

## 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 BS degree in Chemical Engineering, and you can pursue a career in the chemical, petroleum, or advanced materials industry, just as any other BS 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 below have also gone on to graduate school in Bioengineering and to medical school. **Your transcript and diploma will show the Concentration in Biochemical Engineering**, so potential employers and graduate schools will know that you have completed a formal training program in bioengineering.

#### 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 have given much thought to how to integrate bioengineering together 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 members of our Departmental Advisory Board, which includes representatives from Bayer Healthcare, Amgen, Merck, Pfizer, and Millennium Pharmaceuticals. Employers overwhelmingly prefer students with a BS degree in a traditional engineering field and with specialized training in biochemistry and the life sciences.

#### What will I learn?

Students in the program will gain the skills necessary to design, analyze, and control biological processes. Students will also have the opportunity to perform bioengineering research with faculty. Faculty associated with the concentration are leaders in their field and include four NSF CAREER Award winners and leaders of interdisciplinary initiatives on campus, including the Institute for Cellular Engineering, ICE ([www.umass.edu/ice](http://www.umass.edu/ice)). For more information on faculty research, see the Chemical Engineering website or the ICE website.

Specifically, students will acquire the following skills:

- 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 optimization of processes in the food and pharmaceutical industries, including enzyme catalysis, metabolic engineering and regulation, fermentation, microbial growth, bioreactor design, and product recovery and purification,
- An appreciation for emerging areas in biochemical engineering, gained through independent study or special topics courses.

### How do I sign up for the Concentration?

You may sign up any time after you become a Chemical Engineering major, which is typically after the spring of your freshman year. Fill out a “Change of Major, Track, Honors, and/or Degree Form,” available during the Pre-registration Advising Period. Fill in “Chemical Engineering” as your Major and “Biochemical Engineering” as the Subplan. Turn this form in to the ChemE main office (159 Goessmann) for processing. If you have any questions, please contact the advisors for the Concentration, Prof. Susan Roberts ([sroberts@ecs.umass.edu](mailto:sroberts@ecs.umass.edu)) or Prof. Neil Forbes ([forbes@ecs.umass.edu](mailto:forbes@ecs.umass.edu)).

### The Curriculum

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

Biochem 285 – Cellular and Molecular Biology<sup>1</sup>  
 Chem 490 – Biochemistry<sup>2</sup>  
 ChE 592 – Introduction to Biochemical Engineering<sup>3</sup>

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

ChE 590 – Bioprocessing Engineering Laboratory  
 ChE 597B – Soft Materials and Biomaterials  
 ChE 597C – Introduction to Biomolecular Engineering  
 ChE 597D – Nanostructured Biomaterials  
 ChE 296, 396, 496 – Independent Study in bioengineering<sup>4</sup>  
 ChE 296H, 396H, 496H – Honors Independent Study in bioengineering<sup>4</sup>  
 ChE 499Y, 499T – Honors Senior Thesis in bioengineering<sup>4</sup>  
 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. A recommended sequence of courses is below. **Students are strongly encouraged to take Biochem 285 during the spring semester.** This course is typically over-enrolled in the fall semester, and Biochemistry majors will have first priority for taking this course in the fall.

Freshman, Fall  
ENGLWP 112  
ENGIN 110  
MATH 131  
CHEM 111  
Social World

Freshman, Spring  
ChE 120  
PHYSIC 151  
PHYSIC 153  
MATH 132  
CHEM 112

Sophomore, Fall  
PHYSIC 152  
ChE 291A  
BIO 100  
MATH 233  
CHEM 261  
Social World

Sophomore, Spring  
ChE 226  
MATH 331  
CHEM 262  
CHEM 269A  
Biochem 285  
Social World

Junior, Fall  
ENGIN 351  
ChE 325  
ChE 330  
ChE 391A  
ChE 320  
CHEM 475

Junior, Spring  
Social World  
ChE 333  
ChE 338  
CHEM 490  
ChE 361

Senior, Fall  
ChE 401  
ChE 444  
ChE 446  
ChE 491A  
Bioeng Special Topic

Senior, Spring  
ChE 402 or ChE 590  
Bioeng Special Topic  
ChE 592  
Social World  
Social World

<sup>1</sup>Students must take Bio 100 (a requirement for all Chemical Engineering majors) before enrolling in Biochem 285. Students should not expect that the Biochemistry department will waive this requirement.

<sup>2</sup>It 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 523 rather than Chem 490; 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.

<sup>3</sup>ChE 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.

<sup>4</sup>Only three-credit 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.