

# PHD IN CHEMICAL, ENVIRONMENTAL, AND MATERIALS ENGINEERING

## Overview

The Department of Chemical, Environmental, and Materials Engineering (CEME) offers a Doctor of Philosophy (Ph.D.) degree in Chemical, Environmental, and Materials Engineering with the following areas of emphasis:

- Chemical Engineering
- Environmental Engineering
- Materials Science and Engineering

The educational objectives of the program are to produce graduates whom:

1. Have advanced technical knowledge in at least one specialty area of chemical, environmental and materials engineering
2. Have advanced capability to apply advanced knowledge to engineering problems
3. Have made significant contributions in at least one specialty area of chemical, environmental, and materials engineering

The specialty areas of study for the Ph.D. include:

- Aerosols and Air Quality
- Water Quality
- Materials Synthesis
- Synthetic Biology
- Sustainable Energy & Environment
- Chemical Product Design

Students in the PhD program are required to complete at least 72 credits beyond a Bachelors degree. At least 36 credits will be coursework credits, and at least 36 credits will be research credits. For students who enter the PhD program with an earned Masters degree in a related field, the Masters degree coursework can count up to a maximum of 12 credits towards the required coursework, with approval of the Graduate Program Director and the Supervisory Committee. All PhD students are required to engage in supervised research and defend a dissertation.

## Admission Requirements

Admission requirements are the same as the College of Engineering requirements. The transfer policy complies with the rules of the Graduate School.

## Curriculum Requirements

### Ph.D. in Chemical, Environmental, and Materials Engineering

#### FOR students without a prior master's degree

Code	Title	Credit Hours
<b>Graduate Coursework</b>		<b>27</b>
At least 6 course credits must be at the 700-level in the CEmaT department		
<b>Seminar Series</b>		<b>6</b>
CET 703	Graduate Research Seminar (New Course: CET Seminar Series)	
<b>Teaching Requirement</b>		<b>3</b>
CET 704	Graduate Teaching (New Course: Mentored Teaching Experience)	
<b>Dissertation</b>		<b>36</b>
CET 830	Pre-Candidacy Doctoral Dissertation	
CET 840	Post-Candidacy Doctoral Dissertation	
CET 850	Research in Residence	
<b>Total Credit Hours</b>		<b>72</b>

#### For students with a prior master's degree\*

\*Assuming 12 graduate credit hours are approved to count toward the doctoral program

Code	Title	Credit Hours
<b>Graduate Coursework</b>		<b>15</b>
At least 6 course credits must be at the 700-level in the CEmaT department		
<b>Seminar Series</b>		<b>6</b>
CET 703	Graduate Research Seminar (New Course: CET Seminar Series)	
<b>Teaching Requirement</b>		<b>3</b>
CET 704	Graduate Teaching (New Course: Mentored Teaching Experience)	
<b>Dissertation</b>		<b>36</b>
CET 830	Pre-Candidacy Doctoral Dissertation	
CET 840	Post-Candidacy Doctoral Dissertation	
CET 850	Research in Residence	
<b>Total Credit Hours</b>		<b>60</b>

## Graduation Requirements

The average grade in curricular coursework should be B or better, and no grade below C will be counted. Other requirements are identical to the College of Engineering requirements.

## Supervisory Committee Requirements

The supervisory committee must have at least four members, with at least two members being Graduate Faculty members in CEME. The chair must be regular faculty and a member of the Graduate Faculty, and may or may not be from CEME. If the chair is from CEME and a member of the Graduate Faculty, then only one other member of the committee must be from CEME and a member of the Graduate Faculty. There must be at least one outside (non-CEME) member.

## Qualifying Examination and Proposal Defense

### Qualifying Exam

- Each PhD student chooses at least 2 courses from at least 2 out of 3 Core areas, each with options. The Core areas and associated courses are:
  - Math/Statistics (MAE 601 Methods of Engineering Analysis, MTH 613 Partial Differential Equations I, MTH 642 Statistical Analysis, ISE 616 Introduction to Applied Data Analytics, BST 625 Survey of Statistical Computing),
  - Transport/ Fluid Mechanics (CET 730 Advanced Fluid Mechanics, MAE 713 Transport Phenomena, MAE 612 Intermediate Fluid Mechanics, MAE 714 Computational Fluid Dynamics),
  - Reaction/Kinetics (CET 761 Engineering Reaction Kinetics, ATM 750 Reaction Kinetics and Molecular Dynamics). Only students with a 3.25 GPA or higher in these courses will be permitted to proceed with their qualifying exam.
- The qualifying exam consists of an oral exam and a written exam. The oral exam to test student's ability for research (not progress) will be conducted by the end of the student's 1st year. Departmental committee conducts this oral exam. Students can (1) pass, (2) conditional pass, (3) fail with an option to retake only one more time, (4) fail.
- Students who pass the oral exam can submit their dissertation proposal as the written exam of their qualifying exam. This should be completed within 30 months' time frame, counting from the beginning of their program. Upon successful oral defense of the dissertation proposal, the student is admitted to candidacy.
- Students who receive College of Engineering Fellowships must substantively participate in teaching beginning in Year 2.
- Students must defend a dissertation at the end of the program.
- Students are encouraged to publish their research findings in refereed journals.

