

Concentration in Biochemical Engineering

Interested in pursuing an undergraduate degree at the interface of life sciences and engineering?

The **Concentration in Biochemical Engineering** is for students majoring in **Chemical Engineering** who have an interest in pursuing careers or graduate studies in biotechnology, bioengineering or the pharmaceutical industry. This program represents the first formal training program in bioengineering at UMass Amherst, and we are very excited about it! We hope you are excited about this opportunity as well.

What will I be able to do with this Concentration?

At the end of the program, you will have a B.S. degree in Chemical Engineering, and you can pursue a career in the chemical, petroleum, or advanced materials industry, just as any other B.S. Chemical Engineer would. However, you will also have specialized training that will make you a better candidate for a career in the biotechnology and pharmaceutical industries. Employers of chemical engineers in Massachusetts and Connecticut are heavily based in the life sciences and pharmaceutical sectors. ChemE students taking the courses listed on the next page have also gone on to graduate programs in Bioengineering and to medical schools.

Why a Biochemical Engineering Concentration rather than a degree in Bioengineering?

You may be considering other universities that offer B.S. degrees in Bioengineering. Our faculty has given much thought to how to integrate bioengineering with the traditional engineering disciplines, and whether or not to offer a distinct degree program. However, nationwide statistics show that students with core training in a traditional area of engineering and a specialization in bioengineering have **much better placement** than students with an undergraduate degree in bioengineering. This feedback has been echoed by our Departmental Advisory Board, which includes representatives from Bayer Healthcare, Amgen, Merck, Pfizer and Millennium Pharmaceuticals.

What will I learn?

Students in the program will gain the skills necessary to design, analyze and operate biochemical processes:

- A basic understanding of molecular and cellular biology, including structure and function at the cellular, subcellular and molecular levels.
- An understanding of the chemical principles underlying the molecular components and the networks of reactions in living cells, including protein structure, reaction networks involved in metabolism, biosynthesis, signaling, transfer of genetic information and recombinant DNA technology
- An appreciation for the application of chemical engineering and biochemistry principles to the design and operation of processes in the food and pharmaceutical industries, including enzyme catalysis, metabolic engineering, fermentation, microbial growth, bioreactor design, and product recovery and purification
- An appreciation for emerging areas in bioengineering, gained through research or special topics courses

Will I get any hands-on experience?

YES! Students will have the opportunity to perform bioengineering research with faculty through independent study projects and senior theses. Faculty members associated with the concentration are widely recognized in their fields and leaders of interdisciplinary initiatives on campus. For more information on faculty research, see the Chemical Engineering website.

How do I sign up for the Concentration?

You may sign up any time after you become a Chemical Engineering major, however, **we strongly encourage students to sign up as soon as your decision is made to pursue the Concentration.** Fill out a “Change of Major, Track, Honors, and/or Degree Form,” available from Marston 126 or from the wall outside Tami Paluca’s office (112E Goessmann). Fill in “Chemical Engineering” as your Major and “Biochemical Engineering Concentration” as the Subplan. This form needs to be signed by Tami Paluca and then brought to 126 Marston (The Office of Student Affairs) for the Dean’s signature and processing. If you have questions, contact the advisor for the Concentration, Prof. Michael Henson (henson@ecs.umass.edu) or Undergraduate Advisor, Tami Paluca (paluca@ecs.umass.edu).

The Curriculum

Students must take a total of 15 credits. The following nine credits are required:

Biochem 275 –Molecular Biology¹ OR Biochem 285 - Cellular and Molecular Biology¹
Chem 423 – Biochemistry²
ChE 592 – Introduction to Biochemical Engineering³

Students must also take an additional **six credits** of advanced coursework or research in *special topics in bioengineering*. Approved courses are listed below. Additional courses may be used to meet this requirement, but advance approval of Prof. Henson is required.

Biochem 657 – Drug Design
Biology 383H – Gene and Genome Analysis
ChE 220 – ChE Principles of Biological Systems
ChE 510 – Immunoengineering
ChE 535 - Microfluidics and Microscale Analysis in Materials and Biology
ChE 575 – Tissue Engineering
ChE 589 – Nanostructured Biomaterials
ChE 597B – Soft Materials and Biomaterials
ChE 597C – Introduction to Biomolecular Engineering
ChE 296, 396, 496 – Independent Study in Bioengineering⁴
ChE 296ISH, 396ISH, 496ISH – Honors Independent Study in Bioengineering⁴
ChE 499Y, 499T – Honors Senior Thesis in Bioengineering⁴
ChE 697A – Special Topics: Molecular and Systems Biotechnology

The required courses for this program fit into the required Advanced Chemistry elective and Technical Electives that all Chemical Engineering students are required to take, so you do not have to take “extra” courses on top of what is required for the Chemical Engineering major. See the next page for a recommended sequence of courses.

Students are strongly encouraged to take Biochem 275 or Biochem 285 during the fall semester.

A smaller section may be offered in the spring but enrollment may prove difficult.

