

# CHEMICAL ENGINEERING UNDERGRADUATE MAJOR

## COVID-19-Related Degree Requirement Changes

For information on how Chemical Engineering degree requirements have been affected by the pandemic, see the "COVID-19 Policies tab (<http://exploreddegrees.stanford.edu/schoolofengineering/chemicalengineering/#covid19policiestext>)" in the "Chemical Engineering" of this bulletin. For University-wide policy changes related to the pandemic, see the "COVID-19 and Academic Continuity (<http://exploreddegrees.stanford.edu/covid-19-policy-changes/>)" section of this bulletin.

See the "Department of Chemical Engineering (<http://exploreddegrees.stanford.edu/schoolofengineering/chemicalengineering/>)" section of this bulletin for additional information on the department, and its programs and faculty.

The department offers a B.S. as well as a minor in Chemical Engineering.

## Chemical Engineering

Completion of the undergraduate program in Chemical Engineering leads to the conferral of the Bachelor of Science in Chemical Engineering.

### Mission of the Undergraduate Program in Chemical Engineering

Chemical engineers are responsible for the conception and design of processes for the purpose of production, transformation, and transportation of materials. This activity begins with experimentation in the laboratory and is followed by implementation of the technology in full-scale production. The mission of the undergraduate program in Chemical Engineering is to develop students' understanding of the core scientific, mathematical, and engineering principles that serve as the foundation underlying these technological processes. The program's core mission is reflected in its curriculum which is built on a foundation in the sciences of chemistry, physics, and biology. Course work includes the study of applied mathematics, material and energy balances, thermodynamics, fluid mechanics, energy and mass transfer, separations technologies, chemical reaction kinetics and reactor design, and process design. The program provides students with excellent preparation for careers in the corporate sector and government, or for graduate study.

### Requirements

	<b>Units</b>
<b>Mathematics (24-30 units)</b> <sup>1</sup>	<b>10</b>
The following sequence or approved AP credit	
MATH 19	Calculus
MATH 20	Calculus
MATH 21	Calculus
Select one of the following:	5-10
CME 100	Vector Calculus for Engineers
MATH 51 & MATH 52	Linear Algebra, Multivariable Calculus, and Modern Applications and Integral Calculus of Several Variables
Select one of the following:	5
CME 102	Ordinary Differential Equations for Engineers
or MATH 53	Ordinary Differential Equations with Linear Algebra
Select one of the following:	4-5
CME 104	Linear Algebra and Partial Differential Equations for Engineers

or CME 106	Introduction to Probability and Statistics for Engineers	
<b>Science (23-29 units)</b> <sup>1</sup>		
CHEM 31M	Chemical Principles: From Molecules to Solids	5
CHEM 33	Structure and Reactivity of Organic Molecules	5
CHEM 121	Understanding the Natural and Unnatural World through Chemistry	5
PHYSICS 41	Mechanics	4
or PHYSICS 41E	Mechanics, Concepts, Calculations, and Context	
PHYSICS 43	Electricity and Magnetism	4
<b>Technology in Society (3-5 units)</b>		
One course required, see Basic Requirement 4; course chosen must be on the SoE-Approved Courses list at <ughb.stanford.edu> the year taken.		3-5
<b>Engineering Fundamentals (7-9 units)</b>		
Two courses minimum; see Basic Requirement 3		
CHEMENG/ENGR 20	Introduction to Chemical Engineering Fundamentals Elective from another School of Engineering department	4
		3-5
See the UGHB for a list of courses.		
<b>Chemical Engineering Depth (51 units minimum)</b>		
CHEMENG 100	Chemical Process Modeling, Dynamics, and Control	3
CHEMENG 110A	Introduction to Chemical Engineering Thermodynamics <sup>3</sup>	3
CHEMENG 110B	Multi-Component and Multi-Phase Thermodynamics	3
CHEMENG 120A	Fluid Mechanics	4
CHEMENG 120B	Energy and Mass Transport	4
CHEMENG 130A	Microkinetics - Molecular Principles of Chemical Kinetics	3
CHEMENG 130B	Introduction to kinetics and reactor design	3
CHEMENG 150	Biochemical Engineering	3
CHEMENG 180	Chemical Engineering Plant Design	4
CHEMENG 181	Biochemistry I	4
CHEMENG 185A	Chemical Engineering Laboratory A (WIM)	5
CHEMENG 185B	Chemical Engineering Laboratory B	5
CHEM 171	Foundations of Physical Chemistry <sup>4</sup>	4
Select 1 of the following:		3
CHEMENG 140	Micro and Nanoscale Fabrication Engineering	
CHEMENG 142	Basic Principles of Heterogeneous Catalysis with Applications in Energy Transformations	
CHEMENG 160	Polymer Science and Engineering	
CHEMENG 174	Environmental Microbiology I	
CHEMENG 177	Data Science and Machine Learning Approaches in Chemical and Materials Engineering	
CHEMENG 183	Biochemistry II	
CHEMENG 190	Undergraduate Research in Chemical Engineering	
CHEMENG 190H	Undergraduate Honors Research in Chemical Engineering	
CHEMENG 196	Creating and Leading New Ventures in Engineering and Science-based Industries	
<b>Total Units</b>		<b>108-118</b>

