

University of Wisconsin-Madison
Department of Chemical and Biological
Engineering

Curriculum Guide for
Chemical Engineering Undergraduates

For students entering the CHE program Fall 2017 or later

Chemical Engineering Curriculum

Requirement Summary

Mathematics, 19 cr

Physics, 10 cr

Chemistry, 20 cr

Life Science, 6 cr

Engineering, 49 cr

Communication Skills, 6 cr

Liberal Studies, 16 cr

Professional Breadth, 6 cr

Total Credits: 132

I. Mathematics, 19 cr¹

Math 221 Calculus and Analytic Geometry, 5 cr,²

Math 222 Calculus and Analytic Geometry, 4 cr,

Math 234 Calculus -- Functions of Several Variables, 4 cr

Math 319 Techniques in Ordinary Differential Equations, 3cr,

or Math 320 Linear Algebra and Differential Equations, 3 cr

Statistics 324 Introductory Applied Statistics for Engineers, 3 cr

- Math 217 or 275 can be taken in place of Math 221.
- Math 276 can be taken in place of Math 222.

II. Science, 36 cr

A. Physics, 10 cr

Physics 201 or 207 General Physics, 5 cr

Physics 202 or 208 General Physics, 5 cr

Transfer students who receive fewer than 6 credits for Physics 201/202 or 207/208 courses must make up the credit shortage with another Physics course. EMA 201 and 202 can be substituted for Physics 201.

B. Chemistry, 20 cr

Chem 109 General and Analytical Chemistry I, 5 cr³

Chem 329 Fundamentals of Analytical Science, 4 cr

Chem 343 Organic Chemistry I, 3 cr

Chem 344 Introductory Organic Chemistry Lab, 2 cr

Chem 345 Organic Chemistry II, 3 cr

Chem 562 Physical Chemistry, 3 cr

¹Transfer students must have equivalent math courses to meet the requirement of the three basic calculus courses with at least 12 credits.

²Meets the Quantitative Reasoning, Part A General Education Requirement.

³Meets the Quantitative Reasoning, Part B and Natural Science General Education Requirement.

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- Chem 103 and 104 can be substituted for Chem 109.
- Chem 115 and 116 can be taken in place of Chem 109 and 329.
- Chem 327 is not an acceptable substitution for Chem 329.

C. Life Science, 6 cr

Introductory Biology requirement: Zool 153 (3 cr) or Zool 151 (5 cr) or score of 4 or 5 on AP Biology Exam

Advanced Biology requirement: Biochem 501 (3 cr) or Biochem 507 (3 cr) or Zool 570 (3 cr) or Gen 466 (3 cr) or Microbio 303 (3 cr)

Biocore 381 and 383 may be used to satisfy the Life Science requirements. Students who meet the Introductory Biology requirement with an AP exam are encouraged to take 2 advanced biology electives.

IV. Engineering, 49 cr

CBE 150 Introduction to Chemical Engineering, 1 cr

CBE 250 Process Synthesis, 3 cr

CBE 255 Introduction to Chemical Process Modeling, 3 cr

CBE 310 Chemical Process Thermodynamics, 3 cr

CBE 311 Thermodynamics of Mixtures, 3 cr

CBE 320 Introductory Transport Phenomena, 4 cr

CBE 324 Transport Phenomena Lab, 3 cr

CBE 326 Momentum and Heat Transfer Operations, 3 cr

CBE 424 Operations and Process Laboratory, 5 cr

CBE 426 Mass Transfer Operations, 3 cr

CBE 430 Chemical Kinetics and Reactor Design, 3 cr

Materials Elective (CBE 440 Chemical Engineering Materials, 3 cr

or CBE 540 Polymer Science and Technology, 3 cr

or CBE 547 Introduction to Colloid and Interface Science, 3 cr)

CBE 450 Process Design, 3 cr

CBE 470 Process Dynamics and Control, 3 cr

CBE Electives, 6 cr

Chemical Engineering electives may be chosen from any of the CBE courses that are not required, numbered 300 or above (excluding seminar courses). A maximum of two credits of co-op work (CBE 001) may be used to meet the CBE elective requirement. BSE 642, Food and Pharmaceutical Separations, can be taken as a CBE elective. Qualified undergraduates may take graduate-level (600 or 700) courses to fulfill this requirement.

