

# CHEMICAL ENGINEERING (CME)

**NOTE: All prerequisites for Chemical Engineering (CME) courses must be completed with a grade of "C-" or better.**

## Chemical Engineering (CME) Courses

### **CME 1202. Introduction to Chemical Engineering. (2-0) 2 Credit Hours.**

A broad survey of the practice of chemical engineering, intended to expose students to various areas of chemical engineering and potential career paths (e.g., bioengineering, environmental engineering, materials engineering, and petroleum/energy engineering) through discussions and guest lectures. Students will review ethics and safety, and practice technical communication through oral presentations and written assignments. Course fees: LRE1 \$25; STSE \$20.

### **CME 2103. Chemical Process Principles. (3-0) 3 Credit Hours.**

Prerequisites: A grade of "C-" or better in CHE 1113, CME 1202, and MAT 1214. Students will first learn basic principles of chemical engineering, including temperature, pressure, pressure head, mass, moles, volume, concentration, density, time-dependent variables, and buoyancy. They will apply techniques such as interpolation, linearization, statistical analysis, and Gauss-Jordan elimination. Students will define system boundaries for closed and open systems to apply material and energy balances to single units and multiple unit processes; processes containing recycle loops; non-reactive and reactive processes; processes with ideal and nonideal gases; and processes with liquid-liquid equilibrium, solid-vapor equilibrium, and single and multi-component vapor liquid equilibrium. Students will learn the first law of thermodynamics to derive and apply the general energy balance, mechanical energy balance, and Bernoulli equation. Students will learn the differences between extensive versus intensive variables, and state functions versus path functions. Students will develop an understanding of system and stream energies (enthalpy, internal energy, potential energy, and kinetic energy) versus energy transfer terms (heat and work) and apply them to non-reactive and reactive chemical processes. Course Fees: LRE1 \$25; STSE \$30; DL01 \$75.

### **CME 2113. Physiology for Chemical Engineering. (3-0) 3 Credit Hours.**

Prerequisites: A grade of "C-" or better in BIO 1203 and MAT 1214. Fundamental principles of general and organs physiology, including composition and concentration of cellular and other body fluids, types of transport (e.g., diffusion, membrane transporters), energy (thermodynamics, metabolism), enzymes, feedback control, and membrane potentials with engineering applications and mathematical modeling. (Same as BME 2103. Credit cannot be earned for both CME 2113 and BME 2103.) Course Fees: LRE1 \$25; STSE \$30.

### **CME 2301. Chemical Process Safety and Risk Management. (1-0) 1 Credit Hour.**

(This course is for students in catalogs prior to 2022-2024.) Application of chemical process safety, risk assessment and management, including hazardous waste disposal and remediation. (Same as CME 3302 and CME 4001. Credit cannot be earned for more than one of the following: CME 2301, CME 3302, and CME 4001.) Course Fees: LRE1 \$25; STSE \$10.

### **CME 2303. Transport Phenomena I. (3-1) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2103. This course covers the fundamentals of momentum transport, fluid mechanics, and fluid unit operations. Topics discussed include fluid statics, fluid properties and fluid flow, overall mass, energy and momentum balances, incompressible and compressible flow in pipes, flow in packed and fluidized beds, pumps, compressors, agitators and nozzles, differential equations of fluid flow, non-Newtonian fluids, potential and creeping flow, and boundary layer and turbulent flow. This course includes a 3-hour lecture and a 1-hour recitation per week. (Credit cannot be earned for both CME 2303 and CME 3303). Course Fees: LRE1 \$25; STSE \$30.

### **CME 2403. Introduction to Programming for Engineers. (3-0) 3 Credit Hours.**

This course is designed to provide a foundation in programming. Topics include data types, the use of variables for storing data, arrays and strings, mathematical and logical expressions, loops, intro to data structures, structured program design, file input and output, plotting 2-D and 3-D data, and application to solving engineering problems. Course fees: LRE1 \$25; STSE \$30.

