Chemical and Molecular Engineering (CME)

Major in
Chemical and Molecular Engineering
Department of Materials Science and Engineering, College of Engineering and Applied Sciences
CHAIRPERSON: Michael Dudley  UNDERGRADUATE PROGRAM DIRECTORS: Miriam Rafailovich and Devinder Mahajan
ADMINISTRATIVE ASSISTANT: Lynn Allopenna  OFFICE: Engineering 314  PHONE: (631) 632-8484
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Faculty
Please see the faculty listing in the entry for the Engineering Science major.

The Department of Materials Science and Engineering offers two majors leading to the Bachelor of Engineering (B.E.) degree, Engineering Science (see entry in the alphabetical listings of Approved Majors, Minors, and Programs) and Chemical and Molecular Engineering. The program in Chemical and Molecular Engineering is designed to meet the expanding demand for chemical engineers in the pharmaceutical and pharmaceutical industries for food, health products, and cosmetics in the New York region. It emphasizes engineering at the molecular level rather than traditional large-scale process engineering. In a rigorous cross-disciplinary environment, the program provides students with knowledge in the basic physical sciences, mathematical techniques, and computational modeling tools that form the foundation of modern chemical and molecular engineering. A broad spectrum of courses prepares students to assimilate and apply their knowledge creatively to solve complex problems involving not only scientific but also ethical and moral considerations, and utilizing effective communication skills for working in an interdisciplinary team. Employment opportunities for graduates of the program include high-technology industries and institutions that are engaged in research and advanced manufacturing related to nanotechnology, pharmaceuticals, biotechnology, future fuels, waste management, and the synthesis of new materials.

The program’s mission is to (a) serve the community by becoming a resource for regional economic development and (b) serve the nation by training students who can assume leadership in technological innovation, public service, and ethical standards. Its goal is to achieve international recognition as a center of excellence in molecularly based chemical engineering education and research.

Program Educational Objectives
The undergraduate program in chemical and molecular engineering has the following five specific program educational objectives:

1. Provide students with an in depth knowledge of the basic physical sciences, mathematical techniques, and computational tools that form the foundation of modern chemical and molecular engineering.

2. Develop a program that immediately provides the students with a sense of work place relevance by effectively integrating classroom instruction with research, informal education, management, and industrial experience.

3. Build a broad based interdisciplinary educational program in which students are taught to assimilate a complex set of knowledge and provide solutions to difficult problems involving both scientific, ethical, and moral considerations.

4. Educate students to operate effectively as part of a coordinated team, which requires: good communication skills (written and oral); leadership and mentoring skills; the ability to provide original contributions which build upon enhances the group effort; and a strong commitment to upholding ethical and moral standards of intellectual property.

5. Graduate students who are well prepared and committed to a lifetime of continuous learning in order to meet the constantly emerging needs of the chemical and molecular engineering profession.

Program Outcomes
To prepare students to meet the above program educational objectives, a set of program outcomes that describes what students should know and be able to do when they graduate, have been adopted. We expect students to gain:

- the ability to apply knowledge of mathematics, science, and engineering to chemical engineering problems;
- the ability to design and conduct experiments, as well as to analyze and interpret data;
- the ability to design a system, component, or process to meet desired needs;
- the ability to function on multidisciplinary teams;
- the ability to identify, formulate, and solve engineering problems;
- the understanding of professional and ethical responsibility;
- the ability to communicate effectively;
- the broad education necessary to understand the impact of biomedical engineering solutions in a global and societal context;
- the recognition of the need for and an ability to engage in life-long learning;
- a knowledge of contemporary issues;
- the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
- a thorough grounding in chemistry and a working knowledge of advanced chemistry such as organic, inorganic, physical, analytical, materials, biochemical, or environmental sciences, selected based on the student's interest;
- a working knowledge, including safety and environmental aspects, of material and energy balances applied to chemical processes; thermodynamics of physical and chemical equilibria; heat, mass, and momentum transfer; chemical reaction engineering; continuous and stage-wise separation operations; process dynamics and control.