Students must earn a grade of C or better in CBE 250, 310, 311, and 320.

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V. Professional Breadth Requirement, 6 cr

The objective of this requirement is to provide students with skills to interact with professionals from other disciplines. Suitable courses for this requirement include upper-level courses in engineering (excluding CBE), science, math, or business. A list of approved courses is available online in [Guide](#). A recent version of this list is appended.

VI. Communication Skills Requirements⁵

For Part A of the General Education Communication Requirement (3 cr) students must select one course with a designation of “Gen-Ed: Com A” in the Course Guide, such as the following: Engl 100, Com Arts 100, L Sc Com 100, ESL 118 (for students required to study English as a second language), and Com Arts 118 (Honors).

For Part B of the General Education Communication Requirements, students must take InterEgr 397 Engineering Communication, 3cr.

VII. Liberal Studies Requirements, 16 cr⁶

- 1) Liberal Studies elective courses must have a breadth designation in the Course Search and Enroll of either humanities, social science or literature. At least 6 credits must have a breadth designation of humanities, and at least 3 credits must have a breadth designation of social science. Foreign language courses count as humanities credits.
- 2) A minimum of 2 courses must be taken from the same subject listing. At least 1 of these 2 courses must be at an intermediate or advanced level (designated in Course Search and Enroll).

⁵Meets the Communication Skills Part A and Part B General Education Requirement.

⁶Meets the Humanities/Literature/Arts and Social Studies General Education Requirement.

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- 4) A 3-credit ethnic-studies course must be taken. Acceptable courses are identified by the designation “Ethnic studies” in Course Search and Enroll. If appropriate, the ethnic-studies course may be among those used to satisfy the concentration requirement.
- 5) Retroactive credits may be awarded for foreign language work done in high school. The following conditions apply:
 - a) A university-level foreign language course must be taken before the student has earned 30 college credits in residence;
 - b) A Retroactive Language Credit Request Form must be completed and submitted to the language instructor during the first two weeks of class;
 - c) The student must earn a B or better in this course.

Such credits do not count towards the 16 liberal-studies credits required. They may, however, be used to satisfy the concentration and depth requirements stated in Item 2 above and count as degree credits.

- 6) English composition courses, English as a Second Language courses, and basic Communications Arts courses are not accepted as liberal-studies electives.

Recommended Course Sequence

Freshman year, First semester, 17 credits

Course number	Course Name	Prerequisites	Cr
Chem 109	<i>Advanced General Chemistry</i>		5
Math 221	<i>Calculus and Analytic Geometry</i>		5
Communications Elective			3
Liberal Studies Elective			3
CBE 150	<i>Introduction to Chemical Engineering</i>		1

Freshman year, Second Semester, 16 credits

Chem 329	<i>Fundamentals of Analytical Science</i>	Chem 104 or 109	4
Math 222	<i>Calculus and Analytic Geometry</i>	Math 217, 221 or 275	4
Physics 201	<i>General Physics</i>	Math 217, 221 or 275	5
Liberal Studies Elective			3

Sophomore year, First semester, 18 credits

CBE 250	<i>Process Synthesis</i>	Chem 116, 329 or con reg	3
Chem 343	<i>Organic Chemistry I</i>	Chem 104, 109 or 116	3
Math 234	<i>Calculus---Functions of Several Variables</i>	Math 222 or 276	4
Physics 202	<i>General Physics</i>	Physics 201 or 207 or EMA 201; Math 217, 221 or 275	5
Zool 153	<i>Introductory Biology</i>		3

Sophomore year, Second Semester, 17 credits

CBE 255	<i>Introduction to Chemical Process Modeling</i>	CBE 250 or con reg; MATH 319, 320, 376, or con reg	3
CBE 310	<i>Chemical Process Thermodynamics</i>	Math 234 or 376; Physics 201, 207, or EMA 202; CBE 250; CBE 255 or con reg	3
Chem 344	<i>Introductory Organic Chemistry Lab</i>	Chem 345 or con reg	2
Chem 345	<i>Intermediate Organic Chemistry</i>	Chem 343 with grade of C or better	3
Math 319 or Math 320	<i>Techniques in Ordinary Differential Equations or Linear Algebra and Differential Equations</i>	Math 222 or 276	3
Stat 324	<i>Intro Applied Statistics for Engineers</i>	Math 221 or 275	3

