CHEMICAL ENGINEERING AND MATERIALS SCIENCE

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http://engineering.wayne.edu/che/

Chemical Engineering

The field of chemical engineering embraces those industries in which matter is treated to effect a change of state, energy content, or composition, and in which the chemical engineer may be concerned with either the processes or the process equipment used for them. Examples of such industries are: fuels and petroleum processing; heavy, fine and pharmaceutical chemicals; textiles and fibers; food processing and products; natural and synthetic rubbers and plastics; explosives, pulp and paper; surface coatings; disposal of chemical plant wastes; atomic energy processes; environmental control and medical systems; and the general fields of biotechnology.

Areas of specialized research and support for graduate students include thermodynamics and transport properties of polymer solutions and melts, processing, rheology and separations of polymers, heterogeneous catalysis, surface science of catalytic and polymeric materials, laser-based imaging of chemical species and reactions, environmental transport and management of hazardous waste, process design, control, and manufacturing based on sustainability principles, biocatalysis in multiphase systems, bioremediation for waste treatment, tissue engineering, and pharmacokinetics.

Materials Science and Engineering

Materials problems constitute an important area of research and development in the complex technology of our industrial society. The use of advanced materials, such as thermoplastic and thermoset polymers, intermetallic alloys, reinforced plastic or metal composites, ceramics and electronic materials, in the manufacturing of durable goods and devices has presented challenges to the profession of materials science and engineering. Materials engineers must understand the behavior of advanced materials, their chemical, mechanical, optical, thermal, and electrical properties, and the atomic or molecular structure that determines these properties. They can then apply their knowledge to the synthesis and processing of materials into useful products by controlling and improving their properties.

Areas of specialized research and support for graduate students include processing and rheology of polymers, thermodynamics and transport properties of polymer solutions and melts, computer simulation of polymeric and microporous materials, deformation and fracture of materials at elevated temperatures, effects of processing on mechanical properties of intermetallic alloys, influences of microstructure on fatigue, fracture toughness, stress cracking and corrosion in metals, nondestructive mechanical testing of composites, surface science of catalytic and polymeric materials, laser-based imaging of chemical species and reactions, electronic materials and sensors for automotive applications.

CAO, ZHIQIANG: Ph.D., University of Washington; M.Eng., B.Eng., Tianjin University; Assistant Professor

DENG, DA: Ph.D., BEng, National University of Singapore; Assistant Professor

HUANG, YINLUN: Ph.D., M.S., Kansas State University; B.S., Zhejiang University; Professor

LEFFERT, CHARLES B.: Ph.D., Wayne State University; M.S., University of Pittsburgh; B.S., Purdue University; Associate Professor Emeritus

LIU, HAIPENG: Ph.D., Purdue; M.S., Huazhong University of Science and Technology; Assistant Professor

MANKE, CHARLES W.: M.S., Ph.D., University of California at Berkeley; B.S., Oregon State University; Professor

MAO, GUANGZHAO: Ph.D., University of Minnesota; B.S., Nanjing University; Professor and Chair

MATTHEW, HOWARD: Ph.D., M.S., Wayne State University; B.S., University of the West Indies; Professor

NG, SIMON: Ph.D., M.S., B.S., University of Michigan; Professor

NIKOLLA, ERANDA: Ph.D., M.S.E., University of Michigan; B.S., Oakland University; Assistant Professor

POTOFF, JEFFREY: Ph.D. Cornell University; B.S. Michigan State University; Professor

PUTATUNDA, SUSIL: Ph.D., Indian Institute of Technology; M.S., University of Mysore; B.S., Institution of Engineers; Professor

ROTHE, ERHARD W.: Ph.D., M.S., B.S., University of Michigan; Professor Emeritus

SALLEY, STEVEN: Ph.D., M.S., B.S., University of Detroit; Professor

SHREVE, GINA: Ph.D., M.S., University of Michigan; B.S., Michigan State University; Associate Professor

TORABI, KOROSH: Ph.D., Purdue University; M.S., Illinois Institute of Technology; M.S., Sharif University of Technology; B.S., University of Istahan; Assistant Professor

ZHU, YINGXI E.: Ph.D., University of Illinois at Urbana-Champaign; B.S., Tsinghua University; Professor

- Polymer Engineering (Graduate Certificate) (http://bulletins.wayne.edu/graduate/college-engineering/chemical-engineering-materials-science/polymer-engineering-graduate-certificate)
- Chemical Engineering (M.S.) (http://bulletins.wayne.edu/graduate/college-engineering/chemical-engineering-materials-science/chemical-engineering-ms)
- Materials Science and Engineering (M.S.) (http://bulletins.wayne.edu/graduate/college-engineering/chemical-engineering-materials-science/materials-science-engineering-ms)
- Chemical Engineering (Ph.D.) (http://bulletins.wayne.edu/graduate/college-engineering/chemical-engineering-materials-science/chemical-engineering-phd)
- Materials Science and Engineering (Ph.D.) (http://bulletins.wayne.edu/graduate/college-engineering/chemical-engineering-materials-science/materials-science-engineering-phd)
Chemical Engineering

CHE 5050 Statistics and Design of Experiments Cr. 3
Application of modern statistical experimental design methods to improve effectiveness and success in experimental projects, in chemical industry manufacturing, and research and design. Offered Winter.
Prerequisites: ([BE 2100 with a minimum grade of C-]) AND ([BE 1500 with a minimum grade of C-]) AND ([CHE 3200 with a minimum grade of C-]) AND ([CHE 3300 with a minimum grade of C-])