## Suggested Plan of Study

### Ph.D. in Chemical, Environmental, and Materials Engineering

Direct B.S. to Ph.D. Pathway - Fall Admission

Year One		Credit Hours
<b>Fall</b>		
Graduate Course		3
Graduate Course		3
Graduate Course		3
CET 703	Graduate Research Seminar	1
CET 830	Pre-Candidacy Doctoral Dissertation	1
<b>Credit Hours</b>		<b>11</b>

<b>Spring</b>		
Graduate Course		3
Graduate Course		3
Graduate Course		3
CET 703	Graduate Research Seminar	1
CET 830	Pre-Candidacy Doctoral Dissertation	1
<b>Credit Hours</b>		<b>11</b>
<b>Year Two</b>		
<b>Fall</b>		
Graduate Course		3
Graduate Course		3
Graduate Course		3
CET 703	Graduate Research Seminar	1
CET 704	Graduate Teaching	2
CET 830	Pre-Candidacy Doctoral Dissertation	1
<b>Credit Hours</b>		<b>13</b>
<b>Spring</b>		
CET 703	Graduate Research Seminar	1
CET 704	Graduate Teaching	1
CET 840	Post-Candidacy Doctoral Dissertation	1
<b>Credit Hours</b>		<b>3</b>
<b>Year Three</b>		
<b>Fall</b>		
CET 703	Graduate Research Seminar	1
CET 830	Pre-Candidacy Doctoral Dissertation	8
Dissertation Proposal (Admission to Candidacy)		
<b>Credit Hours</b>		<b>9</b>
<b>Spring</b>		
CET 703	Graduate Research Seminar	1
CET 840	Post-Candidacy Doctoral Dissertation	8
<b>Credit Hours</b>		<b>9</b>
<b>Year Four</b>		
<b>Fall</b>		
CET 840	Post-Candidacy Doctoral Dissertation	8
<b>Credit Hours</b>		<b>8</b>
<b>Spring</b>		
CET 840	Post-Candidacy Doctoral Dissertation	8
<b>Credit Hours</b>		<b>8</b>
<b>Total Credit Hours</b>		<b>72</b>

**M.S. to Ph.D. Pathway - Fall Admission**

<b>Year One</b>		
<b>Fall</b>		<b>Credit Hours</b>
Graduate Course		3
Graduate Course		3
Graduate Course		3
CET 703	Graduate Research Seminar	1
CET 830	Pre-Candidacy Doctoral Dissertation	1
<b>Credit Hours</b>		<b>11</b>
<b>Spring</b>		
Graduate Course		3
Graduate Course		3

CET 703	Graduate Research Seminar	1
CET 830	Pre-Candidacy Doctoral Dissertation	1
<b>Credit Hours</b>		<b>8</b>
<b>Year Two</b>		
<b>Fall</b>		
CET 703	Graduate Research Seminar	1
CET 704	Graduate Teaching	2
CET 830	Pre-Candidacy Doctoral Dissertation	1
<b>Credit Hours</b>		<b>4</b>
<b>Spring</b>		
CET 703	Graduate Research Seminar	1
CET 704	Graduate Teaching	1
CET 840	Post-Candidacy Doctoral Dissertation	1
<b>Credit Hours</b>		<b>3</b>
<b>Year Three</b>		
<b>Fall</b>		
CET 703	Graduate Research Seminar	1
CET 840	Post-Candidacy Doctoral Dissertation	8
<b>Credit Hours</b>		<b>9</b>
<b>Spring</b>		
CET 703	Graduate Research Seminar	1
CET 840	Post-Candidacy Doctoral Dissertation	8
<b>Credit Hours</b>		<b>9</b>
<b>Year Four</b>		
<b>Fall</b>		
CET 840	Post-Candidacy Doctoral Dissertation	8
<b>Credit Hours</b>		<b>8</b>
<b>Spring</b>		
CET 840	Post-Candidacy Doctoral Dissertation	8
<b>Credit Hours</b>		<b>8</b>
<b>Total Credit Hours</b>		<b>60</b>

## Mission

The mission of the Department of Chemical, Environmental, and Materials Engineering is to:

- Provide high-quality undergraduate and graduate education in chemical, environmental, and materials engineering that will prepare graduates for professional careers and a lifetime of learning.
- Conduct high-quality research that will advance the current body of knowledge and engage in new discoveries to improve the quality of human life; and
- Serve the engineering profession and society through active involvement in professional organizations and contribution of professional expertise.

The departmental mission will be accomplished by providing an integrated and multidisciplinary scientific education. Graduates will be involved in the transfer of scientific discoveries to modern technologies and novel products that benefit society and minimize the impact on the environment. They will be trained to address multi-scale aspects of generating clean energy, producing novel and superior materials, and utilizing the biological revolution to manufacture new products. They will be involved in the development and manufacture of consumer products, as well as in design, operation, and control of processes in a variety of industries (e.g. petroleum, petrochemical, chemical, consumer products, semiconductor, environmental technologies, advanced materials, food, feed and pharmaceuticals).

## Educational Objectives

The educational objectives of the Ph.D. program are to produce graduates whom:

- Have advanced technical knowledge in at least one specialty area of chemical, environmental, or materials engineering;
- Have advanced capability to apply advanced knowledge to engineering problems; and
- Have made significant contributions in at least one specialty area of chemical, environmental, or materials engineering.

Specialty areas include aerosols and air quality, water quality, materials synthesis, synthetic biology, sustainable energy & environment, and chemical product design .

## **Student Learning Outcomes**

- Students will demonstrate an advanced knowledge of the discipline (mathematics, science, and engineering), including methodology relevant to a specialty area.
- Students will demonstrate an advanced ability to identify, formulate, and solve engineering problems to carry out supervised research.
- Students will demonstrate an advanced ability to generate technical contributions and effectively communicate them to the scientific community.