Recommended Course Sequence (Continued)

Junior year, First semester, 16 credits

CBE 320	<i>Introductory Transport Phenomena</i>	Physics 201, 207, 247, or EMA 201; Math 319, 320 or 376	4
CBE 311	<i>Thermodynamics of Mixtures</i>	CBE 310	3
Advanced Biology Elective			3
Liberal Studies Elective			3
Professional Breadth Elective			3

Junior year, Second Semester, 16 credits

CBE 324	<i>Transport Phenomena Lab</i>	CBE 310; CBE 320 or con reg; Stat 324	3
CBE 326	<i>Momentum and Heat Transfer Operations</i>	CBE 310 & 320	3
Chem 562	<i>Physical Chemistry</i>	CBE 310; Physics 202 or 208	3
Liberal Studies Elective			4
InterEgr 397	<i>Technical Communication</i>		3

Senior year, First semester, 15 credits

CBE 426	<i>Mass Transfer Operations</i>	CBE 311 & 320	3
CBE 430	<i>Chemical Kinetics and Reactor Design</i>	CBE 311 & 320	3
CBE 440 or CBE 540 or CBE 547	<i>Chemical Engineering Materials Polymer Science and Technology Introduction to Colloid and Interface Science</i>	CBE 310; Chem 345 Chem 345 Chem 561 or 562; CBE 311	3
CBE Elective			3
Liberal Studies Elective			3

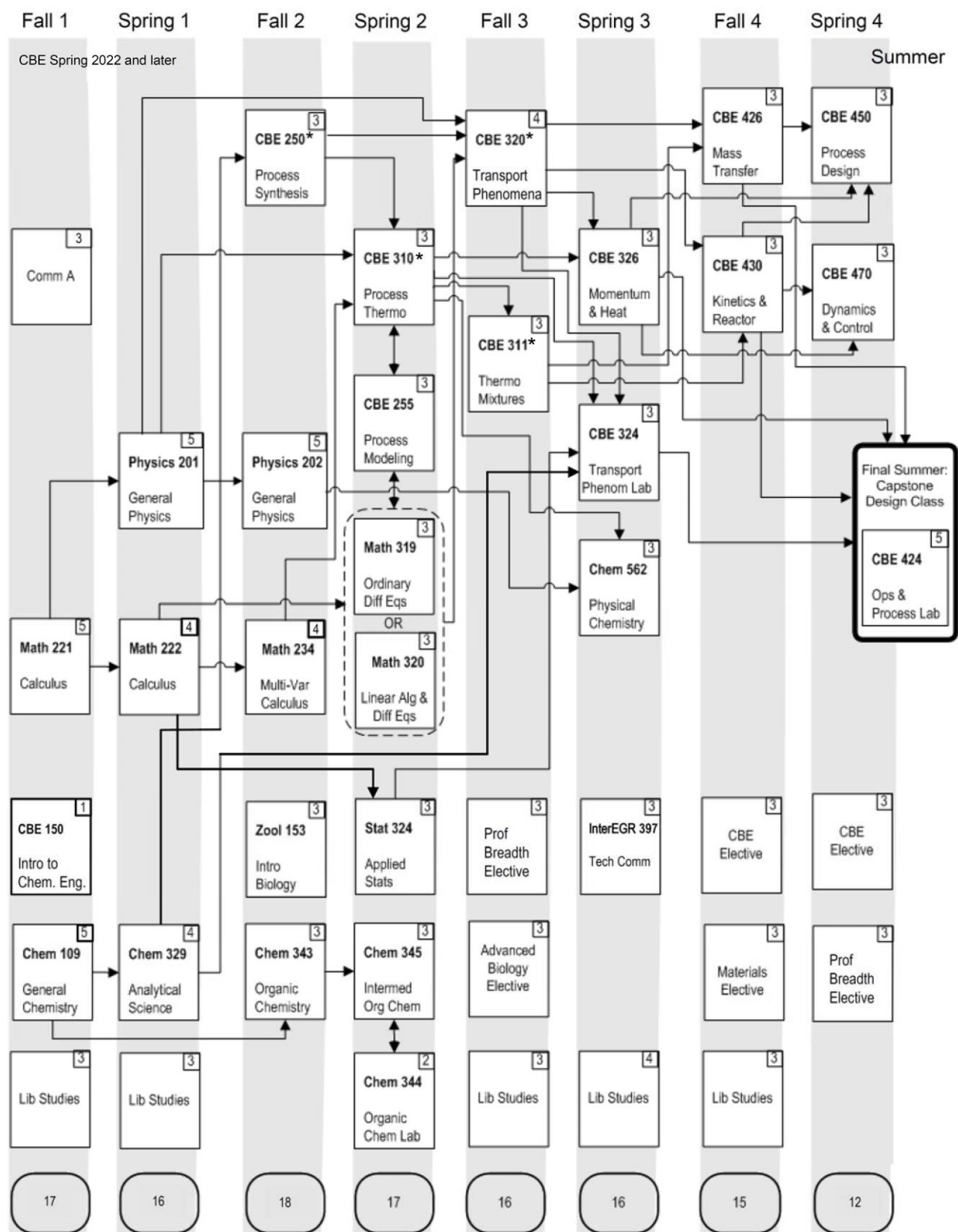
Senior year, Second Semester, 12 credits

