

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

Chemical and Molecular Engineering

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, nutraceutical, pharmaceutical, environmental, and energy industries. 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 Chemical and Molecular Engineering program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.

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.

Student Outcomes

The students will demonstrate the following:

- 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 life-long learning;
- j. A knowledge of contemporary issues;
- k. The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Requirements for the Major in Chemical and Molecular Engineering

Acceptance into the Major

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 100-level mathematics, physics and chemistry courses required by the major. A grade of B- or better is required in CHE 321, CHE 383 or 327, and CME 304, unless permission to waive is granted by the undergraduate program director.
2. Students must have an overall GPA of 3.2 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. A minimum of one semester, carrying a full-time load with a minimum of 12 credits in residence at Stony Brook University is required for all transfer students.

Requirements for the Major

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 three-course sequence at the 300 level or above (four courses if admitted prior to Fall 2012) as an area of specialization which may also qualify the students for a minor in the respective department. The program culminates in the submission and acceptance of a senior thesis describing an original research project completed by the student which is defended at the end of the senior year. Students are encouraged to select original research projects which can be published in peer reviewed journals.

Completion of the major requires approximately 100 credits.

1. Mathematics

- a. AMS 151, AMS 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, AMS 161: MAT 131, MAT 132 or MAT 125, MAT 126, MAT 127 or MAT 141, MAT 142

2. Natural Sciences

a. Chemistry

- CHE 131, CHE 132 General Chemistry I, II
 CHE 133, CHE 134 General Chemistry Laboratory I, II
 CHE 321 Organic Chemistry I

CHE 327 Organic Chemistry Laboratory or CHE 383 Introductory Synthetic and Spectroscopic Laboratory Techniques

Note: The following alternate chemistry/organic chemistry course sequence may be substituted for CHE 131/CHE 132/CHE 321: CHE 152/CHE 331/CHE 332 with lab CHE 154

b. Physics

- PHY 131, PHY 132 Classical Physics I, II
 PHY 133, PHY 134 Classical Physics Laboratory I, II

Note: The following alternate physics course sequences may be substituted for PHY 131/PHY 133, PHY 132/PHY 134: PHY 125, PHY 126, PHY 127, PHY 133, PHY 134 Classical Physics A, B, C and Laboratories or PHY 141, PHY 142, PHY 133, PHY 134 Classical Physics I, II: Honors

3. Computer Programming

one of the following:

- CSE 130 Introduction to Programming in C
 ESG 111 C Programming for Engineers
 ESE 124 Computer Techniques for Electronic Design

4. Chemical Engineering

- CME 101 Introduction to Chemical and Molecular Engineering
 CME 233 Ethics and Business Practices for Engineers
 CME 304, CME 314 Chemical Engineering Thermodynamics I, II
 CME 312 Material and Energy Balance
 CME 315 Numerical Methods for Chemical Engineering Analysis
 CME 318 Chemical Engineering Fluid Mechanics

CME 322 Chemical Engineering Heat and Mass Transfer
CME 323 Reaction Engineering and Chemical Kinetics
CME 360 Nanomaterials and Applications
CME 401 Separation Technologies
CME 310, CME 320, CME 410, CME 420 Chemical Engineering Laboratory I, II, III, IV
CME 427 Molecular Modeling for Chemical Engineers or CME 425 Introduction to Catalysis
CME 440, CME 441 Process Engineering and Design I, II
CME 480 Cellular Biology for Chemical Engineers

5. Specializations in Chemical and Molecular Engineering

Chemical and Molecular Engineering students must choose from one of the eight specializations offered. Each specialization requires the completion of three (four for students admitted prior to Fall 2012) technical elective courses at the 300 level or higher.

6. 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, except in CME 304 which must be taken for a letter grade of B- or higher.