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Courses Offered in Chemical and Molecular Engineering

CME 101 Introduction to Chemical and Molecular Engineering
CME 199 Introduction to Undergraduate Research
CME 300 Writing in Chemical and Molecular Engineering
CME 304 Chemical Engineering Thermodynamics I
CME 310 Chemical Engineering Laboratory I: Unit Operation and Fundamentals
CME 312 Material and Energy Balance
CME 314 Chemical Engineering Thermodynamics II
CME 315 Numerical Methods for Chemical Engineering Analysis
CME 318 Chemical Engineering Fluid Mechanics
CME 320 Chemical Engineering Laboratory II: Chemical and Molecular Engineering
CME 322 Chemical Engineering Heat and Mass Transfer
CME 323 Reaction Engineering and Chemical Kinetics
CME 327 Molecular Modeling for Chemical Engineers
CME 371 Biomedical Polymers
CME 401, 402 Separation Technologies I, II
CME 410 Chemical Engineering Laboratory III: Instrumentation, Material Design, and Characterization
CME 420 Chemical Engineering Laboratory IV: Directed Research
CME 440, 441 Process Engineering and Design I, II
CME 488 Industrial Internship
CME 499 Research in Chemical Engineering

Acceptance into the Major in Chemical and Molecular Engineering

Freshman and transfer applicants who have specified their interest in the major in Chemical and Molecular Engineering may be accepted directly into the major upon admission to the University. Applicants admitted to the University but not immediately accepted into the Chemical and Molecular Engineering major may apply for acceptance at any time during the academic year by contacting the director of the undergraduate program. Priority for admission is given to those students who have:

1. completed AMS 151, PHY 131/133 and CHE 131/133 (or their equivalents),
2. earned a g.p.a. of 3.00 in these mathematics, physics, and chemistry courses with not more than one grade of C or lower; and
3. received completed course evaluations for all transferred courses that are to be used to meet requirements of the major.

Sample Course Sequence for the Major in Chemical and Molecular Engineering

<table>
<thead>
<tr>
<th>Freshman Fall</th>
<th>Credits</th>
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<tbody>
<tr>
<td>First Year Seminar 101</td>
<td>1</td>
</tr>
<tr>
<td>WRT 101 or 102</td>
<td>3</td>
</tr>
<tr>
<td>CME 101</td>
<td>3</td>
</tr>
<tr>
<td>AMS 151</td>
<td>3</td>
</tr>
<tr>
<td>CHE 131, 133</td>
<td>4, 1</td>
</tr>
<tr>
<td>ESG 111</td>
<td>3</td>
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<tr>
<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Sophomore Fall</th>
<th>Credits</th>
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<tbody>
<tr>
<td>AMS 261</td>
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<tr>
<td>CHE 321</td>
<td>3</td>
</tr>
<tr>
<td>CHE 383</td>
<td>2</td>
</tr>
<tr>
<td>PHY 132, 134</td>
<td>4</td>
</tr>
<tr>
<td>ESG 332</td>
<td>4</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
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<table>
<thead>
<tr>
<th>Junior Fall</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CME 312</td>
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</tr>
<tr>
<td>CME 310, 300</td>
<td>2, 0</td>
</tr>
<tr>
<td>CME 318</td>
<td>3</td>
</tr>
<tr>
<td>CME 314</td>
<td>3</td>
</tr>
<tr>
<td>CME 315 or D.E.C.*</td>
<td>3</td>
</tr>
<tr>
<td>Specialization course 1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Senior Fall</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CME 401</td>
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<tr>
<td>CME 470</td>
<td>3</td>
</tr>
<tr>
<td>CME 440</td>
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<tr>
<td>Specialization course 3</td>
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<tr>
<td>D.E.C.</td>
<td>3</td>
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<tr>
<td>D.E.C.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
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* Students take either CME 315 or CME 327, but not both.

Chemical and Molecular Engineering (CME)

The curriculum begins with a focus on mathematics, physics, and chemistry, followed by courses covering specific chemical engineering topics as well as an intensive laboratory sequence. In addition, each student chooses a four-course sequence as an area of specialization and completes the curriculum with a year-long capstone course in process engineering and design that integrates the knowledge acquired in the sciences, engineering, and communication.

Completion of the major requires approximately 112 credits.