CBE 450	<i>Process Design</i>	CBE 326, 426 & 430	3
CBE 470	<i>Process Dynamics and Control</i>	CBE 326; CBE 430 or con reg	3
CBE Elective			3
Professional Breadth Elective			3

Senior year, Summer session, 5 credits

CBE 424	<i>Operations and Process Lab</i>	CBE 324, 326, 426 & 430	5
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Chemical Engineering Curriculum Flow Diagram



*CBE department requires C or better in CBE 250, 310, 311, and 320

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Elective Course Lists

I. Communication Part A

Comm Arts 100, Introduction to Speech Composition Sem. I, II; 3 cr.

English 100, Introduction to College Composition, Sem. I, II; 3 cr.

Life Sci Com 100, Science and Storytelling, Sem I, II, 3 cr.

Com Arts 181, Elements of Speech – Honors Course. Sem I; 3 cr.

II. Professional Breadth Elective Courses

- A. Courses of level 300 or higher from the following College of Engineering departments and programs may be used:

Biomedical Engineering
Civil and Environmental Engineering
Electrical and Computer Engineering
Engineering Mechanics and Astronautics
Engineering Professional Development
Geological Engineering
Industrial Engineering
Interdisciplinary Courses (Engineering)
Materials Science and Engineering¹
Mechanical Engineering
Nuclear Engineering
Engineering Physics

- B. Any course of level 300 or higher from the following departments in the College of Letters and Sciences may be used:

Chemistry
Computer Sciences
Math
Physics

¹ Full degree credit is not allowed if a student takes both CBE 440 and MS&E 350. MS&E 350 will be awarded only 1 degree credit.

C. The following courses may also be used:

Acct IS 300 Accounting Principles
Bact 303 Biology of Microorganisms
Biochem 501 Introduction to Biochemistry
or Biochem 507 General Biochemistry
Biocore 381 Evolution, Ecology and Genetics
Biocore 383 Cell Biology
BSE 364 Engineering Properties of Food and Biological Materials
BSE 367 Renewable Energy Systems
BSE 642 Food and Pharmaceutical Separations
Econ 343 Environmental Economics
Envir St 343 Environmental Economics
Envir St/Geosci 411 Energy Resources
Envir St/Phil 441 Environmental Ethics
Finance 300 Introduction to Finance
Food Sci 550 Fermented Foods and Beverages
Gen Bus 310 Fundamentals of Accounting and Finance for Non-Business Majors
Gen Bus 311 Fundamentals of Management and Marketing for Non-Business Majors
Gen/Botany/Zool 466 General Genetics
Hist Sci 337 History of Technology
MHR 300 Managing Organizations
Stat 424 Experimental Design
Zool 570 Cell Biology

Students may petition the department to allow other courses related to engineering professional practice. To request that a course that is not listed above be used, the student should fill out the Professional Breadth Requirement Course Request form available online, and submit it to his/her advisor. The department will then determine if the course can be counted toward the Professional Breadth Requirement. **Petitions must be submitted before the beginning of the semester in which the class is to be taken.**

Curriculum Specialization for Chemical Engineering

Students wishing to specialize or to prepare for graduate study may use electives to achieve a curriculum that will enhance their professional development. Examples for several areas are listed below. Students should consult their advisers.

