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
E-MAIL: Devinder.Mahajan@stonybrook.edu or Miriam.Rafailovich@stonybrook.edu

Minors of particular interest to students majoring in Chemical and Molecular Engineering: Pharmacology (BCP), Business (BUS), Chemistry (CHE)

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 nanotechnology, neuropeptide, pharmaceutical, environmental, and energy industries. It emphasizes engineering at the molecular level rather than traditional large-scale process engineering. In a rigorous interdisciplinary 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 serve the community by becoming a resource for regional economic development and to 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 four specific program educational objectives:

1. The students will be prepared to assume positions in industry or research institutions that require knowledge of chemical engineering principles.
2. The students will be prepared to demonstrate leadership, teamwork, and communication skills.
3. The students will be committed to lifelong learning, ethical conduct, and be able to meet the constantly emerging needs of the chemical engineering profession.
4. The students will be educated in chemical engineering fundamentals and modern computational tools that enable them to succeed in graduate programs and research in chemical engineering.

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:

a. the ability to apply knowledge of mathematics, science, and engineering to chemical engineering problems;
b. the ability to design and conduct experiments, as well as to analyze and interpret data;
c. the ability to design a system, component, or process to meet desired needs;
d. the ability to function on multidisciplinary teams;
e. the ability to identify, formulate, and solve engineering problems;
f. the understanding of professional and ethical responsibility;
g. the ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i. the recognition of the need for and an ability to engage in lifelong learning;
j. a knowledge of contemporary issues;
k. the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Courses Offered in Chemical and Molecular Engineering

CME 101 Introduction to Chemical and Molecular Engineering
CME 199 Introduction to Undergraduate Research
CME 201-H Sustainable Energy
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 and Statistical 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

Fall 2007: updates since Spring 2007 are in red
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. Final decisions on admission will be made by the undergraduate program director. Minimum requirements for acceptance are as follows:

1. Students must have a grade of B or higher in all math, physics and chemistry courses required by the major that have been completed.

2. Students must have an overall g.p.a. of 3.0 with not more than one grade of C or lower in any course, unless permission to waive is granted by the undergraduate program director.

3. Department must receive completed course evaluations for all transferred courses that are to be used to meet requirements of the major.

Requirements for the Major in 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 specialization as an area of specialization and completes the curriculum with an 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 117 credits.

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 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

Note: The following alternate physics course sequences may be substituted for PHY 131/133, 132/134:

- PHY 125, 126, 127
- or PHY 141, 142

3. Computer Programming
one of the following:

- CSE 130 Introduction to Programming in C
- ESG 111 C Programming for Engineers
- MEC 111 Computer Science for Engineers
- MEC 112 Practical C/C++ for Scientists and Engineers
- 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 and Statistical Analysis
- CME 327 Molecular Modeling for Chemical Engineers or 300-level BUS course
- 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

All courses taken to satisfy requirements 1-6 above must be taken for a letter grade of C or higher.

Specializations

Students must complete four courses in a chosen specialization. (In some cases, there is also a pre- or co-requisite course attached to one of the courses.) In consultation with a faculty advisor, students select their area of specialization before registering for the first semester of the junior year and not later than upon earning 57 credits. Students are urged to meet regularly with their advisors regarding completion of the course requirements for the chosen specialization. Other courses may be used towards this requirement with the prior permission of the undergraduate program director.

A. Pharmacology

Ensures a sound background in pharmacology coupled with a foundation in chemical process control, distillation, and molecular modeling for students interested in pursuing a career in the food, cosmetics, or pharmaceutical industries or in medical instrumentation.

B. Materials Science

Provides a foundation in properties of materials, engineering mechanics, and electronic materials for students interested in computer-related industries, nanotechnology, and electronics.

EES 331 Materials Science II:
Electronic Properties

EES 334 Materials Engineering

EES 335 Strength of Materials

EES 336 Electronic Materials

C. Polymer Science

Provides a foundation in the properties of polymers, spectroscopy of organic compounds, polymer synthesis, and polymer processing for students interested in pursuing research in major laboratories or in academia.

EES 369 Polymers

CHE 384 Intermediate Synthetic and Spectroscopic Laboratory Techniques

CME 371 Biomedical Polymers

CME 470 Polymer Synthesis

D. Tissue Engineering

Recommended for students who are interested in the biochemical foundations of cellular function and the design of materials scaffolds for tissue engineering. It is also recommended for students interested in drug delivery systems and premedical or pharmacological professions.

The following courses can be used to satisfy the CME Tissue Engineering Specialization:

- BIO 202-E Fundamentals of Biology: Molecular and Cellular Biology or BIO 203-E Fundamentals of Biology: Cellular and Organ Physiology
- BME 404 Essentials of Tissue Engineering
- Any TWO of the following courses:
  - CHE 346 Biomolecular Structure and Reactivity
  - CME 371 Biomedical Polymers
  - BIO 210-E Human Physiology
  - BIO 310 Cell Biology
  - BIO 311 Techniques in Molecular and Cellular Biology
  - BIO 328 Mammalian Physiology
  - BME 306 Animal Physiology Laboratory

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BIO 317  Principles of Cellular Signaling  
BIO 318-H  Bioethics and Policy  

E. Business  
The Business specialization is recommended for students interested in the economic implications of chemical engineering and in financial management of intellectual property.  
The following four courses satisfy the requirement for the business specialization in the CME program. They also form the major component of a minor in business.  
BUS 215 Introduction to Business Statistics  
BUS 340 Information Systems in Management  
BUS 351 Human Resource Management  
BUS 441 Business Strategy  

F. Custom Specialization  
This category is created to allow students to choose their own specialization. Students will select four upper level courses related to the chosen specialty within the courses offered at the university and approved by the CME undergraduate program director. The goal is to provide a basic foundation for students and prepare them for the job market in the chosen specialty.