

CHEMICAL ENGINEERING

Courses

CME 101. Introduction to Chemical Engineering. 1 Hour

Introduction to the chemical engineering faculty, facilities, and curriculum; survey of career opportunities in chemical engineering. Introduction to the University first-year experience.

CME 198. Research&Innvtn Lab. 1-6 Hours

RESEARCH AND INNOVATION LABORATORY - Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

CME 203. Material & Energy Balances. 3 Hours

Introductory course on the application of mass and energy conservation laws to solve problems typically encountered in chemical process industries. Prerequisite(s): CHM 123; MTH 138 or 168. Corequisite(s): CME 211.

CME 211. Introduction to Thermodynamics for Chemical Engineers. 3 Hours

First law of thermodynamics, states of matter, equations of state, open and closed system energy balances, reactive energy balances, entropy, 2nd law of thermodynamics, introduction to power cycles and refrigeration. Prerequisite(s): PHY 206; CHM 123; MTH 138 or 168.

CME 281. Chemical Engineering Computations. 3 Hours

Development of computational skills with an emphasis on algorithm development and problem solving. Computational skills are applied to typical problems in chemical engineering, data analysis, numerical methods. Corequisite(s): CME 203, MTH 169.

CME 298. Research & Innovation Laboratory. 1-6 Hours

Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

CME 306. Chemical Reaction Kinetics & Engineering. 3 Hours

Chemical reaction kinetics, ideal reactor analysis and design, multiple reactor/reaction systems, and heterogeneous catalysis. Prerequisite(s): CME 311. Corequisite(s): CME 324.

CME 311. Chemical Engineering Thermodynamics. 3 Hours

Development and application of the fundamental principles of chemical thermodynamics: Vapor/liquid equilibrium, solution thermodynamics, chemical reaction equilibria, and thermodynamic analysis of chemical engineering processes. Prerequisite(s): CME 203; CME 211; MTH 218.

CME 324. Transport Phenomena I. 3 Hours

Integrated study of the fundamentals of momentum, energy, and species mass transport. Includes constitutive relations and transport properties (viscosity, thermal conductivity, and mass diffusivity); shell balance development of momentum, energy, and species mass conservation equations; and general conservation equations for isothermal, non-isothermal, and multicomponent systems. Prerequisites: CME 203, CME 211; MTH 219. Corequisites: CME 281 (may be taken concurrently).

CME 325. Transport Phenomena II. 3 Hours

An in depth study into multidimensional momentum, energy, and mass transport, dimensionless parameters, turbulence and numerical solution methods. Prerequisites: CME 324. Corequisites: CME 381 (may be taken concurrently).

CME 326L. Transport Phenomena Laboratory. 3 Hours

Experimental determination of transport properties (viscosity, thermal conductivity, and mass diffusivity) and interphase transport coefficients (drag coefficient, heat transfer coefficient, and mass transfer coefficient); measurement of velocity, temperature, and concentration profiles; study of turbulence and transient and multidimensional transport phenomena; utilization of instrumentation for measurement of flow rate, temperature, and pressure; elemental data and error analysis; communication of results via written reports and oral presentations. Prerequisites: CHM 124L; CME 324.

CME 365. Separation Techniques. 3 Hours

A study into numerous chemical engineering separation techniques and unit operations including equilibrium staged separations, distillation, extraction and absorption. Prerequisites: CME 311. Corequisites: CME 324 (may be taken concurrently).

CME 381. Applied Mathematics for Chemical Engineers. 3 Hours

Study of analytical and numerical techniques applied to engineering topics to support upper-level chemical engineering classes. Topics include matrices, numerical differentiation, solving ordinary and partial differential equations numerically, curve fitting, probability and statistics, and optimization. Prerequisite(s): CME 281; MTH 219.

CME 398. Research & Innovation Laboratory. 1-6 Hours

Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

CME 400. Senior Seminar I. 1 Hour

Presentation on contemporary chemical engineering subjects by students, faculty, staff, and engineers in active practice. The seminar explores career options including entry level chemical engineering jobs and graduate and professional school. This seminar helps prepare students to search for full time employment post-graduation. Registration required for senior CME students. Corequisites: CME 430.

