University of Wisconsin-Madison
Department of Chemical and Biological Engineering

Curriculum Guide for Chemical Engineering Undergraduates

Last modified 2/29/16 DJK

Chemical Engineering Curriculum

Requirement Summary
Mathematics, 19 cr
Physics, 10 cr
Chemistry, 20 cr
Life Science, 6 cr
Engineering, 48 cr
Communication Skills, 2 cr
Liberal Studies, 16 cr
Free Electives, 6 cr
Professional Breadth, 6 cr
Total Credits: 133

I. Mathematics, 19 cr[1]
Math 221 Calculus and Analytic Geometry, 5 cr[2]
Math 222 Calculus and Analytic Geometry, 5 cr
Math 234 Calculus -- Functions of Several Variables, 3 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

---

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 cr[3]
Chem 329 Fundamentals of Analytical Science, 4 cr
Chem 343 Introductory Organic Chemistry, 3 cr
Chem 344 Introductory Organic Chemistry Lab, 2 cr
Chem 345 Intermediate Organic Chemistry, 3 cr
Chem 562 Physical Chemistry, 3 cr

---

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

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

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

- 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 Bact 303 (3 cr)

Biocore 301 and 303 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, 48 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[4]
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 544 Processing of Electronic Materials, 3 cr
or CBE 547 Introduction to Colloid and Interface Science, 3cr)
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 & Pharmaceutical Separations, can be taken as a CBE elective. Qualified undergraduates may take graduate-level (600 or 700) courses to fulfill this requirement.

[4]Meets the Communication Skills, Part B General Education Requirement.

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 through the CBE department website. A recent version of this list is appended.

VI. Communications Skills Requirements[5]

For Part A of the General Education Communication Requirement (2 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), Com Arts 118 (Honors)., and EPD 155

CBE 424 satisfies Part B of the General Education Communication Skills Requirement.

VII. Liberal Studies Requirements, 16 cr[6]

1) Liberal Studies elective courses must have a breadth designation in the Course Guide 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 department or program. At least 1 of these 2 courses must be at an intermediate or advanced level (designated in the Course Guide).

---

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

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

4) A 3-credit ethnic-studies course must be taken. Acceptable courses are identified by the designation "Ethnic: Yes" in the Course Guide. 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.

VIII. Free Electives, 6 cr

A free elective is any non-required course listed in the Course Guide that is not used to satisfy another degree requirement. Students are required to take a minimum of 6 credits of free electives. Students who satisfy some degree requirements by examination or transfer courses may have to increase free elective credits to meet the minimum of 133 total credits for the Chemical Engineering degree.

Recommended Course Sequence

Freshman year, First semester, 15 credits

Course number	*Course Name*	Prerequisites	Cr
Chem 109	*General and Analytical Chemistry*		5
Math 221	*Calculus and Analytic Geometry*		5
Communications Elective			2
Liberal Studies Elective			3

Freshman year, Second Semester, 17 credits

Chem 329	*Fundamentals of Analytical Science*	Chem 109	4
Math 222	*Calculus and Analytic Geometry*	Math 221	5
Physics 201	*General Physics*	Math 221	5
Liberal Studies Elective			3

Sophomore year, First semester, 17 credits

CBE 250	*Process Synthesis*	Chem 329 or Chem 343, or con reg	3
Chem 343	*Introductory Organic Chemistry*	Chem 104 or 109	3
Math 234	*Calculus -- Functions of Several Variables*	Math 222	3
Physics 202	*General Physics*	Physics 201 or equiv.	5
Zool 153	*Introductory Biology*		3

Sophomore year, Second Semester, 17 credits

CBE 255	*Introduction to Chemical Process Modeling*	Math 319 or 320 or con reg	3
CBE 310	*Chemical Process Thermodynamics*	Math 234; Physics 201 or equiv; CBE 255 or equiv or con reg; CBE 250 with grade of C or better	3
Chem 344	*Introductory Organic Chemistry Lab*	Chem 345 or con reg	2
Chem 345	*Intermediate Organic Chemistry*	Chem 343 with grade of C or better	3
Math 319 or Math 320	*Techniques in Ordinary Differential Equations* or *Linear Algebra and Differential Equations*	Math 222	3
Stat 324	*Intro Applied Statistics for Engineers*	Math 222	3

