

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.

3 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 - H: 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.

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.

Prerequisites: CME 314 and CHE 384 and CHE 326

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

4 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).

Corequisites: AMS 361 or MAT 303

Prerequisite: CME Major

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.

Prerequisite: CME 310; CME Major

2 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 318; 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 333: Business Economics 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. Quality management: Six Sigma concept.

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.

Pre- or Corequisite: CHE 321 or permission by the instructor.

Prerequisite: CME Major

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.

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.

Prerequisite: CME 410

2 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.

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.

Prerequisites: CME 401 and 440

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
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
0-12 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