Specializations

Students must complete three (four for students admitted prior to Fall 2012) 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 program director, students select their area of specialization by the Spring semester of their sophomore year in the Chemical and Molecular Engineering program. 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. 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 332 Materials Science I
ESG 333 Materials Science II: Electronic Properties
ESM 335 Strength of Materials
ESM 336 Electronic Materials

B. Nanotechnology

CME 360 Nanomaterials and Applications
CME 460 Nanomaterials: Synthesis, Processing and Characterization

Students can select any one of the following courses (provided the course was not used to satisfy a core requirement):

CME 425 Intro to Catalysis
CME 427 Molecular modeling
CME 369 Polymer Engineering
CME 372 Colloids, emulsions, micelles

C. Polymer specialization

CME 369 Polymer Engineering
CME 371 Biomedical Polymers
CME 470 Polymer Synthesis

Students may replace any one of the above by selecting any one of the following courses (provided the course was not used to satisfy a core requirement):

CME 425 Intro to Catalysis
CME 427 Molecular modeling

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:

BME 404 Essentials of Tissue Engineering
Any TWO (three for students admitted prior to Fall 2012) of the following courses:
CHE 346 Biomolecular Structure and Reactivity
CME 371 Biomedical Polymers
BIO 310 Cell Biology
BIO 311 Techniques in Molecular and Cellular Biology
BIO 328 Mammalian Physiology

BIO 335 Animal Physiology Laboratory
 BIO 317 Principles of Cellular Signaling
 CME 481 Advanced Cell Biology for Chemical Engineers

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 Business specialization consists of 12 credits of any upper division (300 level or above) Business courses not required for the CME major.

F. Chemistry

The Chemistry specialization consists of 12 credits of upper level CHE 300 courses not already required for the CME Major.

G. Physics

The Physics specialization consists of 12 credits of any upper division (300 level or above) Physics courses not required for the CME major.

HF. Custom Specialization

This category is created to allow students to choose their own specialization. Students will select three upper level courses (four for students admitted prior to fall 2012) 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.

Sample Course Sequence for the Major in Chemical and Molecular Engineering A course planning guide for this major may be found here.

FRESHMAN

FALL	Credits
First Year Seminar 101	1
WRT 102 (WRT)	3
AMS 151 (QPS)	3
CME 101	2
CHE 131, CHE 133 (SNW)	5
PHY 131, PHY 133	4
Total	18

SPRING	Credits
First Year Seminar 102	1
SBC	3
AMS 161	3
CHE 132, CHE 134	5
PHY 132, PHY 134	4
Total	16

SOPHOMORE

FALL	Credits
AMS 261	4
CHE 321	4
CHE 383 or CHE 327	2
CME 304	3
SBC	3
Total	16

SPRING	Credits
AMS 361	4

CME 233	3
SBC	3
CME 312	3
CME 314	3
Total	16

JUNIOR

FALL	Credits
ESG 111	3
CME 310, CME 300	2, 0
CME 318	3
CME 322	3
CME 360	3
Total	14

SPRING	Credits
CME 323	3
CME 320	3
CME 315	3
SBC	3
Specialization Course	3
Total	14

SENIOR

FALL	Credits
CME 401	3
CME 410	2
CME 440*	3
CME 480	3
SBC	3
Specialization course	3
Total	17

SPRING	Credits
CME 420	2
CME 441*	3
CME 427 or CME 425**	3
SBC	3
SBC	3
Specialization course	3
Total	17

*Note: This course partially satisfies the following: ESI, CER, SPK, WRTD, SBS+, STEM+, EXP+. For more information contact the CEAS Undergraduate Student Office.

**Note: CME 425 is offered in Fall and Spring terms.

CME

Chemical and Molecular Engineering

CME 101: Introduction to Chemical and Molecular Engineering

Integrates students into the community of the College of Engineering and Applied Sciences and the major in Chemical and Molecular Engineering with a focus on personal and institutional expectations. Emphasizes the interdisciplinary role of the chemical engineering profession in the 21st century. Includes consideration of professional teamwork and the balance of professional growth with issues of societal impact.

2 credits

CME 199: Introduction to Undergraduate Research

An introduction to independent research and basic research skills. Students perform an independent research project in chemical and molecular engineering under the supervision of a faculty member. May be repeated for a maximum of 3 credits.