Requirements for the Major in

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1. Mathematics
   a. AMS 151, 161 Applied Calculus  
      I, II
   b. AMS 261 or MAT 203 or MAT  
      205 Calculus III
   c. AMS 361 or MAT 303 or MAT  
      305 Calculus IV
   Note: The following alternate  
   calculus course sequences may  
   be substituted for AMS 151, 161:  
   MAT 131, MAT 132
   or MAT 125, 126, 127
   or MAT 141, 142
   or MAT 171

2. Natural Sciences
   a. Chemistry
      CHE 131, 132 General  
      Chemistry  
      I, II
      CHE 133, 134 General  
      Chemistry Laboratory I, II
      CHE 321 Organic Chemistry I  
      and CHE 322 Organic  
      Chemistry II A or CHE 326  
      Organic Chemistry II B
      CHE 383, 384 Introductory and  
      Intermediate Synthetic and  
      Spectroscopic Laboratory  
      Techniques
   b. Physics
      PHY 131, 132 Classical Physics  
      I, II
      PHY 133, 134 Classical Physics  
      Laboratory I, II
      PHY 251 Modern Physics and  
      PHY 252 Modern Physics  
      Laboratory
      or ESG 281 Engineering  
      Introduction to the Solid State
   c. Mathematics
      ESE 124 Computer Techniques for  
      Electronic Design

4. Engineering
   ESG 332 Materials Science I:  
   Structure and Property of Materials

5. Chemical Engineering
   CME 101 Introduction to Chemical  
   and Molecular Engineering
   CME 304, 314 Chemical Engineering  
   Thermodynamics I, II
   CME 312 Material and Energy  
   Balance
   CME 315 Numerical Methods for  
   Chemical Engineering Analysis  
   or CME 327 Molecular Modeling for  
   Chemical Engineers
   CME 318 Chemical Engineering  
   Fluid Mechanics
   CME 322 Chemical Engineering  
   Heat and Mass Transfer
   CME 323 Reaction Engineering and  
   Chemical Kinetics
   CME 401, 402 Separation  
   Technologies I, II
   CME 310, 320, 410, 420 Chemical  
   Engineering Laboratory  
   I, II, III, IV
   CME 440, 441 Process Engineering  
   and Design I, II

6. Specializations in Chemical and  
   Molecular Engineering
   Chemical and Molecular Engineering  
   students must choose from one of the  
   six specializations offered. Each  
   specialization requires the completion of  
   four technical elective courses.

7. Upper-Division Writing Requirement:  
   CME 300 Writing in Chemical and  
   Molecular Engineering
   All degree candidates must  
   demonstrate skill in written English at a  
   level acceptable for engineering majors. All  
   Chemical and Molecular Engineering  
   students must complete the writing course  
   CME 300 concurrently with CME 310. The quality of  
   writing in technical reports submitted for CME 310 is evaluated, and  
   students whose writing does not meet the required standard are  
   referred for remedial help. Satisfactory writing warrants an S  
   grade for CME 300, thereby satisfying the requirement.

Grading

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D. Business Management and Technology Transfer
Provides a foundation in financial accounting and management science for students who plan to pursue a career in business administration in the high-technology industry or in patent law.
BUS 210 Financial Accounting
EST 392 Engineering and Managerial Economics
EST 393 Production and Operations Analysis
EST 421 Starting the High-Technology Venture

E. Environmental Sensing and Compliance
Provides a background in environmental studies enabling students to apply their knowledge of molecular chemistry to air pollution and control, environmental remediation, waste disposal, and compliance with OSHA safety standards in industry.
ATM 397 Air Pollution and its Control
MAR 308 Principles of Instrumental Analysis
MAR 334 Remote Sensing of the Environment

F. Nuclear and Chemical Hazard Detection and Prevention
Prepares students to address societal issues related to nuclear, chemical, and biological hazard detection, chemical and radioactive waste disposal, and compliance with OSHA standards for safety and security.
BIO 202 Fundamentals of Biology: Molecular and Cellular Biology
MAR/BCP 394 Environmental Toxicology and Public Health
CHE 361, 362 Nuclear Chemistry and Laboratory
EST/POL 411 Science, Technology, and Arms Control
or EST 412 Intelligence Organizations, Technology, and Democracy