### **CME 2503. Thermodynamics I. (3-1) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2103. Thermodynamic analysis and modeling of pure component and constant concentration systems. Topics include basic thermodynamic variables, introductory equations of state, first and second laws of thermodynamics (close and open systems), reversible and irreversible processes, thermodynamic cycles, thermodynamic potentials, Maxwell relations, phase change properties and introduction to statistical thermodynamics. (Credit cannot be earned for both CME 2503 and CME 3103 or ME 3293.) This course includes a 3-hour lecture and a 1-hour recitation per week. Course Fees: LRE1 \$25; STSE \$30.

### **CME 2803. Biomechanics I. (3-1) 3 Credit Hours.**

Prerequisites: A grade of "C-" or better in EGR 2323 and PHY 1963. Introduction to fundamental engineering mechanics with focus on the human body. (Same as BME 2203. Credit cannot be earned for both CME 2803 and BME 2203.) Course Fees: LRE1 \$25; STSE \$30; DL01 \$75.

### **CME 3003. Introduction to Materials Science and Engineering. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 1202. Foundation for understanding the structure and properties of engineering materials such as ceramics, glass, polymers, composites, biomaterials, metals and alloys. An integrated introduction of materials' microstructure, thermodynamic properties, and corresponding mechanical, electrical, optical, and magnetic properties. (Same as BME 3003. Credit cannot be earned for both CME 3003 and BME 3003.) Differential Tuition: \$165. Course fee: DL01 \$75.

### **CME 3103. Thermodynamics I. (3-0) 3 Credit Hours.**

Prerequisites: A grade of "C-" or better in CME 2103 and completion of or concurrent enrollment in CHE 3804. This course is intended for students in catalogs prior to the 2022-2024 edition. Heat, work, equations of state, thermodynamic systems, control volume, first and second laws of thermodynamics, applications of the laws of thermodynamics, reversible and irreversible processes, introduction to basic thermodynamic cycles, vapor-liquid equilibria, and non-ideal solutions. One hour of problem solving recitation per week. (Credit cannot be earned for more than one of the following: CME 2503, CME 3103, CME 3203, and ME 3293). Differential Tuition: \$165.

**CME 3113. Cellular Biology for Chemical Engineering. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2103. Introduction to concepts and principles in cell and molecular biology. Topics include the structure and function of biomolecules, the fundamentals of DNA synthesis and repair, gene expression, cell metabolism, cell signaling, the cytoskeleton, and the cell cycle. This class consists of a 3-hour lecture. (Same as BME 3114 and BME 3113.) Credit can only be earned for one of the following: CME 3113, BME 3114, or BME 3113.) Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 3123. Computational Methods in Chemical Engineering. (3-1) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2403; completion of or concurrent enrollment in EGR 3323. Introduction to numerical techniques and computational tools essential for chemical engineering, including the use of data acquisition and processing, numerical analysis of linear, non-linear, and differential equations. Students will learn to use computer software to aid in their analysis (e.g., Matlab). This course includes a 3-hour lecture and a 1-hour recitation per week. Differential Tuition: \$165.

**CME 3203. Thermodynamics II. (3-1) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 3603 (CME 2203 in previous catalogs). Thermodynamic analysis and modeling of pure and multicomponent mixtures with variable concentration. This course focuses mainly on phase and chemical equilibria. Topics covered include thermodynamic properties estimation, equations of state, fugacity, activity coefficient models, chemical reactions and equilibrium, and intermolecular forces. (Credit cannot be earned for both CME 3203 and CME 3103 or ME 3293.) This course includes a 3-hour lecture and a 1-hour recitation per week. Differential Tuition: \$165.

**CME 3302. Chemical Process Safety and Risk Management. (2-0) 2 Credit Hours.**

Application of process safety and risk assessment and management in the petrochemical and related industries. The Risk Based Process Safety (RBPS) framework is used. Process safety design strategies are incorporated in a team project to complete a Hazard Identification and Risk Analysis (HIRA) for a given petrochemical process. Impact on employees, community, and the environment are addressed. The course includes lectures, guest speakers from industry, and investigation of case studies involving significant process safety events. (Same as CME 2301 and CME 4001. Credit cannot be earned for more than one of the following: CME 2301, CME 3302, and CME 4001.) Differential Tuition: \$110.