CME 401. Senior Seminar II. 1 Hour

Presentation on contemporary chemical engineering subjects by students, faculty, staff and professionals and engineers in active practice. This course has a focus on professional development and preparation for real life considerations once the students are successfully integrated within the chemical engineering or post-graduate workforce. Students will become familiar with professional and ethical responsibilities within the chemical engineering vocation. Corequisites: CME 431.

CME 408. Seminar. 0-1 Hours

Presentation of lectures on contemporary chemical engineering subjects by students, faculty, and engineers in active practice. Registration required of senior students only. Corequisite(s): CME 430.

CME 430. Chemical Engineering Design I. 3 Hours

This course includes a study of basic process synthesis and design, chemical process safety and health issues, capital cost estimation, manufacturing cost estimation, engineering economics and profitability analysis, and materials of construction. Pre/corequisites: CME 452; CME 465 (may be taken concurrently). Prerequisites: CME 306; CME 365.

CME 431. Chemical Engineering Design II. 3 Hours

Project-based study of principles of process design and economics, use of process flowsheet simulators, short-cut design procedures, process optimization, and plant layout. Prerequisite(s): CME 306, CME 365, CME 430, CME 465.

CME 432. Chemical Product Design. 3 Hours

Application of the design process to products based on chemical technology. Coverage of the entire design process from initial identification of product needs, to the generation and selection of product ideas, and culminating in the manufacture of a new product.

CME 440. Food Engineering Design. 3 Hours

This course introduces students to industrial processes in food and beverage manufacturing, process safety in the food industry, and processing requirements for specialized diets. Prerequisites: CME 311; CME 324; or permission of instructor.

CME 441. Particles and Powders in Food Engineering. 3 Hours

Introduction to powder and particles in food engineering, covering production, properties, characterization, and their applications in the food industry. Additionally, introduction to state-of-the-art 3D printing technologies and their applications in food engineering. Prerequisites: CME 311 or permission of instructor.

CME 442. Transport Processes in Food Engineering. 3 Hours

Fundamentals of transport phenomena principles, fluid properties, and unit operation applications in the food processing industry. Prerequisites: CME 324 or instructor permission.

CME 452. Process Control. 3 Hours

Mathematical models, Laplace transform techniques, and process dynamics. Feedback control systems, hardware, and instrumentation. Introduction to frequency response, advanced techniques, and digital control systems. Prerequisite(s): CME 381. Corequisite(s): CME 306.

CME 453L. Process Control Laboratory. 3 Hours

Team-based, project oriented laboratory-based study of process dynamics and digital control using computer-based data acquisition and control systems with a focus on real time process monitoring and control. In addition to the technical content, this course will focus on communication through engagement in civil discourse and to explain complex ideas, while maintaining an audience centered approach. Prerequisites: CME 452 or permission of instructor.

CME 465. Fluid Flow & Heat Transfer Processes. 3 Hours

Fluid mechanics, transportation and metering of fluids, heat transfer and its applications. Prerequisite(s): CME 311, CME 324.

CME 466L. Chemical Engineering Unit Operations Laboratory. 3 Hours

Study of the equipment and utilization of various chemical engineering processes. Team based experimentation includes designing, and performing experiments on common chemical process unit operations apparatuses. After experimentation, students analyze data and compare with literature for experiment validation. Report writing and group presentations are emphasized. Prerequisites: CME 365. Corequisites: CME 465 (may be taken at the same or prior to CME 466L).

CME 486. Introduction to Petroleum Engineering. 3 Hours

Introduction to the fundamental concepts in petroleum engineering. Petroleum topics include overviews of areas such as petroleum geology, petroleum fluids and thermodynamics, drilling and completion, and production and multiphase flow. In addition this course will cover refinery operations.

CME 489. Principles of Biology for Bioengineers. 3 Hours

This course is designed for students with undergraduate majors in engineering or non-biological sciences. The focus of the course is to provide a common broad base of basic knowledge and terminology in the biological sciences required for coursework in the bioengineering emphasis tracts. Prerequisite(s): (BIO 151, BIO 152) or permission of instructor.