Bioprocess Engineering/Biotechnology

Materials: CBE 540

CBE elective: CBE 361, CBE 560, BSE 642

Adv Biol elective: Biochem 501

Prof Breadth elective: Micro 303, Zoo 570, Zoo 151 in place of Zoo 153 (2 Breadth elective credits)

Biomedical and Premedical

Materials: CBE 540

CBE elective: CBE 560

Adv Biol elective: Biochem 501

Prof Breadth elective: BME courses 300 level or above, Zoo 151 in place of Zoo 153 (2 Breadth elective credits), Zoo 152

(Students should contact a prehealth advisor. See <http://prehealth.wisc.edu/> for more information.)

Energy and Sustainability

Materials: CBE 440

CBE elective: CBE 562 (senior elective courses on energy with Profs. Root or Huber)

Prof Breadth elective: CEE 320, 326, 521, 522, Envir St. 343, Geol 411

Environmental Engineering

Materials: CBE 440

CBE elective: CBE 567, 535

Prof Breadth elective: CEE 320, 326, 521, 522, Envir St. 343, Geol 411

Polymers/Soft Materials

Materials: CBE 540

CBE elective: CBE 525, 541, 547

Prof Breadth elective: ME 417, 418

Food Engineering

Materials: CBE 540

CBE elective: CBE 547, 560

Prof Breadth elective: MicroBio 325, BSE 642, Food Sci 410

Process Systems Engineering

Prof Breadth elective: ISyE 313, 433, CS 412, 513, Math 340, 415

Solid State Materials

Materials: CBE 440

Prof Breadth elective: MSE 448, 570, ECE 335, 466, Physics 531, 551

Business/Entrepreneurship

CBE elective: CBE 505

Prof Breadth elective: Acct IS 300, Finance 300, Gen Bus 310, 311, MHR 300

Certificates

There are numerous certificates that students can complete to further their professional development. These are listed at https://guide.wisc.edu/explore-majors/#filter=.filter_45

Second Majors

Students may also earn a second major. Popular second majors include Chemistry, Mathematics, and Biochemistry. Students should consult the department of their second major for advising as early as possible, preferably before the end of their fifth semester.

Course Substitution Regulations

CBE Course Substitution Regulations

1. Any student may, with adviser approval, replace up to 12 credits of required courses in the curriculum (except CBE 424) by an equal number of credits of other courses within the limitations listed under (2).
2. Restrictions on course substitutions are the following:
 - a. Physics courses may be replaced by science or engineering courses;
 - b. Chemistry/life science courses must be replaced by courses with significant chemistry/life science content;
 - c. Engineering courses must be replaced by engineering courses;
 - d. Lab courses must be replaced by an equal number of hours of lab courses;
 - e. English 101, English as a second language courses, and Math 112-114 may not be used for course substitutions.
3. A student who wishes to make a course substitution must obtain a **Course Substitution Form** from room 3035 (also available online). The form must be signed by the student's adviser and turned into the Undergraduate Office, Room 3035, for entry into the student's record.
4. Course substitution requests must be submitted before the beginning of the semester in which the course will be taken, **and** course substitution requests must be submitted at least two semesters prior to graduation in order to allow sufficient time for departmental review of the request without delaying the student's graduation.

Appendix B

Pass/Fail Regulations

Pass/Fail Regulations applicable to Chemical Engineering undergraduate students:

1. Courses taken to satisfy degree requirements **cannot** be taken pass/fail.
2. Students are free at any time to take courses in excess of degree requirements on a pass/fail basis.
3. Pass/Fail Requests can be accessed through your Student Center in My UW Madison. Requests should be submitted before the end of the fourth week of classes. The pass/fail election may be withdrawn anytime before the end of the fourth week of classes.
4. A grade of “C” shall be the minimum acceptable for “Pass.” Pass/fail grades are not included in the calculation of the grade point average or the point credit ratio.