CHEMICAL ENGINEERING

Kristen Krupa-Comfort, Department Chairperson
Kevin J. Myers, Chemical Engineering Program Coordinator

Master of Science in Chemical Engineering (CME)

The program of study leading to the Master of Science in chemical engineering must include a minimum of 30 semester hours consisting of the following:

Fifteen semester hours of chemical engineering graduate courses, including:		15
CME 507	Advanced Thermodynamics	
CME 521	Advanced Transport Phenomena	
or CME 522	Advanced Topics in Transport Phenomena	
CME 542	Chemical Engineering Kinetics	
or CME 543	Chemical Reactor Analysis & Design	
CME 581	Advanced Chemical Engineering Calculations I	
or CME 582	Advanced Chemical Engineering Calculations II	
Nine semester hours of electives as approved by the advisor and the department chair. [1]		9
Thesis project [2]		6
Total Hours		30

1 With the approval of the faculty advisor and the department chair, a student may include up to 3 semester hours of 400 level courses in their program of study. The work done shall be of the grade of B or higher for that credit to be accepted toward a graduate degree. See also Master's Degree Requirements in School of Engineering section in the Catalog and consult with the advisor.

2 A final examination is required at the completion of the thesis. Upon the request of the student and with the approval of the faculty advisor and chair of the department, six hours of additional coursework plus three hours of special problem work may be substituted for the thesis.

The program of study allows focuses in the following areas:

- Fuels and Combustion
- Environmental Engineering
- Materials Engineering
- Process Modeling and Control
- Bio-Engineering

Courses

CME 507. Advanced Thermodynamics. 3 Hours
Entropy balance. Thermodynanics of energy conversion. Mixtures. Equilibria. Current applications.

CME 508. Advanced Topics in Chemical Engineering. 3 Hours
Advanced Topics in Chemical Engineering.

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.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. Prerequisite(s): Permission of instructor.

CME 515. Statistics in Thermodynamics. 3 Hours
Statistics in Thermodynamics.

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. Prerequisite(s): (BIE 503 or BIE 505; BIO 151, BIO 152; MTH 218) or permission of instructor.

CME 524. Electrochemical Power. 3 Hours
The course will cover fundamental as well as engineering aspects of fuel cell technology. Specifically, the course will cover basic principles of electrochemistry, electrical conductivity (electronic and ionic) of solids, and development/design of major fuel cells (alkaline, polymer electrolyte, phosphoric acid, molten carbonate, and solid oxide). A major part of the course will focus on solid oxide fuel cells (SOFC), as it is emerging to be dominant among various fuel cell technologies. The SOFC can readily and safely use many common hydrocarbon fuels such as natural gas, diesel, gasoline, alcohol, and coal gas. Prerequisite(s): CME 311, CME 324, 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, semiempical, and DFT metods 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. Prerequisite(s): CHM124, or consent of instructor.

CME 530. Biomaterials. 3 Hours
The course introduces students with 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 failutre analysis. A spectrum of materials including metals, polymers, ceramics, and composites used in biomedical applications will be considered.

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 550. Agitation. 3 Hours
Agitator design and scaleup for blending and motion, solids suspension, gas dispersion, and viscous operations; experimental, computational, and design tools of agitation; static mixing; and mixing with chemical reaction. Prerequisite(s): CME 465 or permission of instructor.

CME 560. Biological Processing of Wastewater. 3 Hours
Measuring the characteristics of wastewater produced from domestic and industrail sources. Principles of designing and operating microbiological processes for the treatment of wastewater. Mechanisms and kinetics of biological reactions emphasized. Prerequisite(s): CHM 124.

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. Prerequisite(s): CHM 123; CME 465, or permission of instructor.

CME 563. Hazardous Waste Engineering. 3 Hours
The fundamental principles of the design and operation of hazardous waste remediation processes. Characterizing contaminated sites and conducting treatability studies to select remediation strategies. Prerequisite(s): CHM 123; CME 465, or permission of instructor.

CME 564. Solid Waste Engineering. 3 Hours
Solid Waste Engineering.

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 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. Prerequisite(s): (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 576. Environmental Engineering Separation Processes. 3 Hours
No description available.

CME 579. Materials for Advanced Energy Applications. 3 Hours
Successful long-term application of many advanced energy technologies is ultimately based on the utilization of materials in 'real world' environmental conditions. The physical/mechanical properties and application of various materials (i.e. superallyos, refractory metal alloys, ceramics) being employed in advanced energy applications are discussed. Several advanced energy technologies (i.e. fuel cells, nuclear energy, and others) are covered with emphasis on how the selection of advanced materials enhances their commercial application. Prerequisite(s): (MAT 501, MAT 502) or permission of instructor.

CME 580. Polymer Decomposition, Degradation & Durability. 3 Hours
An in-depth study of the mechanisms leading to polymer decomposition and degradation, as well as methods for analyzing and preventing or minimizing these processes and thereby improving polymer durability. Topics include thermal/pyrolytic, thermo-oxidative, hydrolysis, photo/UV/weathering, flammability, mechanical, and degradation in earth orbit. Prerequisite(s): CME 509 / MAT 509 or CME 510 / MAT 510.

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 583. Process Modeling. 3 Hours
No description available.

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. Second term, each year. Prerequisite(s): Permission of instructor.

CME 590. Introduction to Bioengineering. 3 Hours
This class provides an introduction to bioengineering - a branch of engineering forcusing 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 propery apply enginerring fundamentals, including transport phenomena and reaction kinetics, to these systems. Prerequisite(s): 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. Second term, each year. Prerequisite(s): 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 rmore 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 presense of toxic chemical or biological agents. Prerequisite(s): 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. 3-6 Hours
Chemical Engineering Thesis.