CME 490. Introduction to Bioengineering. 3 Hours

This class provides an introduction to bioengineering - a branch of engineering focusing on biological systems, biomaterials, engineering applications in living systems, and many other areas. By the end of this course, students will be able to understand bioengineering applications and processes, and properly apply engineering fundamentals, including transport phenomena and reaction kinetics, to these systems. Prerequisite(s): (BIO 151 or BIO 152); (CME 324 or MEE 307) or permission of instructor.

CME 491. Biomedical Engineering I. 3 Hours

Introduction to the fundamental concepts in biomedical engineering with a special focus on chemical engineering applications. Biomedical topics include overviews of areas such as biomaterials, tissue engineering, biosensors and biomedical engineering technology. Prerequisite(s): ((BIO 151 or BIO 152); CME 324) or permission of instructor.

CME 492. Chemical Sensors & Biosensors. 3 Hours

Analysis performed with chemical sensors complement laboratory analyses and offer the potential for more rapid and on-line analyses in complex sample matrices. The demand for new chemical sensors, biosensors, and sensing concepts is rapidly increasing and associated with the growing need to understand and/or control complex chemical and biochemical processes or detect the presence of toxic chemical or biological agents. Prerequisite(s): Permission of instructor.

CME 493. Honors Thesis. 3 Hours

Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program.

CME 494. Honors Thesis. 3 Hours

Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program. Prerequisite(s): CME 493.

CME 498. Research & Innovation Laboratory. 1-6 Hours

Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

CME 499. Special Problems in Chemical Engineering. 0-6 Hours

Particular assignments to be arranged and approved by chairperson of the department.

CME 507. Advanced Thermodynamics. 3 Hours

Entropy balance. Thermodynamics of energy conversion. Mixtures. Equilibria. Current applications.

CME 509. Introduction to Polymer Science - Thermoplastics. 3 Hours

Broad technical overview of the nature of synthetic macromolecules, including the formation of polymers and their structure, structure-property relationships, polymer characterization and processing, and applications of polymers. Fundamental topics such as viscoelasticity, the glassy state, time-temperature superposition, polymer transitions, and free volume will also be reviewed. The course focuses on thermoplastic polymers. Prerequisite(s): Organic chemistry; College Physics, Differential Equations.

CME 510. High Performance Thermoset Polymers. 3 Hours

Survey of high performance thermosetting resins, focusing on chemistry, processing and properties of six general resin families; vinyl ester, epoxy phenolic, cyanate ester, bismaleimide and polyimides. The course will include fundamental discussions of polymerization mechanisms, network structure development, rheology and time-temperature transformation, resin toughening, and structure processing property relationships. Characterization techniques will also be reviewed. Prerequisite(s): Organic Chemistry.

CME 511. Principles of Corrosion. 3 Hours

Theoretical and practical application of electrochemical principles to the field of corrosion covering thermodynamics, kinetics, forms of corrosion and methods for characterizing and controlling corrosion in areas of biomedical engineering, aerospace, automotive, and marine environments. Prerequisite(s): MAT 501.

CME 512. Advanced Composites. 3 Hours

Materials and processing. A comprehensive introduction to advanced fiber-reinforced polymeric matrix composites. Constituent materials and composite processing will be emphasized with special emphasis placed on structure-property relationships, the role of matrix in composite processing, mechanical behavior, and laminate processing. Specific topics will include starting materials, material forms, processing, quality assurance, test methods, and mechanical behavior. Prerequisites: Permission of instructor.

CME 521. Advanced Transport Phenomena. 3 Hours

Applications of the principles of momentum, heat and mass transfer to steady state and transient problems. Molecular concepts. Transport in turbulent flow. Boundary layer theory. Numerical applications. Prerequisite(s): CME 324, CME 381 or equivalent.

CME 522. Advanced Topics in Transport Phenomena. 3 Hours

The equations of change for multicomponent systems. Turbulent mass transport. Interphase transport in multicomponent systems. Combustion analysis. Macroscopic balances. Prerequisite(s): CME 325, CME 581, or equivalent.