**CME 3303. Transport Phenomena I. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2103. This course is intended for students in catalogs prior to the 2022-2024 edition. This course covers the fundamental of momentum transport, fluid mechanics and fluid unit operations. Topics discussed include fluid statics, fluid properties and fluid flow, overall mass, energy and momentum balances, incompressible and compressible flow in pipes, flow in packed and fluidized beds, pumps, compressors, agitators and nozzles, differential equations of fluid flow, non-Newtonian fluids, potential and creeping flow and boundary layer and turbulent flow. (Credit cannot be earned for both CME 3303 and CME 2303.) Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 3403. Separation Processes. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2303 (Formerly CME 3303). This course covers unit operations associated with mass transfer. Topics covered include absorption and stripping, humidification processes, filtration and membrane separations, distillation, liquid-liquid extraction, adsorption and ion exchange, settling, evaporation and drying. Differential Tuition: \$165.

**CME 3413. Biocompatibility of Materials: Tissue-Biomaterial Interaction. (3-0) 3 Credit Hours.**

Prerequisites: A grade of "C-" or better in CME 3003 and CME 3113. This course is an introduction to the interactions of cells and tissues with biomaterials. Blood composition and blood-material interactions, responses of the inflammatory and immune systems to biomaterials, the process of wound healing, protein structure and interactions with material surfaces, and the mechanisms of cell interactions with extracellular matrix components as well as cell/tissue responses to implant materials are reviewed in detail. Case studies of cardiovascular and orthopedic implants are discussed to illustrate that judicious selection of materials is a key aspect of implant design and a crucial choice for the success of various biomedical applications (e.g., in tissue engineering and biotechnology) which require regeneration of tissues. (Same as BME 3413. Credit cannot be earned for both CME 3413 and BME 3413.) Differential Tuition: \$165.

**CME 3433. Crystal Chemistry of Structure and Properties. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 3003. Principles of crystal chemistry applied to the relationships of crystallographic structures, compositions, and engineering properties of materials. Differential Tuition: \$165.

**CME 3503. Kinetics and Reactor Design. (3-0) 3 Credit Hours.**

Prerequisites: A grade of "C-" or better in CHE 3804 and CME 2303 (Formerly CME 3303). Fundamental principles to the design and analysis of batch, continuously stirred tank, and fixed bed chemical reactors; steady and unsteady state operations; effects of pressure and temperature; heterogeneous catalysis; analysis of transport processes in catalysis; special topics may include enzyme catalysis; fluid bed reactors; membrane reactors; and microscale reactors. Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 3513. Nanomaterials and Nanobiotechnology. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 3003. This course will introduce an overview of nanomaterials and nanotechnology development. Topics may include biocompatible nanomaterials, microfabrication, microfluidics, lab-on-a-chip, and applications in biomedical engineering. (Same as BME 3503. Credit cannot be earned for both CME 3513 and BME 3503.) Differential Tuition: \$165.

**CME 3601. Chemical Engineering Laboratory I. (0-3) 1 Credit Hour.**

Prerequisite: Completion of or concurrent enrollment in CME 3503. Basic principles and statistical design of experiments using software tools; experiments demonstrating key unit operations with emphasis on fluid flow and heat transfer. Written reports and oral presentations required. Differential Tuition: \$55.

**CME 3603. Computational Methods in Chemical Engineering. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2403. Introduction to numerical techniques and computational tools essential for chemical engineering, including the use of data acquisition and processing, numerical analysis of linear, non-linear, and differential equations. Students will learn to use computer software to aid in their analysis (e.g., Matlab). This course includes a 3-hour lecture and a 1-hour recitation per week. (Formerly CME 2203. Credit cannot be earned for both CME 3603 and CME 2203.) Differential Tuition: \$165.