¹Students **MUST** take ChE 220 or Bio 151 or Bio 190H (a requirement for all Chemical Engineering majors) *before* enrolling in Biochem 275 or Biochem 285. Students should not expect the Biochemistry department to waive this requirement. For the complete list of prerequisites for Biochem 275, please refer to the “Course Catalog” section of “Course Guides” in Spire.

²It is the student’s responsibility to ensure that he or she has the correct pre-requisites for this course. Chemical Engineering students will typically take this course junior year, after completing a year of organic chemistry. Students may elect to take Biochem 423 (formerly Biochem 523) rather than Chem 423; however, it is the responsibility of the student to arrange to take the necessary pre-requisites before enrolling in this course. Pre-requisites will not be waived. If you elect to take Biochem 423 instead of Chem 423, you must contact Tami (paluca@ecs.umass.edu) so that she can make the necessary exceptions in Spire.

³ChE 592 is typically offered once a year or once every two years. Students should check with the most recent instructor of the course to determine when it will be offered, and make plans accordingly. Some students may have to take this course during their junior year.

⁴Only three-credit Bioengineering independent study courses may be used to fulfill this requirement. Students wishing to fulfill this requirement with an independent study or thesis must gain approval of the topic by the Concentration advisors **BEFORE** enrolling for credit. This will typically occur at the start of the semester.

Recommended Sequence of Courses for Students Completing BioChE Concentration
For Students Entering the University AFTER June 2018

<u>Freshman, Fall</u>	<u>Freshman, Spring</u>	<u>Sophomore, Fall</u>	<u>Sophomore, Spring</u>
ENGLWP 112 (3credits)	ChE 120 (3)	PHYSIC 152 (4)	ChE 231 (3)
ENGIN 110 (3)	PHYSIC 151 (4)	ChE 226 (3)	ChE 325 (3)
MATH 131 (4)	Math 132 (4)	ChE 220 ⁵ - BIO Requirement (4)	MATH 331(3)
CHEM 111 (4)	CHEM 112 (4)	ChE 291A (1)	CHEM 262 (3)
Social World (4) ¹⁰		MATH 233 (4)	CHEM 269 (2)
ENGIN 191 – Freshman Seminar (1) ¹¹		CHEM 261 (3)	
<i>19 credits</i>	<i>15 credits</i>	<i>19 credits</i>	<i>14 credits</i>
<u>Junior, Fall</u>	<u>Junior, Spring</u>	<u>Senior, Fall</u>	<u>Senior, Spring</u>
Biochem 275 or 285 (3)	ChE 333 (3)	ChE 401 ⁶ (4)	ChE 402 (4)
ChE 320 (3)	ChE 338 (3)	ChE 444 (3)	Bioeng Special Topic ^{7,8,9} (3)
ChE 330 (3)	CHEM 423 (3)	ChE 446 (3)	Bioeng Special Topic ^{7,8,9} (3)
ChE 391A (1)	Social World (4)	ChE 491A (1)	Social World (4)
ChE 475 (3) (PChem)	Social World (4)	ChE 592 (3)	
ENGIN 351 (3)			
<i>16 credits</i>	<i>17credits</i>	<i>14 credits</i>	<i>14 credits</i>

⁵ All ChE majors are expected to take ChE 220. Exceptions: 1.) We will accept AP Bio, which transfers in as Bio 110, 2.) We will accept Bio 190H, and 3.) We will accept Bio 151 taken previously, or as a transfer course, which is equivalent to Bio 151. Any other exception requests: contact Tami and the instructor. They will be considered on an individual basis. NOTE: As mentioned in Note 1, AP Bio credit is NOT sufficient as a prerequisite for Biochem 275 or 285. While you can complete the chemical engineering degree with AP Bio, you will NOT be able to complete the Concentration without ChE 220 or Bio 151.

⁶ Completion of a General Education Integrative Experience (IE) course is a senior year requirement for all students who entered the University after June 2010. ChE 401 will fulfill this IE requirement.

⁷ See page two for list of approved special topics courses in bioengineering.

⁸ The Chemical Engineering degree requires that you to complete 4 technical electives – at least 2 must be in engineering. Please be sure that one or both your Bioeng Special Topics courses are fulfilling your required tech electives as well. Please be reminded that you are allowed to count only **ONE** Independent Study towards your required Technical Electives. Refer to the main department flowsheet for the rules regarding tech electives.

⁹ IMPORTANT – Although ChE 220 can count towards your departmental Bio requirement **and** 4 of the 6 elective Bioeng Special Topic credits, it will NOT count towards one of the required departmental tech electives as well; i.e. triple count.

¹⁰ All entering students, freshmen and transfers, are required to take one of their two required diversity courses within their first year on campus.

¹¹ All Engineering students are required to enroll in a 1-credit Freshman Seminar in their first semester.

*****ALWAYS CHECK YOUR ACADEMIC REQUIRMENT REPORT ON SPIRE TO BE SURE THAT BOTH YOUR CHEM-ENG AND BIOCHEMICAL ENGINEERING CONCENTRATION REQUIREMENTS ARE BEING FULFILLED. ***