CME 523. Transport Phenomena in Biological Systems. 3 Hours

An integrated interdisciplinary systems-based examination of biological transport phenomena (momentum, heat, and mass) and hemodynamics through mathematical modeling and biological processes as applied to physiological systems, with a focus on the cardiovascular, respiratory, and renal systems. Prerequisites: BIE 503 or BIE 505; BIO 151, BIO 152; MTH 218 or permission of instructor.

CME 527. Methods of Polymer Analysis. 3 Hours

Modern laboratory techniques used in preparation and characterization of polymers; experimental investigations of polymer structure-property relations; measurement of molecular weight averages and distributions, thermal and mechanical properties, viscoelastic and rheological properties; transitions and crystallinity. Prerequisite(s): CME 509, CME 510 or consent of instructor.

CME 528. Chemical Behavior of Materials. 3 Hours

This course will address chemical behavior as a subject complementary to mechanical behavior of materials. A special emphasis will be given to structure-property relationships of the major classes of materials. Physical/chemical periodicity, bonding, processing chemistry, and chemical behavior in the application environment will be addressed. Each major class of materials will be discussed with specific case studies for each. Prerequisite(s): College chemistry or permission of the instructor.

CME 529. Computational Chemistry. 3 Hours

Introduction to computational chemistry including a discussion of ab initio, semiempirical, and DFT methods and an overview of molecular mechanics and molecular simulation methods. Lectures are supplemented by simulation exercises using commercial programs such as Gaussiari and Molecular Studio. Prerequisites: CHM 124 or consent of instructor.

CME 530. Biomaterials. 3 Hours

The course introduces students to engineering materials used in dentistry, manufacture of surgical devices, prosthetics, and repair of tissues. Topics include bonding and atomic arrangement in materials, material selection, testing, and characterization, biocompatibility, tissue response to materials, and failure analysis. A spectrum of materials including metals, polymers, ceramics, and composites used in biomedical applications will be considered.

CME 531. Particles and Powders in Food Engineering. 3 Hours

Introduction to powder and particles in food engineering, covering production, properties, characterization, and their applications in the food industry. Additionally, introduction to state-of-the-art 3D printing technologies and their applications in food engineering. Prerequisites: Thermodynamics.

CME 532. Chemical Product Design. 3 Hours

Application of the design process to products based on chemical technology. Coverage of the entire design process from initial identification of product ideas, and culminating in the manufacture of a new product. Prerequisite(s): CME 311 and CME 324 or consent of instructor.

CME 533. Biofuel. 3 Hours

The course will provide an overview of the range of fuels derived from biological materials and processes, with a focus on anaerobic digestion, bioethanol and biodiesel, and production of synthetic fuel from biological materials. The course will include an overview of the biochemistry of energy production in biological systems, discussions of the economics and environmental sustainability of biofuels, and a review of reactor and separation systems concepts relevant to biofuel production. Prerequisite(s) EGR 202, CHM 123, or consent of instructor.

CME 541. Process Dynamics. 3 Hours

Mathematical modeling and computer simulation of process dynamics and control for chemical engineering processes.

CME 542. Chemical Engineering Kinetics. 3 Hours

Reaction kinetics. Heterogeneous catalytic reactions. Transport processes with fluid-solid heterogeneous reactions. Noncatalytic gas-solid reactions. Catalyst deactivation. Gas-liquid reactions. Prerequisite(s): CME 381, CME 306, or equivalent.

CME 543. Chemical Reactor Analysis & Design. 3 Hours

Design for optimum selectivity. Stability and transient behavior of the mixed flow reactor. Nonideal flow and balance models. Fixed and fluidized bed reactors. Multiphase flow reactors. Prerequisite(s): CME 381, CME 306, or equivalent.

CME 560. Biological Processes in Wastewater Engineering. 3 Hours

Measuring the characteristics of wastewater produced from domestic and industrial sources. Principles of designing and operating microbiological processes for the treatment of wastewater. Mechanisms and kinetics of biological reactions are emphasized. Required background in a college-level general chemistry.

