

Bioprocess Engineering

The Master of Bioprocess Engineering (MBPE) degree is 9-month degree program designed to prepare graduates for meaningful careers in Bioprocess Engineering spanning the biopharmaceutical, industrial biotech, and food tech industries (and beyond). These include ways to produce bio-based chemicals and fuels, proteins, pharmaceuticals, and other high-value biologics; how to design and/or operate appropriate unit operations (e.g., fermentation systems), mammalian-cell culture systems, and instrumentation to monitor and control biotechnological processes; and how to apply and test bioproduct separation and purification technologies. The MBPE program has access to state-of-the-art bioprocessing equipment both on campus and at the Advanced Biofuels and Bioproducts Process Demonstration Unit (ABPDU), which is part of the Lawrence Berkeley National Laboratory funded by US DOE. Emphasis on translating fundamentals into practical applications across the bench, pilot, and commercial production scales offers an integrated didactic experience. As a result, you will be able to immediately apply hands-on skills and knowledge to develop, design, and scale-up bio-based processes and products from concept through commercialization.

After completion of the MBPE degree, every student who wishes to can be placed in a 3-12 month industry apprenticeship for an additional opportunity to apply Bioprocess Engineering in an industrial research and development or production operations setting.

Industrial Advisory Board

- Paul Hill, Amyris
- Ashley Hesslein, Bayer Pharmaceuticals
- Paul Wu, Bayer Pharmaceuticals
- Marcella Yu, Boehringer Ingelheim
- Brian Kelley, Vir Biotechnology
- Jay Keasling, UC Berkeley

MBPE admissions requirements include a background in Chemical Engineering (B.S.) and an undergraduate biochemistry/molecular biology course equivalent to BIO ENG 11 or MCELLBI 102. Candidates from other backgrounds will be reviewed on a case-by-case basis with focus on a strong foundation to undergo the MBPE program. We are open to working with the motivated applicant (either graduating senior student or industry worker) who wishes to complete appropriate coursework during the summer prior to joining the program.

Minimum Requirements for Admission

The following minimum requirements apply to all graduate programs and will be verified by the Graduate Division:

1. A bachelor's degree or recognized equivalent from an accredited institution;
2. A grade point average of B or better (3.0);
3. If the applicant has completed a basic degree from a country or political entity (e.g., Quebec) where English is not the official language, adequate proficiency in English to do graduate work, as evidenced by a TOEFL score of at least 90 on the iBT test, 570 on the paper-and-pencil test, or an IELTS Band score of at least 7 on a 9-point scale (note that individual programs may set higher levels for any of these); and

4. Sufficient undergraduate training to do graduate work in the given field.

Applicants Who Already Hold a Graduate Degree

The Graduate Council views academic degrees not as vocational training certificates, but as evidence of broad training in research methods, independent study, and articulation of learning. Therefore, applicants who already have academic graduate degrees should be able to pursue new subject matter at an advanced level without the need to enroll in a related or similar graduate program.

Programs may consider students for an additional academic master's or professional master's degree only if the additional degree is in a distinctly different field.

Applicants admitted to a doctoral program that requires a master's degree to be earned at Berkeley as a prerequisite (even though the applicant already has a master's degree from another institution in the same or a closely allied field of study) will be permitted to undertake the second master's degree, despite the overlap in field.

The Graduate Division will admit students for a second doctoral degree only if they meet the following guidelines:

1. Applicants with doctoral degrees may be admitted for an additional doctoral degree only if that degree program is in a general area of knowledge distinctly different from the field in which they earned their original degree. For example, a physics PhD could be admitted to a doctoral degree program in music or history; however, a student with a doctoral degree in mathematics would not be permitted to add a PhD in statistics.
2. Applicants who hold the PhD degree may be admitted to a professional doctorate or professional master's degree program if there is no duplication of training involved.

Applicants may apply only to one single degree program or one concurrent degree program per admission cycle.

Required Documents for Applications

1. **Transcripts:** Applicants may upload *unofficial* transcripts with your application for the departmental initial review. *If the applicant is admitted*, then *official* transcripts of all college-level work will be required. Official transcripts must be in sealed envelopes as issued by the school(s) attended. If you have attended Berkeley, upload your unofficial transcript with your application for the departmental initial review. *If you are admitted*, an official transcript with evidence of degree conferral *will not* be required.
2. **Letters of recommendation:** Applicants may request online letters of recommendation through the online application system. Hard copies of recommendation letters must be sent directly to the program, not the Graduate Division.
3. **Evidence of English language proficiency:** All applicants who have completed a basic degree from a country or political entity in which the official language is not English are required to submit official evidence of English language proficiency. This applies to institutions from Bangladesh, Burma, Nepal, India, Pakistan, Latin America, the Middle East, the People's Republic of China, Taiwan, Japan, Korea, Southeast Asia, most European countries, and Quebec (Canada). However, applicants who, at the time of application, have already completed at least one year of full-time academic course work with grades of B or better at a US university may submit an

official transcript from the US university to fulfill this requirement. The following courses will not fulfill this requirement:

- courses in English as a Second Language,
- courses conducted in a language other than English,
- courses that will be completed after the application is submitted, and
- courses of a non-academic nature.