Prerequisite: Permission of instructor

0-3 credits

CME 201: Sustainable Energy - Evaluating the Options

Assessment of current and future energy delivery systems; extraction, conversion, and end-use will be discussed with the emphasis on meeting 21st Century regional and global energy needs in a sustainable manner. Different renewable and conventional energy technologies will be examined and analyzed and their attributes (both positive and negative) described within a framework that takes into account the technical, economic, social, political and environmental objectives associated with a sustainable energy policy. Case studies of specific applications of sustainable energy to societal needs will be analyzed and discussed.

DEC: H

SBC: TECH

3 credits

CME 233: Ethics and Business Practices for Engineers

Critical business concepts as they relate to engineering practices. Survey of general business environment and business functions, with an emphasis on ethics and law, economics, finance, and marketing. Project management of cost, risk and alternatives.

3 credits

CME 240: Introduction to Food Technology

This course will introduce students to various topics of food science and technology such as food processing, nutrition, food safety, packaging and sensory science. Topics in nanotechnology and nutraceuticals will also be covered. Students will examine current challenges facing food scientists and technologists in today's global society. Each week we will read and discuss selected chapters from the textbook, as well as articles from news sources and scientific journals. During the last three weeks of the semester students will team up and participate in a laboratory exercise in food development.

SBC: TECH

3 credits

CME 300: Writing in Chemical and Molecular Engineering

See "Requirements for the Major in Chemical and Molecular Engineering, Upper-Division Writing Requirement."

Prerequisites: CME major; U3 or U4 standing; WRT 102

Corequisite: CME 310

S/U grading

CME 304: Chemical Engineering Thermodynamics I

First and second laws of thermodynamics, PVT behavior of pure substances, equations of state for gases and liquids, phase equilibria, mass and energy balances for closed and open systems, reversibility and equilibrium, application of thermodynamics to flow processes, heat effects during chemical reactions and combustion.

Prerequisites: PHY 132 and CHE 132 and AMS 161

3 credits

CME 310: Chemical Engineering Laboratory I: Unit Operation and Fundamentals

Introduces general safety in a chemical engineering laboratory handling high pressure equipment. Selection and identification of unit components. Batch and continuous units. Reactor types: stirred, bubble column, and slurry-phase reactors. Precise measurements of pressure and temperature variables. Mass balance in a chemical reaction. Simulated distillation. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisites: CME 314 and CHE 384 and CHE 326

Corequisite: CME 300

2 credits

CME 312: Material and Energy Balance

Introduces analysis of chemical processes using the laws of conservation and energy as they apply to non-reacting and reacting systems. Integration of the concepts of equilibrium in physicochemical systems, and utilization of basic principles of thermodynamics. Numerical methods used in the design an optimization of chemical engineering processes. Solution of complex chemical engineering problems.

Prerequisites: ESG 111; CHE 132 and 134; AMS 261 or MAT 203; B- or higher in CME 304; CME Major

3 credits

CME 314: Chemical Engineering Thermodynamics II

Equilibrium and the Phase Rule; VLE model and K-value correlations; chemical potential and phase equilibria for ideal and non-ideal solutions; heat effects and property changes on mixing; application of equilibria to chemical reactions; Gibbs-Duhem and chemical potential for reacting systems; liquid/liquid, liquid/solid, solid/vapor, and liquid/vapor equilibria; adsorption and osmotic equilibria, steady state flow and irreversible processes. Steam power plants, internal combustion and jet engines, refrigeration cycle and vapor compression, liquefaction processes.

Prerequisite: B- or higher in CME 304; CME Major

3 credits

CME 315: Numerical Methods for Chemical Engineering Analysis

Critical analysis of experimental data development of engineering models by integrating a variety of computer-based programs: (1) Executing numerical calculus and solving numerical equations using a mathematical program (Mathematica); (2) Process using a simulation for typical chemical engineering processes (unit operation, distillation, etc.) using a simulation program (Lab-view).