CME 562. Physical & Chemical Wastewater Treatment Processes. 3 Hours

Designing of physical and chemical unit processes to treat wastewater originating primarily from industrial sources. Industry pretreatment technologies and the basis for their development. Prerequisites: CHM 124; CME 465 or permission of instructor.

CME 563. Hazardous Waste Engineering. 3 Hours

The fundamental principles of the design and operation of hazardous waste control and hazardous substances remediation processes. Hazardous waste regulations, risk assessment, and management. Required background in a college-level chemistry.

CME 564. Solid Waste Engineering. 3 Hours

Characterizing solid waste. Managing solid waste collection, transport, minimization, and recycling. The design of solid waste disposal and resource recovery facilities.

CME 565. Fundamentals of Combustion. 3 Hours

Flames and combustion waves, detonation waves in gases, the chemistry of combustion, combustion of hydrocarbons, special aspects of gaseous combustion, combustion in mixed and condensed phases, explosions in closed vessels, and combustion and the environment. Prerequisite(s): CME 311, CME 306, or permission of instructor.

CME 566. Advanced Separations. 3 Hours

Azeotropic separations, complex column design, batch distillation, introduction to surface science, adsorptive separations, membrane separations, introduction to biological separations.

CME 574. Fundamentals of Air Pollution Engineering I. 3 Hours

Air pollution; combustion fundamentals; pollutant formation and control in combustion; pollutant formation and control methods in internal combustion engines; particle formation in combustion. Prerequisites: CME 311 or MEE 301, MEE 302; CME 324 or MEE 410 or permission of instructor.

CME 575. Fundamentals of Air Pollution Engineering II. 3 Hours

Review of the concepts of air pollution engineering; aerosols; removal of particles from gas streams; removal of gaseous pollutants from effluent streams; optimal air pollution control strategies. Prerequisite(s): CME 574 or permission of instructor.

CME 581. Advanced Chemical Engineering Calculations I. 3 Hours

Applications of ordinary and partial differential equations to engineering problems. Classical methods of solution. Prerequisite(s): MTH 219 or permission of instructor.

CME 582. Advanced Chemical Engineering Calculations II. 3 Hours

Analyses and solutions of engineering problems described by differential equations. Numerical methods of solution.

CME 586. Introduction to Petroleum Engineering. 3 Hours

Introduction to the fundamental concepts in petroleum engineering. Petroleum topics include overviews of areas such as petroleum geology, petroleum fluids and thermodynamics, drilling and completion, and production and multiphase flow. In addition this course will cover refinery operations. Prerequisite(s): Permission of instructor.

CME 590. Introduction to Bioengineering. 3 Hours

This class provides an introduction to bioengineering - a branch of engineering focusing on biological systems, biomaterials, engineering applications in living systems, and many other areas. By the end of this course, students will be able to understand bioengineering applications and processes, and properly apply engineering fundamentals, including transport phenomena and reaction kinetics, to these systems. Prerequisites are BIO 151, CME 324 or MEE 308 or permission of instructor.

CME 591. Biomedical Engineering I. 3 Hours

Introduction to the fundamental concepts in biomedical engineering with a special focus on chemical engineering applications. Biomedical topics include overviews of areas such as biomaterials, tissue engineering, biosensors and biomedical engineering technology. Prerequisites: BIO 151 and CME 324, or BIE 501 or permission of instructor.

CME 592. Chemical Sensors & Biosensors. 3 Hours

Analysis performed with chemical sensors complement laboratory analysis and offer the potential of more rapid and on-line analysis in complex sample matrices. The demand for new chemical sensors, biosensors and sensing concepts is rapidly increasing and associated with the growing need to understand and/or control complex chemical and biochemical processes or detect the presence of toxic chemical or biological agents. Prerequisites: Permission of instructor.

CME 595. Special Problems in Chemical Engineering. 1-6 Hours

Special assignments in Chemical Engineering to be arranged and approved by the advisor and the program director.

CME 597. Research Methods. 3 Hours

This course will provide students the ability to apply research methods and problem solving skills to identify and define a research problem, develop hypotheses and research plans to test those hypotheses. Students will write and present an original research proposal.

CME 599. Thesis. 1-6 Hours

Chemical Engineering Thesis.