**CME 3703. Transport Phenomena II. (3-1) 3 Credit Hours.**

Prerequisite: CME 2303 (CME 3303 in previous catalogs) or instructor approval. This course focuses on the fundamentals and applications associated with heat and mass transfer. Topics discussed steady state conduction, principles of unsteady state heat transfer, convection, heat transfer coefficients, heat exchangers, radiation, steady state mass transfer, diffusions, convection, mass transfer coefficients, and unsteady state mass transfer. This course includes a 3-hour lecture and a 1-hour recitation per week. Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 3803. Biomechanics II. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2803. Continuation of fundamental biomechanics to include elasticity, viscoelasticity, deformation, stress analysis, blood flow in the systemic and pulmonary circulation, and fluid-structure interaction. (Same as BME 3203. Credit cannot be earned for both CME 3803 and BME 3203.) Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 3903. Bioinstrumentation. (3-1) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 2803. Topics include: principles of transducer operation, amplifiers and signal processing, recording and display. This course includes a 3 hour lecture and a 1 hour recitation per week. (Same as BME 3303. Credit cannot be earned for both CME 3903 and BME 3303.) Differential Tuition: \$165.

**CME 4103. Process Dynamics and Control. (3-1) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 3403. Modeling of dynamic processes; response of uncontrolled systems; transfer functions; response and stability of controlled systems; frequency response; design of feedback controllers; cascade, feed forward and multivariable control systems; process Instrumentation; use of simulators to design feedback controllers. One hour of problem solving recitation per week. Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 4163. Chemical Engineering Design Fundamentals. (3-0) 3 Credit Hours.**

Prerequisites: A grade of "C-" or better in CME 3203 and CME 3403. Application of design and economic principles to chemical engineering systems; analysis of costs of equipment, feedstocks, utilities, and risk assessment; optimization of equipment design using simulation tools. Students will be assembled in teams to perform materials and energy balances on their capstone design projects. (Formerly titled Thermodynamics II.) Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 4201. Chemical Engineering Laboratory II. (0-3) 1 Credit Hour.**

Prerequisite: Completion of or concurrent enrollment in CME 4103. Experiments demonstrating key unit operations with emphasis on mass transfer with and without reactions; hands on experience with process control. Written and oral reports required. Differential Tuition: \$55.

**CME 4263. Plant Design. (3-0) 3 Credit Hours.**

Prerequisite: A grade of "C-" or better in CME 4163 and CME 3302. Strategic application of technical and economic constraints in the design of a chemical processing plant including most aspects of typical industrial design, integration of process safety, and environmental impact factors. Students will work in small groups and submit a plant design project report that has a comprehensive design of all equipment included in the plant. Students will present the results of their design in a College of Engineering and Integrated Design-wide symposium. Differential Tuition: \$165.

**CME 4423. Rheology. (3-0) 3 Credit Hours.**

Prerequisites: To be determined by the instructor. This course covers the fundamentals of rheology as they apply to the oil and gas industry. Topics covered include crude oil flow rheology, drilling fluids, fluids in completion, crude oil pipelining, and fractal characterization of wax. Differential Tuition: \$165.

**CME 4433. Process Optimization. (3-0) 3 Credit Hours.**

Modern optimization theory, algorithms, and applications for large scale chemical engineering real-world problems. Topics included in the course and prerequisites required for the course will be decided upon by the instructor who teaches the course. Differential tuition: \$165.

**CME 4513. Selected Topics in Bioengineering. (3-0) 3 Credit Hours.**

Prerequisites: May vary with the topic (refer to the course syllabus on Bluebook or contact the instructor). An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. May be repeated for credit when topics vary, but not more than 6 semester credit hours will apply to a bachelor's degree. Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 4523. Selected Topics in Petroleum/Energy Engineering. (3-0) 3 Credit Hours.**

Prerequisites: May vary with the topic (refer to the course syllabus on Bluebook or contact the instructor). An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. May be repeated for credit when topics vary, but not more than 6 semester credit hours will apply to a bachelor's degree. Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 4533. Selected Topics in Materials Science and Engineering. (3-0) 3 Credit Hours.**

