS 1001	Moderns	3
CHE 1102	Material Balances	3
MAT 1505	Calculus II	4
PHY 2400	Physics I Mechanics	3
CHM 1104	General Chemistry Lab II	1
CHM 1152	General Chemistry II	4
EGR 1002	Career Compass First Yr B	0.5

## Sophomore Year

### First Semester

Course	Title	Credits
MAT 2705	Diff Equation with Linear Alg	4
CHE 2101	Thermodynamics 1	3
CHE 2201	Fluid Dynamics	3
CHE 2301	ChE Computational Methods	3
CHM 2201	Organic Chemistry Lab I	1
CHM 2211	Organic Chemistry I	3
EGR 2003	Career Compass Second Yr A	0.5

## Second Semester

Course	Title	Credits
CHE 2102	Thermodynamics 2	3
CHE 2202	Heat Transfer	3
CHE 2402	Technical Communications	3
CHM 2202	Organic Chemistry Lab II	1
CHM 2212	Organic Chemistry II	3
	Elective - Humanities/Social Sci	3
EGR 2004	Career Compass Second Yr B	0.5

## Junior Year

### First Semester

Course	Title	Credits
CHE 3201	Mass Transfer	3
CHE 3202	Reactor Design	3
CHE 3401	Unit Operations Lab 1	3
	Elective - CBE	3
	Elective - Science	3
	Elective - Humanities/Social Sci	3
EGR 3005	Career Compass Third Yr A	0.5

### Second Semester

Course	Title	Credits
CHE 3301	ChE Applied Mathematics	3
CHE 3402	Unit Operations Lab 2	3
CHM 3402	Physical Chem Lab II	1
CHM 3416	Physical Chem for Engineers	3
	Elective - Ethics (for Chemical Engineering)	3
	Elective - CBE	3
EGR 3006	Career Compass Third Yr B	0.5

## Senior Year

### First Semester

Course	Title	Credits
CHE 4201	Process Design	3
	Elective - CBE	3
	Elective - CBE	3
	Elective - Science	3

### Second Semester

Course	Title	Credits
CHE 4202	Process Controls	3
	Elective - THL (2000 or above)	3
	Elective - THL/PHI	3
	Elective - CBE	3
	Elective - Free	3

# Academic Requirements

Students must earn a minimum grade of C- in all required CHE (Chemical Engineering) courses to satisfy the degree requirements.

These courses include the following:

[CHE 1102 Material Balances](#)

[CHE 2101 Thermodynamics 1](#)

[CHE 2102 Thermodynamics 2](#)

[CHE 2201 Fluid Dynamics](#)

[CHE 2202 Heat Transfer](#)

[CHE 2301 ChE Computational Methods](#)

[CHE 2402 Technical Communications](#)

[CHE 3201 Mass Transfer](#)

[CHE 3202 Reactor Design](#)

[CHE 3301 ChE Applied Mathematics](#)

[CHE 3401 Unit Operations Lab 1](#)

[CHE 3402 CHE Unit Operations Lab 2](#)

[CHE 4201 Process Design](#)

[CHE 4202 Process Controls](#)

A student earning a grade of D+, D, or D- in a required CHE course must retake that course and earn a minimum grade of C- to satisfy the degree requirement.

If an approved equivalent course is taken at another institution, a minimum grade of C is required to transfer the credits to Villanova. Students requesting to take a course elsewhere should complete the appropriate form which can be found on the [Current Engineering Undergraduate Students Intranet site](#).

A student earning a grade of F in a required CHE course that is a prerequisite for a subsequent required CHE course may not enroll in the subsequent course until the prerequisite requirement is satisfied.

For CBE Elective courses or courses offered by other departments, a minimum passing grade of D- is sufficient for the course to satisfy a degree requirement.

## Category Descriptions

### Elective - Humanities/Social Sci

Credits: 3

Electives are subject to change. Electives may be added to this list at the discretion of the College of Engineering.

Select one humanities or social science elective from the list below:

## Humanities

- Arab & Islamic Studies
- Art History
- Classical Studies
- Communications
- Ethics
- English (excluding internship courses)
- Global Interdisciplinary Studies
- History
- Honors Program (eligible students only)
- Humanities
- Modern Languages (except speaking courses in native language)
- Philosophy
- Theatre
- Theology (2000 and above or course section with core theology attribute)

## Social Sciences

- Criminology
- Economics
- Geography and the Environment (courses with Core Social Science or Sustainability-Humanities STEM attribute)
- Humanities: HUM designated PSC
- Peace and Justice
- Political Science
- Public Administration
- Psychology
- Sociology
- Gender and Women's Studies

## Elective - CBE

Credits: 3

Electives are subject to change. Electives may be added to this list at the discretion of the College of Engineering.

- AP credit cannot satisfy a CBE Elective.
- CBE Electives are typically only available to Juniors and Seniors.
- Students must take both Senior Project Studio courses if selected.
- Seniors must have special permission to take ChemE Graduate Courses (CHE  $\geq$  7000).
  - Students requesting permission to take a graduate level course should complete the appropriate form which can be found in the [Current Engineering Undergraduate Students Intranet site](#).
- Any graduate level course counted towards a B.S. degree cannot also be counted towards an M.S. degree.

- For CBE elective courses or courses offered by other departments, a minimum passing grade of D- is sufficient for the course to satisfy a degree requirement.
- Electives are available based upon instructor availability and student demand.

