Chemical and Molecular Engineering (CME)

**Major in Chemical and Molecular Engineering**

Department of Materials Science and Engineering, College of Engineering and Applied Sciences

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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 nutraceutical 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.

**Courses Offered in Chemical and Molecular Engineering**

- CME 101 Introduction to Chemical and Molecular Engineering
- 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 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

**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.

**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 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.
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
   - MAT 125, 126, 127
   - MAT 141, 142

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 IIA or CHE 326 Organic Chemistry IIB
      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 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
      - PHY 141, 142

3. Computer Programming
   One of the following:
   - ESG 111 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 for Chemical 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.

Specializations

Students must complete four courses in a chosen specialization. (In some cases, there is also a pre- or corequisite 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 pursing a career in the food, cosmetics, or pharmaceutical industries or in medical instrumentation.

BIO 361, 362 Biochemistry I, II
BCP 401 Principles of Pharmacology
BCP 402 Advanced Pharmacology

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.

ESG 333 Materials Science II: Electronic Properties
ESM 334 Materials Engineering
ESM 335 Mechanical Properties of Materials
ESM 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.

ESM 369 Polymers
CHE 344 Spectroscopy of Organic Compounds
ESM 370 Polymer Synthesis
ESM 371 Polymer Processing

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
MAR 391 Environmental Policy