If applicants have previously been denied admission to Berkeley on the basis of their English language proficiency, they must submit new test scores that meet the current minimum from one of the standardized tests. Official TOEFL score reports must be sent directly from Educational Test Services (ETS). The institution code for Berkeley is 4833. Official IELTS score reports must be sent electronically from the testing center to University of California, Berkeley, Graduate Division, Sproul Hall, Rm 318 MC 5900, Berkeley, CA 94720. TOEFL and IELTS score reports are only valid for two years.

Where to Apply

Visit the Berkeley Graduate Division application page (<http://grad.berkeley.edu/admissions/apply/>).

Required Courses

Master of Bioprocess Engineering degree candidates will be required to complete a minimum of 24 core units over two semesters. This includes a Biochemical Engineering lecture and laboratory series covering 1) cells and the production of biomolecules; and 2) the recovery, separations, and purification of biomolecules, respectively. This foundational series is complemented by required coursework in Good Manufacturing Practice (GMP), Quality by Design (QbD), statistical experimental design, and a Bioprocess Industry seminar series to ensure that you graduate with the necessary skill set and exposure to begin or continue your career in the bioprocess industries.

CHM ENG 170A	Biochemical Engineering	4
CHM ENG 170B	Biochemical Engineering	4
CHM ENG C170L	Biochemical Engineering Laboratory	3
CHM ENG 275	Advanced Bioprocess Engineering	3
CHM ENG 275L	Advanced Bioprocess Engineering Laboratory	4
CHM ENG 298	Seminar in Chemical Engineering	1
CHM ENG 298B	Seminar in Bioprocess Engineering (Students are required to take 2 units; 1 unit in fall and 1 unit in spring)	1

The curriculum also allows room to personalize your BPE education and experience by choosing electives from a wide variety of approved options offered by the Department and across campus:

Elective Courses

MBPE admissions requirements include a background in Chemical Engineering (B.S.) and an undergraduate biochemistry/molecular biology course equivalent to BIO ENG 11 or MCB 102. Candidates from other backgrounds will be reviewed on a case-by-case basis with focus on a strong foundation to undergo the MBPE program. We are open to working with the motivated applicant (either graduating senior student or

industry worker) who wishes to complete appropriate coursework during the summer prior to joining the program.

CHM ENG 180	Chemical Engineering Economics	3
CHM ENG 274	Biomolecular Engineering	3
BIO ENG 124	Basic Principles of Drug Delivery	3
BIO ENG 133	Biomolecular Engineering	3
CHEM C130	Biophysical Chemistry: Physical Principles and the Molecules of Life	4
CHEM 135	Chemical Biology	3
CHEM C230	Protein Chemistry, Enzymology, and Bio-organic Chemistry	2
CHEM C271A	Chemical Biology I - Structure, Synthesis and Function of Biomolecules	1
CHEM C271B	Chemical Biology II - Enzyme Reaction Mechanisms	1
CHEM C271C	Chemical Biology III - Contemporary Topics in Chemical Biology	1
IND ENG 185	Course Not Available	
MCELLBI 38	Stem Cell Biology, Ethics and Societal Impact	3
MCELLBI 88	Immunotherapy of Cancer: Success and Failures	2
MCELLBI C95B	Course Not Available	2
MCELLBI 104	Genetics, Genomics, and Cell Biology	4
MCELLBI 110	Molecular Biology: Macromolecular Synthesis and Cellular Function	4
MCELLBI C112	General Microbiology	4
MCELLBI C116	Microbial Diversity	3
MCELLBI 130	Cell and Systems Biology	4
MCELLBI 133L	Physiology and Cell Biology Laboratory	4
MCELLBI 150	Molecular Immunology	4
NUSCTX 115	Principles of Drug Action	2
PB HLTH W236A	Regulatory Science, Drug Development and Public Health	3

Upon completion of the Master of Bioprocess Engineering program, you will be prepared for a role as an Associate Scientist or Bioprocess Engineer in the biopharmaceutical, industrial biotech, or food tech industries.

The CHM ENG 298B Seminar in Bioprocess Engineering provides an interactive interface for students, bioprocess industry experts, and the MBPE program. This 80-min weekly seminar pairs our students with industry partners to discuss relevant bio-based technologies, processes, and products spanning the biopharmaceutical, industrial biotech, and food tech industries (and beyond). After completion of the MBPE degree, every student who wishes to can be placed in a 3–12 month industry apprenticeship for an additional opportunity to apply Bioprocess Engineering in an industrial research and development or production operations setting.