Prerequisite: ESG 111; CME Major

Corequisites: AMS 361 or MAT 303

3 credits

CME 318: Chemical Engineering Fluid Mechanics

Introduces fluid mechanics. Dynamics of fluids in motion; laminar and turbulent flow, Bernoulli's equation, friction in conduits; flow

through fixed and fluidized beds. Study of pump and compressor performance and fluid metering devices. Includes introduction to microfluids.

Prerequisites: AMS 261 (or MAT 203 or 205); PHY 131 (or 125 or 141); CME Major or ESG Major

3 credits

CME 320: Chemical Engineering Lab II: Chemical and Molecular Engineering

Introduction and operation of a continuous unit, handling of air-sensitive/water-sensitive materials, sonolysis and thermal techniques for materials synthesis, preparation of polymer nano-composites and nanosized materials. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisite: CME 310; CME Major

2 credits

CME 321: Introduction To Working In The Good Manufacturing Practice (GMP) Environment

The objective of CME 321 is to introduce students to the fundamentals of the current Good Manufacturing Practice (cGMP). This course is intended to give the student theoretical knowledge and practical experience of working under cGMP and good laboratory practice (GLP) requirements by simulation of chemical engineering process development for pharmaceutical industry.

Prerequisite: CME 304

3 credits

CME 322: Chemical Engineering Heat and Mass Transfer

Heat transfer by conduction, principles of heat flow in fluids with and without phase change, heat transfer by radiation, heat-exchange equipment. Principles and theory of diffusion, mass transfer between phases, distillation, leaching and extraction, fixed-bed membrane separation, crystallization.

Prerequisite: B- or higher in CME 304; CME Major

3 credits

CME 323: Reaction Engineering and Chemical Kinetics

Introduction to chemical reaction engineering and reactor design. Fundamentals of chemical kinetics for homogeneous and heterogeneous reactions, both catalyzed and uncatalyzed. Steady-state approximation. Methods of kinetic data collection, analysis and interpretation. Transport effects in solid and slurry-phase reactions. Batch and flow reactors

including operations under non-ideal and non-isothermal conditions. Reactor design including bioreactors.

Prerequisites: CME major; U3 standing; CME 312 and 314

3 credits

CME 330: Principles of Engineering for Chemical Engineers

This course focuses on the basic principles required for functioning in an engineering environment. Includes equilibrium and dynamics of rigid bodies, analysis of simple structures, conservation of energy, vectorial kinematics, collisions, general circuit analysis, fundamentals of AC power, CAD programs, introduction to market analysis, and discussion on ethics in engineering management.

Prerequisites: U3 or U4 Standing, CME Major

2 credits

CME 350: Comparative Energy Technologies

An introduction to the major energy technologies, both traditional fossil fuel-based and renewables. Review of economics, technical basis, environmental impacts, advantages and disadvantages of each. Discussion of contemporary energy issues via assigned readings from major news outlets.

Prerequisites: AMS 261 or MAT 203 or MAT 205; CHE 321; CME 304

3 credits

CME 355: Chemical Process Safety

Fundamentals of chemical process safety: Industrial hygiene, toxicology, hazard identification, risk assessment, loss prevention, accident investigation.

Prerequisites: PHY 132; PHY 134; CHE 322 or CHE 326; CHE 327 or CHE 384

3 credits

CME 360: Nanomaterials and Applications

Fundamentals of nanomaterials physics, chemistry and structure, nanostructure characterization and practical applications.

Prerequisite: CME 304

3 credits

CME 369: Polymer Engineering

An introductory survey of the physics, chemistry and engineering processes of polymers. Topics covered included classification of polymers, structures of polymers, morphology of polymers, thermodynamics of polymers, phase separation and phase transition of polymers, crystallization of polymers. Case studies

of commercial polymer production and processing.