- <sup>1</sup> Unit count is higher if program includes one or more of the following: MATH 51 and MATH 52 in lieu of CME 100; or CHEM 31A and CHEM 31B in lieu of CHEM 31M.
- <sup>2</sup> A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.
- <sup>3</sup> Students who completed CHEM 171 prior to academic year 2020-21 may substitute CHEMENG 110A with CHEM 171.
- <sup>4</sup> Students who completed CHEM 173 prior to academic year 2020-21 may substitute CHEM 171 with CHEM 173.
- \* For additional information and sample programs, see the Handbook for Undergraduate Engineering Programs (UGHB) (<http://ughb.stanford.edu>)

## Honors Program in Chemical Engineering

The Department of Chemical Engineering offers a program leading to the degree of Bachelor of Science in Chemical Engineering with Honors. Qualified undergraduate majors conduct independent study and research at an advanced level with faculty mentors, graduate students, and fellow undergraduates. This three quarter sequential program requires concurrent participation each quarter in the CHEMENG 191H Undergraduate Honors Seminar; completion of a faculty-approved thesis; and participation in the Chemical Engineering Honors Poster Session held annually during the Mason Lecture Series Spring Quarter. The last requirement may be fulfilled through an alternative, public, oral presentation with the approval of the department chair. A research proposal/application must be submitted at least five quarters prior to graduation with work to begin at a minimum of four quarters prior to graduation.

Admission to the honors program is by application and submission of a research proposal and is subject to approvals by faculty advisers, sponsors, and the chair of the department. Declared Chemical Engineering majors with a cumulative grade point average (GPA) of 3.5 or higher are encouraged to apply. Students must submit their applications no later than the first week in March during Winter Quarter of their junior year, assuming a June degree conferral the following year, e.g. the 2020-2021 deadline is March 1, 2021. An application includes a Stanford transcript in addition to the research proposal, approved by both the student's research thesis adviser, a faculty reader, and, if required, a chemical engineering faculty sponsor. The research adviser or the reader or, alternatively, a faculty sponsor, must be a faculty member in the Department of Chemical Engineering. Students must start their research no later than Spring Quarter their junior year and are encouraged to consider incorporating research opportunities such as those sponsored by Undergraduate Academic Life into their honors research proposal; see [http://ual.stanford.edu/OO/research\\_opps/Grants](http://ual.stanford.edu/OO/research_opps/Grants) ([http://ual.stanford.edu/OO/research\\_opps/Grants/](http://ual.stanford.edu/OO/research_opps/Grants/)). See departmental student services staff in Shriram Center room 129, for more information about the application process, a proposal template, and other assistance.

In order to receive departmental honors, students admitted to the honors program must:

1. Maintain an overall grade point average (GPA) of at least 3.5 as calculated on the unofficial transcript.
2. Complete at least three quarters of research with an aggregate enrollment of a minimum of nine units in CHEMENG 190H Undergraduate Honors Research in Chemical Engineering for a letter grade; up to three units may be used towards the Chemical Engineering depth elective requirements. All quarters must focus on the same topic. The same faculty adviser and faculty reader should be maintained throughout if feasible.

3. Enroll in CHEMENG 191H Undergraduate Honors Seminar, concurrently with each quarter of enrollment in CHEMENG 190H Undergraduate Honors Research in Chemical Engineering.
4. Participate with a poster and oral presentation of thesis work at the Chemical Engineering Honors Poster Session held during the Mason Lectures week, Spring Quarter, or, at the Undergraduate Program Committee's discretion, at a comparable public event. Submit at the same time to student services one copy of the poster in electronic format.
5. Submit final drafts of a thesis simultaneously to the adviser and the reader and, if appropriate, to the Chemical Engineering faculty sponsor, no later than April 5, 2021, or the first school day of the second week of the quarter in which the degree is to be conferred.
6. Complete all work and thesis revisions and obtain indicated faculty approvals on the Certificate of Final Reading of Thesis forms by April 30, 2021, or the end of the first month of the graduation quarter.
7. Submit to departmental student services one (1) final copy of the honors thesis, as approved by the appropriate faculty. Include in each thesis an original, completed, faculty signature sheet immediately following the title page. The 2020-2021 deadline is May 3, 2021.
8. Submit to student services a copy of the honors thesis in electronic format at the same time as the final copy of the thesis.

Upon faculty approval, departmental student services to submit one electronic copy of each honors thesis to Student Affairs, School of Engineering.

## Chemical Engineering Minor

The following core courses fulfill the minor requirements:

		<b>Units</b>
ENGR 20	Introduction to Chemical Engineering	4
CHEMENG 100	Chemical Process Modeling, Dynamics, and Control	3
CHEMENG 110A	Introduction to Chemical Engineering Thermodynamics	3
CHEMENG 110B	Multi-Component and Multi-Phase Thermodynamics	3
CHEMENG 120A	Fluid Mechanics	4
CHEMENG 120B	Energy and Mass Transport	4
CHEMENG 130B	Introduction to kinetics and reactor design	3
CHEMENG 185A	Chemical Engineering Laboratory A	5
CHEMENG 180	Chemical Engineering Plant Design	4
Select one of the following:		3
CHEMENG 140	Micro and Nanoscale Fabrication Engineering	
CHEMENG 142	Basic Principles of Heterogeneous Catalysis with Applications in Energy Transformations	
CHEMENG 160	Polymer Science and Engineering	
CHEMENG 174	Environmental Microbiology I	
CHEMENG 181	Biochemistry I	

Total Units 36