## Advanced Chemical Engineering

Course	Title	Credits
CHE 5032	Equipment Design & Spec.	3
CHE 5062	Chemical Engineering Economics	3
CHE 5132	Transport Phenomena	3
CHE 5232	Industrial Catalytic Processes	3
CHE 5332	Special Topics in CHE	3
CHE 5842	Safety Analysis	3

## Biological Engineering

Course	Title	Credits
CHE 5133	Brewing Science & Tech	3
CHE 5530	Gene Therapy Methods & Research	3
CHE 5532	Intro to Biotechnology	3
CHE 5533	Bioseparations	3
CHE 5534	Biomaterials	3
CHE 5535	Bioengineering Lab Techniques	3
CHE 5536	Biochemical Data Analysis	3
CHE 5540	Cellular Engineering	3

## Advanced Materials Engineering

Course	Title	Credits
CHE 5534	Biomaterials	3
CHE 5632	Polymer Sci and Engr	3
CHE 5633	Nanomaterials & Surface Scienc	3
CHE 5634	Intro to Material Science	3

## Industry Sponsored Research/Design

Course	Title	Credits
CHE 4831	Senior Project Studio I	3
CHE 4832	Senior Project Studio II	3
CHE 6000	CBE Co-Op	6

## Sustainable Engineering

Course	Title	Credits
CHE 5001	Industrial Liq & Sld Waste	3
CHE 5002	Prin of Air Pol Control	3
CHE 5715	Alternative Energy	3

## Other Approved Technical Courses

Course	Title	Credits
CSC 1051	Algorithms & Data Struc I	4
EGR 2021	Elements of Biomed Engr	3
NS 2100	Naval Ships Systems I	3
SUSE 2111	Sus Eng: LCA & Circular Econ	3

### Elective - Science

Credits: 3

Electives are subject to change. Electives may be added to this list at the discretion of the College of Engineering.

- Science elective options should be discussed with a student's academic advisor.
- A student may request that a science course not on the approved list be reviewed and considered as a special exception for a science elective.
- Pre-requisites for science courses must be met, and the CBE Department cannot guarantee admission to a course offered by another department.

<b>Course</b>	<b>Title</b>	<b>Credits</b>
BIO 2105	General Biology I	4
BIO 2106	General Biology II	4
BIO 3055	Human Physiology	4
BIO 3105	Biostatistics & Exp Design	4
BIO 3155	Comparative Anatomy	4
BIO 3225	Imaging Technology	4
BIO 3255	Evolutionary Ecology	4
BIO 3351	Genetics	4
BIO 3455	Histology	4
BIO 3485	Marine Biology	4
BIO 3591	General Microbiology Lecture	3
BIO 3595	General Microbiology	4
BIO 3661	Environment and Human Health	3
BIO 3905	Vascular Plants	4
BIO 4105	Medical Microbiology	4
BIO 4205	Cell Biology	4
BIO 4251	Endocrine Physiol/Pharmacology	3
BIO 4285	Developmental Biology	4
BIO 4305	Evolution	4
BIO 4331	Biology of Cancer	3
BIO 4355	Experimental Genetics	4
BIO 4505	Molecular Biology	4
BIO 4605	Neurobiology	4
CHM 3311	Inorganic Chem II	3
CHM 3417	Biophysical Chemistry	3
CHM 3511	Instrumental Analysis	3
CHM 3514	Bioanalytical Chemistry	3
CHM 4292	Advanced Organic Chemistry	3
CHM 4315	Organometallics	3
CHM 4331	Bioinorganic Chemistry	3
CHM 4611	Survey of Biochemistry	3
CHM 4621	Biochemistry I: Structure	3
CHM 4622	Biochemistry II: Metabolism	3
CHM 4623	Biochemistry III	3
CHM 4633	Biochemical Parasitology	3
CHM 4641	Chemical & Biochemical Imaging	3
CHM 4652	Biochemical Basis of Disease	3
CHM 4664	Signal Transduction	3
PHY 2402	Physics II Elec & Magnet	3
PHY 2416	Modern Physics	3
PHY 3310	Electronics	3
EGR 2020	Physiology for Engineers	3
GEV 1053	Environmental Studies II	3
GEV 2310	Environmental Chemistry	4

### Elective - Ethics (for Chemical Engineering)

Credits: 3

Electives are subject to change. Electives may be added to this list at the discretion of the College of Engineering.

<b>Course</b>	<b>Title</b>	<b>Credits</b>
ETH 2050	The Good Life:Eth & Cont Prob	3
NS 4200	Leadership and Ethics	3
PHI 2115	Ethics for Health Care Prof	3
PHI 2121	Environmental Ethics	3
PHI 2130	Business Ethics	3
PHI 2155	Engineering Ethics	3
PHI 2160	The Ethics of War	3
PHI 2170	Mass Media Ethics	3
PHI 2180	Computer Ethics	3
PHI 2550	Technology & Society	3
PHI 4125	Bioethics	3
PJ 2900	Ethical Issues in P & J	3
PJ 5400	Ethics, Justice and the Family	3
THL 4100	THM Catholic Ethics	3
THL 4200	Ethics of Life and Death	3
THL 4330	Christian Environmental Ethics	3
VSB 2007	Corp Respon & Regulation	3

### Elective - THL (2000 or above)

Credits: 3

Theology (THL) course or course with CTHL (Core Theology) attribute, at the 2000 level or above.

### Elective - THL/PHI

Credits: 3

Electives are subject to change. Electives may be added to this list at the discretion of the College of Engineering.

One 3-credit course from:

- Theology (THL) course or course with CTHL (Core Theology) attribute, at the 2000 level or above
- Philosophy (PHI)
- Peace and Justice (PJ)
- [ETH 2050](#) - The Good Life: Ethics & Cont Prob
- [EGR 2930](#) - Catholic Social Teaching for EGRs
- Any Humanities or Social Science course with a PJ (Peace and Justice) attribute

### Elective - Free

Credits: 3

Any Villanova three credit course or Villanova courses that when combined add up to three credits (for example, three 1-credit Honors courses)