

# CHEMICAL AND BIOMOLECULAR ENGINEERING, PHD

The Ph.D. in Chemical and Biomolecular Engineering is primarily a research-oriented degree for students showing exceptional promise for original contributions to the theory and practice of chemical and biomolecular engineering. The degree is a virtual requirement for those planning to teach chemical and biomolecular engineering, as well as for those planning on a research career. Doctoral candidates are expected to show superior capability for independent work and study.

**For more information:** <http://www.cbe.seas.upenn.edu/prospective-students/doctoral/index.php> (<http://www.cbe.seas.upenn.edu/prospective-students/doctoral/>)

View the University's Academic Rules for PhD Programs (<http://catalog.upenn.edu/pennbook/academic-rules-phd/>).

## Required Courses

Students are required to take a minimum of 10 graduate level courses, including the six required core courses.

Code	Title	Course Units
<b>Core Courses</b>		
ENM 5100	Foundations of Engineering Mathematics - I	1
ENM 5110	Foundations of Engineering Mathematics - II	1
or ENM 5020	Numerical Methods and Modeling	
CBE 6180	Advanced Molecular Thermodynamics	1
CBE 6210	Advanced Chemical Kinetics and Reactor Design	1
CBE 6400	Transport Processes I	1
<b>Electives</b>		
Select five course units <sup>1</sup>		5
<b>Total Course Units</b>		<b>10</b>

<sup>1</sup>

5 electives are required to complete the doctoral program. PhD students in CBE select their electives with their Faculty Advisor. Electives may be chosen from any courses at a level of 5000 or above. Students may take up to one course in the Wharton School. Non-technical classes will be allowed at the discretion of the Graduate Chair.

The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2022 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.

## Sample Plan of Study

Code	Title	Course Units
<b>First Year</b>		
<i>Fall</i>		
CBE 6180	Advanced Molecular Thermodynamics	
CBE 6210	Advanced Chemical Kinetics and Reactor Design	
CBE 6400	Transport Processes I	
ENM 5100	Foundations of Engineering Mathematics - I	
<i>Spring</i>		
CBE 6410	Transport Processes II (Nanoscale Transport)	
ENM 5020	Numerical Methods and Modeling	
Elective <sup>1</sup>		
Qualifier Exam		
<b>Second Year</b>		
<i>Fall</i>		
Electives (2-3) <sup>1</sup>		
Teaching Assistant		
<i>Spring</i>		
Electives (1-2) or CBE Thesis/Dissertation Research <sup>1</sup>		
Teaching Assistant		
<b>Third Year and Beyond</b>		
Thesis/Dissertation Research		
Dissertation Defense		

<sup>1</sup>

Electives can be chosen from most 5000+ level courses in engineering or the sciences and should be chosen with advisor input. Courses outside of engineering MUST have advisor approval for worksheet approval by the Graduate Coordinator.