Recommended Course Sequence (Continued)

Junior year, First semester, 16 credits

CBE 320	*Introductory Transport Phenomena*	Physics 201, Math 319 or 320, CBE 250 with grade of C or better	4
CBE 311	*Thermodynamics of Mixtures*	CBE 310	3
Advanced Biology Elective			3
Liberal Studies Elective			3
Professional Breadth Elective			3

Junior year, Second Semester, 16 credits

CBE 324	*Transport Phenomena Lab*	CBE 310 & 320 or con reg; Stat 324	3
CBE 326	*Momentum and Heat Transfer Operations*	CBE 310 & 320 with grades of C or better	3
Chem 562	*Physical Chemistry*	CBE 310, Physics 202	3
Liberal Studies Elective			4
Professional Breadth Elective			3

Senior year, First semester, 15 credits

CBE 426	*Mass Transfer Operations*	CBE 311 & 320	3
CBE 430	*Chemical Kinetics and Reactor Design*	CBE 311 & 320	3
CBE 440 or CBE 540 or CBE 544 or CBE 547	*Chemical Engineering Materials* *Polymer Science and Technology* *Processing of Electronic Materials* *Introduction to Colloid and Interface Science*	Chem 345 Chem 345; CBE 326 & 430, or con reg; Stat 324 CBE 440 or MS&E 351 or ECE 335 Chem 561 or 562 or equiv,	3
CBE Elective			3
Liberal Studies Elective			3

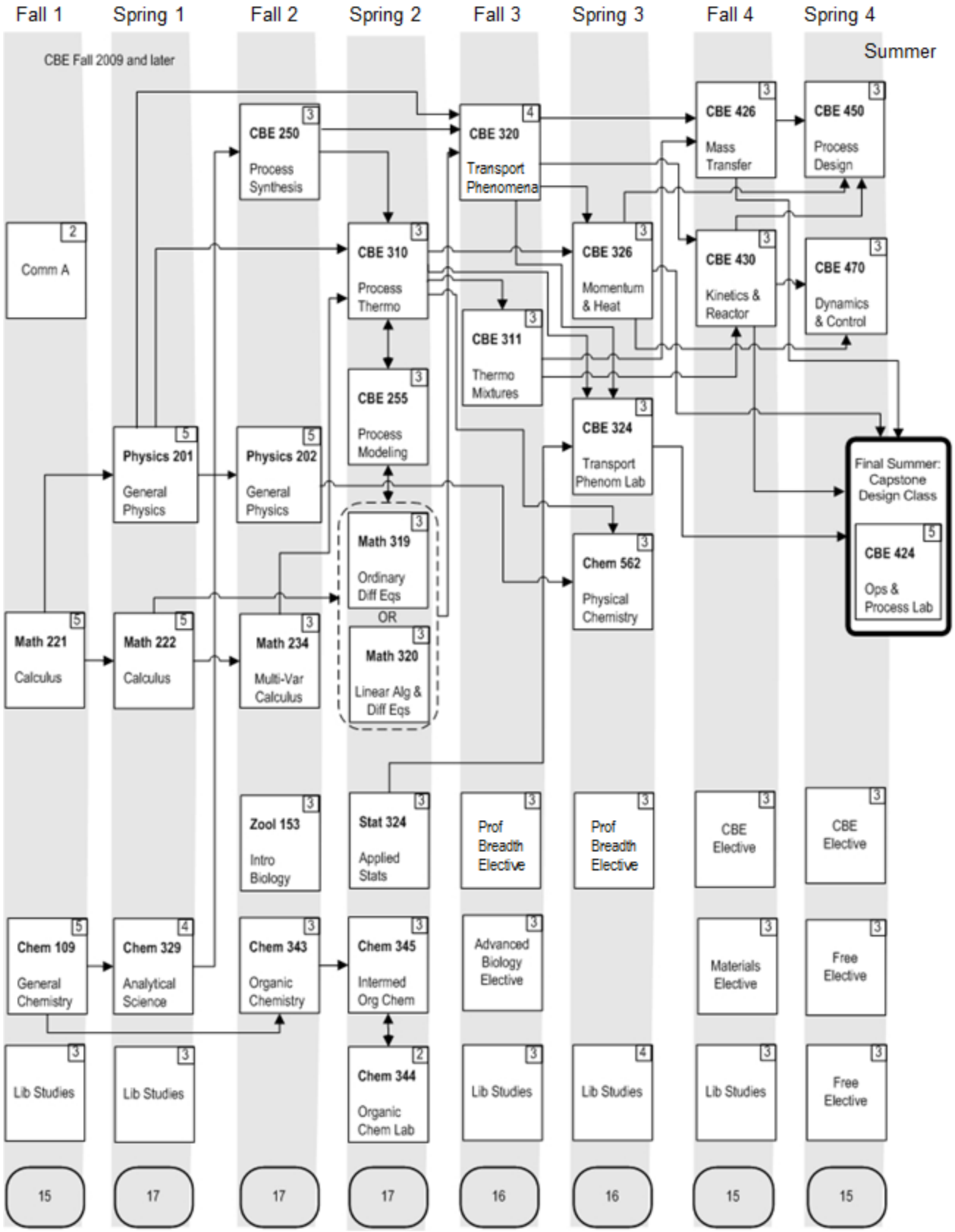
Senior year, Second Semester, 15 credits