Prerequisites: B- or better in CME 304 or ESG 302; AMS 261 or MAT 203 or MAT 205

3 credits

CME 371: Biomedical Polymers

This course focuses on the clinical performance of polymers and discusses the chemical, physical, mechanical and biological questions raised by the unique use of these materials within the human body. The chemistry and properties of key biomedical polymers will be studied and their biomedical applications will be discussed. The biomaterial's response to the various components of its biological environment will be addressed, followed by the response of the host to the presence of the implanted polymer. Special attention will be given to the interaction of the system with two fundamental phenomena: the Foreign Body Response and the Coagulation Cascade. Applications of bio-polymers to tissue engineering and the relevance of nanoscale phenomena are discussed.

Prerequisite: CHE 321; CME 481; CME Major or permission of the instructor.

3 credits

CME 372: Colloids, Micelles and Emulsion Science

This course addresses the fundamental science and chemistry of micro-emulsion and colloid formation, three-component phase diagrams, nanoscale structure and characterization techniques. Specific case studies and issues related to scale-up in food, cosmetics, and biomedical industries are presented.

Prerequisite: CHE 132/134

3 credits

CME 401: Separation Technologies

Fundamentals of separations. Introduction to standard classical and advanced separation methods and their relative merits and limitations. Distillation, crystallization, filtration, centrifugation, absorption and stripping methods. Includes fundamentals of chromatography.

Prerequisites: CME major; U3 or U4 standing; CME 323

3 credits

CME 410: Chemical Engineering Laboratory III: Instrumentation, Material Design and Characterization

Students research a topic and together with the course instructor and undergraduate program director, select an advisor and thesis

committee. The student, with the advisor, drafts a course of preliminary experiments and the student presents a written thesis proposal, with an oral defense, to his/her committee. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisite: CME 320

2 credits

CME 420: Chemical Engineering Laboratory IV: Senior Thesis

Directed laboratory research. At the end of the junior year, in consultation with an advisor, the CME student will write a 1-2 page abstract describing proposed research. This abstract must be approved by the Undergraduate Program Committee (UPC). Through work accomplished in CME 420, the student will expand the research proposal into a senior thesis written in the format of a paper in a scientific journal. The student will defend his/her thesis in front of the UPC prior to the end of the senior year. After the defense, three copies of the finished thesis must be presented to the student's advisor at least 21 days before the date of graduation. The advisor then submits the thesis for final approval to the other UPC members. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisite: CME 410

2 credits

CME 425: Introduction to Catalysis

This course introduces students to the fundamentals of homogeneous and heterogeneous catalysis, kinetics, and catalyst characterization. This course is intended to give the student a background of the fundamentals of the catalytic process and the selection of catalysts for specific applications.

Prerequisites: CHE 322; CME 304; CME 312; CME 314

Corequisite: CME 323

3 credits

CME 427: Molecular Modeling for Chemical Engineers

Molecular modeling techniques and simulation of complex chemical processes. Use of Monte Carlo methods and Molecular Dynamics methods. Emphasis on the simulation and modeling of biopolymeric systems.

Prerequisites: PHY 132; ESG 111; AMS 261 or MAT 203; AMS 361 or MAT 303; B- or higher in CME 304; CME Major

3 credits

CME 440: Process Engineering and Design I

Fundamentals of process control and its role in process design. Process synthesis and reactor design parameters. Process flow sheet, P&ID symbols. Incorporation of environmental and safety aspects into process design. Design project selection with multiple realistic constraints. Team assignments, final project title and industrial mentor assignments. Introduction to CHEMCAD. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisites: CME Major; U4 Standing; CME 320 and CME 315

3 credits

CME 441: Process Engineering and Design II

Review of engineering design principles; engineering economics, economic evaluation, capital cost estimation; process optimization; profitability analysis for efficient and accurate process design. HAZOP analysis. Application of CHEMCAD in a commercial process. Final process flowsheet design preparation incorporating engineering standards. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisites: CME 401 and 440

3 credits

CME 460: Nanomaterials: Synthesis, Processing and Characterization

This course will introduce fundamental approaches and general strategies to the syntheses and processing of nanomaterials. We will discuss methods such as chemical vapor deposition (CVD), soft lithography, dippen nanolithography (DPN) and self-assembly. Several examples from the literature will be utilized in order to demonstrate the design and implementation of various methodologies intended to achieve nanostructures that can be useful in a variety of technologically-relevant applications. Such nanostructures include quantum dots, carbon nanotubes, hierarchical assemblies and molecular patterns (block co-polymers). We will describe a variety of spectroscopic and microscopic techniques that are particularly useful for the characterization of such nanostructures, such as atomic force microscopy (AFM), x-ray photoelectron spectroscopy (XPS) and vibrational spectroscopy (FTIR and Raman).