Prerequisites: May vary with the topic (refer to the course syllabus on Bluebook or contact the instructor). An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. May be repeated for credit when topics vary, but not more than 6 semester credit hours will apply to a bachelor's degree. Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 4543. Selected Topics in Environmental Engineering. (3-0) 3 Credit Hours.**

Prerequisites: May vary with the topic (refer to the course syllabus on Bluebook or contact the instructor). An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. May be repeated for credit when topics vary, but not more than 6 semester credit hours will apply to a bachelor's degree. Course Fees: LRE1 \$25; STSE \$30. Differential Tuition: \$165. Course fee: DL01 \$75.

**CME 4701. Chemical Engineering Research. (0-0) 1 Credit Hour.**

Prerequisite: Permission in writing (form online) from the instructor, the student's advisor, and the Department Chair. Advanced laboratory practice and introduction to chemical engineering research. This course may be used to satisfy one of the electives for the CME tracks. May be repeated for credit but no more than 3 semester credit hours will apply towards the bachelor's degree in Chemical Engineering. This course cannot be taken if 3 semester credit hours in CME 4913 or CME 4803 have already been earned. Differential Tuition: \$55.

**CME 4702. Chemical Engineering Research. (0-0) 2 Credit Hours.**

Prerequisite: Permission in writing (form online) from the instructor, the student's advisor, and the Department Chair. Advanced laboratory practice and introduction to chemical engineering research. This course may be used to satisfy one of the electives for the CME tracks. May be repeated for credit but no more than 3 semester credit hours will apply towards the bachelor's degree in Chemical Engineering. This course cannot be taken if 3 semester credit hours in CME 4913 or CME 4803 have already been earned. Differential Tuition: \$110.

**CME 4703. Chemical Engineering Research. (0-0) 3 Credit Hours.**

Prerequisite: Permission in writing (form online) from the instructor, the student's advisor, and the Department Chair. Advanced laboratory practice and introduction to chemical engineering research. This course may be used to satisfy one of the electives for the CME tracks. May be repeated for credit but no more than 3 semester credit hours will apply towards the bachelor's degree in Chemical Engineering. This course cannot be taken if 3 semester credit hours in CME 4913 or CME 4803 have already been earned. Differential Tuition: \$165.

**CME 4803. Chemical Engineering Internship. (0-0) 3 Credit Hours.**

Prerequisite: Permission in writing (form online) from the instructor, the student's advisor, and the Department Chair. Internship in the chemical engineering industry. No more than 3 semester credit hours will apply to the bachelor's degree in Chemical Engineering. This course cannot be taken if 3 semester credit hours in CME 4913 or CME 4703 have already been earned. Differential Tuition: \$165.

**CME 4911. Independent Study. (0-0) 1 Credit Hour.**

Prerequisites: Permission in writing (Independent Study Form available online) from the instructor and the Department Chair. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 3 semester credit hours of independent study will apply to a bachelor's degree in Chemical Engineering. This course cannot be taken if 3 semester credit hours in CME 4703 or CME 4803 have already been earned. (Formerly CME 4601. Credit cannot be earned for both CME 4601 and CME 4911.) Differential Tuition: \$55.

**CME 4912. Independent Study. (0-0) 2 Credit Hours.**

Prerequisites: Permission in writing (Independent Study Form available online) from the instructor and the Department Chair. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 3 semester credit hours of independent study will apply to a bachelor's degree in Chemical Engineering. This course cannot be taken if 3 semester credit hours in CME 4703 or CME 4803 have already been earned. Formerly CME 4602. Differential Tuition: \$110.

**CME 4913. Independent Study. (0-0) 3 Credit Hours.**

Prerequisites: Permission in writing (Independent Study Form available online) from the instructor and the Department Chair. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 3 semester credit hours of independent study will apply to a bachelor's degree in Chemical Engineering. This course cannot be taken if 3 semester credit hours in CME 4703 or CME 4803 have already been earned. Formerly CME 4603. Credit cannot be earned for both CME 4603 and CME 4913. Differential Tuition: \$165.