CBE 450	*Process Design*	CBE 326, 426 & 430	3
CBE 470	*Process Dynamics and Control*	CBE 326; CBE 430 or con reg	3
CBE Elective			3
Free Elective			6

Senior year, Summer session, 5 credits

CBE 424	*Operations and Process Lab*	CBE 324, 326, 426 & 430	5

Chemical Engineering Curriculum Flow Diagram



Chemical Engineering Curriculum
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.
English 118, Academic Writing II, Sem I, II, SS; 3 cr.
EPD 155, Basic Communication, Sem. I, II, SS; 2 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[1]
Geological Engineering
Industrial Engineering
Interdisciplinary Courses (Engineering)[1]
Materials Science and Engineering[2]
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] InterEgr 160, and any other course of level 200 or higher.

[2] 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 642 Food and Pharmaceutical Separations
Econ 343 Environmental Economics
Envir St 343 Environmental Economics
Envir St/Phil 441 Environmental Ethics
Finance 300 Introduction to Finance
Gen/Botany/Zool 466 General Genetics
Hist Sci 337 History of Technology
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
Free electives: Zoo 151 in place of Zoo 153 (2 free 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
Free electives: Zoo 151 in place of Zoo 153 (2 free 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
Free elective: Envir St. 343, Geol 411

Environmental Engineering
Materials: CBE 440
CBE elective: CBE 567, 535
Prof Breadth elective: CEE 320, 326, 521, 522
Free elective: 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
Free elective: Food Sci 410

Process Systems Engineering
Prof Breadth elective: ISyE 313, 433, CS 412, 513
Free elective: Math 340, 415

Solid State Materials
Materials: CBE 440
CBE elective: CBE 544
Prof Breadth elective: MSE 448, 570, ECE 335, 466
Free elective: Physics 531, 551

Business/Entrepreneurship
CBE elective: CBE 505
Prof Breadth elective: Acct IS 300, Finance 300, Gen Bus 310, 311

Certificates

There are numerous certificates that students can complete to further their professional development. These are listed on the following websites, for different colleges/schools on campus:

Engineering:	http://www.engr.wisc.edu/majorsandcertificates.html
Letters and Sciences:	http://pubs.wisc.edu/ug/ls_majors.htm
Business:	https://bus.wisc.edu/degrees-programs/certificates/undergraduate

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.

Appendix A

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 (3).

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 2035 (also available online). The form must be signed by the student's adviser and turned into the Undergraduate Office, Room 2035, 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. Students in good standing may request to take courses pass/fail. **These courses must be free electives.**

2. 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.

3. 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.

4. All students are free at any time to take courses in excess of degree requirements on a pass/fail basis.