Prerequisites: CHE 326; CHE 384; CME 314
Advisory Prerequisite: CME 360

3 credits

CME 470: Polymer Synthesis: Theory and Practice, Fundamentals, Methods, Experiments

This course teaches general methods and processes for the synthesis, modification, and characterization of macromolecules. This includes general techniques for purification, preparation and storage of monomers; general synthetic methods such as bulk, solution, and heterogeneous polymerization; addition and condensation polymerization; methods of separation and analysis of polymers.

Prerequisites: PHY 132, PHY 134, CHE 322

3 credits

CME 475: Undergraduate Teaching Practicum

May be used as an open elective and repeated once. Students must have U4 standing as an undergraduate major within the college, a minimum gpa of 3.0 in all courses and a grade of 'B' or better in the course in which the student is to assist; permission of the department is required. May be repeated only once. May not be counted toward specialization requirements.

Prerequisites: U4 standing, 3.0 gpa, grade of B or better in course which assisting

SBC: EXP+

3 credits

CME 480: Cellular Biology for Chemical Engineers

The course is intended to describe and introduce cellular and biological concepts and principles for chemical engineers. The course will provide details on the cellular processes, structures and regulations of the cellular homeostasis as response to internal and external changes and stimuli.

Prerequisite: CME Major; U3 or U4 standing; or permission of the Undergraduate Program Director

3 credits

CME 481: Advanced Cell Biology for Chemical Engineers

This course is intended to provide advanced topics in cellular behavior as a result of varying environmental cues. The course will focus on subjects associated with biological research related to various artificial materials and their influence on the cells and their interaction with the materials.

Prerequisite: CME 480

3 credits

CME 488: Industrial Internship in Chemical Engineering

Research project in an industrial setting under joint supervision of an industrial mentor and chemical engineering faculty. Project to cover some or all of the following chemical engineering principles of product synthesis: experiment design, data collection, data analysis, process simulations, and report writing related to an actual production facility. May be repeated up to a maximum of 12 credits. May not be counted toward specialization requirements.

Prerequisites: B average in CME courses; permission of supervising faculty member

SBC: EXP+

0-12 credits

CME 490: Preparation for the Chemical Engineering/Fundamentals of Engineering Examination

Preparatory class that provides an overview of professional licensure testing procedures for the Fundamentals of Engineering Examination and includes the section specific to Chemical Engineering. This class reviews subject areas on the general section of the test as well as the profession-specific section dealing with chemical engineering.

Prerequisite: CME Major

1 credit, S/U grading

CME 491: Sustainable Future through Renewable Energy

So what is required to achieve manageable atmospheric CO₂ levels by 2035? Renewable sources could play a role but to what extent? What types of renewables are feasible and their applications that match to replace fossil fuels? Are all renewables sustainable? The course setting is ideal- Turkana Basin, by its geographic location, is blessed with abundant renewable sources. This course will answer the above posed questions with focus on fundamentals of renewable energy sources, the feasibility of renewable source development and their impact on local Turkana communities.

Prerequisite: U3 or U4 standing in any discipline

DEC: H

SBC: TECH

3 credits

CME 499: Research in Chemical Engineering

Independent research project under the supervision of a chemical engineering or interdisciplinary faculty member. Project to cover some or all of the following chemical engineering principles: experiment design, data collection, data analysis, process simulations,

and report writing. May be repeated but a maximum of 3 allowable total credits. May not be used for specialization requirements.

Prerequisites: B average in CME courses; permission of supervising faculty member

0-3 credits