CHE 5100 Quantitative Physiology Cr. 4
Basic principles of human physiology presented from the engineering perspective. Bodily functions, their regulation and control discussed in quantitative terms and illustrated by mathematical models where feasible. Offered Winter.
Prerequisites: ([BME 5005 with a minimum grade of C]) OR ([BME 2010 with a minimum grade of C])
Equivalent: BME 5010, ECE 5100, IE 5100, ME 5100

CHE 5110 Fundamental Fuel Cell Systems Cr. 4
Introduce various types of fuel cells, materials properties of electrodes and polymeric membranes, and electrochemical mechanisms. Reforming of various types of hydrocarbon fuel to hydrogen, and reforming technology. Offered Fall.
Restriction(s): Enrollment limited to students in the College of Engineering.
Equivalent: AET 5110, EVE 5130, ME 5110

CHE 5120 Fundamentals of Battery Systems for Electric and Hybrid Vehicles Cr. 4
Fundamental electrochemistry and engineering aspects for electric propulsion batteries, including lead acid, nickel metal hydride, and lithium ion technologies. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.
Equivalent: AET 5310, EVE 5120, ME 5215

CHE 5350 Polymer Science Cr. 3
Fundamental relationships between chemical structure and physical properties of high polymers. Basic structures, states and transitions of polymers. Polymerization reactions and processes. Molecular weight, viscous flow and mechanical properties of polymers. Offered Fall.
Prerequisites: (May be taken concurrently: [MAT 2150 with a minimum grade of C-])
Course Material Fees: $10
Equivalent: MSE 5350

CHE 5360 Polymer Processing Cr. 3
A detailed analysis of polymer processing. Rheology of polymers, flow in tubes, calendering, extrusion, coating and injection molding. Offered Winter.
Prerequisites: ([CHE 3200 with a minimum grade of C-])
Course Material Fees: $10
Equivalent: MSE 5360

CHE 5450 Nanocarrier-based Drug Delivery Systems Cr. 3
Fundamental concepts in nanotechnology as it relates to drug delivery, and some of the applications and breakthroughs in this area as it applies to medicine. Offered Fall.
Prerequisites: ([CHE 5420 with a minimum grade of D-])
Restriction(s): Enrollment limited to students with a class of Unranked Undergrad, Junior or Senior, enrollment is limited to Graduate or Undergraduate level students.

CHE 5520 Energy Economics and Policy Cr. 4
Demand for energy, energy supply, energy markets, and public policies affecting energy markets. Coal, oil, natural gas, electricity, and nuclear power sectors and examines energy tax, price regulation, deregulation, energy efficiency and emission control policies. Offered Winter.
Restriction(s): Enrollment limited to students with a class of Applicant Masters, Candidate Masters, Unranked Grad, Graduate Certificate or Senior; enrollment limited to students in the College of Engineering.
Equivalent: EVE 5520

CHE 5700 Process and Materials Safety for Alternative Energy Technology Cr. 4
Fundamentals concerning fires and explosions, control strategies to prevent accidents, fault tree analysis to optimize control strategies, and risk analysis. Regulations and standards relevant to the design, manufacture, and operation of fuel cell and reforming processes. Offered Winter.
Equivalent: AET 5700

CHE 5811 Research Preparation II Cr. 1
Preparation for Senior Research Project, CHE 6810. Offered Every Term.
Prerequisites: ([CHE 3200 with a minimum grade of C-] OR [CHE 3300 with a minimum grade of C-]) OR ([CHE 3300 with a minimum grade of C-] OR [CHE 5809 with a minimum grade of C])

CHE 5995 Special Topics in Chemical Engineering I Cr. 1-4
A consideration of special subject matter in chemical engineering. Topics to be announced in Schedule of Classes. Offered Every Term. Repeatable for 8 Credits

CHE 5996 Chemical Engineering Research Cr. 1-6
Research project. Offered Every Term.
Restriction(s): Enrollment limited to students in the following programs: BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

CHE 6100 Introduction to Sustainable Engineering Cr. 3
Economic, environmental, social, and technological perspectives relevant to the design, operation and management of engineering activities. Multiple perspectives addressed from a system sustainability view point. Offered Yearly.
Equivalent: STE 6100

CHE 6130 Food Preservation Cr. 4
Offered Winter.
Course Material Fees: $20

CHE 6450 Biochemical Engineering Cr. 3
An introductory study of the principles of chemical engineering, biochemical and biological which are essential for the design of industrial systems involving biological transformations. Offered Irregularly.
Prerequisites: ([CHE 3400 with a minimum grade of C] OR [CHE 3800 with a minimum grade of C])

CHE 6570 Safety in the Chemical Process Industry Cr. 3
Fundamental and practical experience necessary for safe operation of a chemical process plant. Actual industrial case studies conducted under industry supervision. Offered Winter.
Prerequisites: ([CHE 3400 with a minimum grade of C] OR [CHE 3800 with a minimum grade of C])

CHE 6610 Risk Assessment Cr. 3
Introduction to risk assessment in environmental hazard management with emphasis on the chemical industry, including hazard identification, exposure analysis and risk characterization. Offered Fall.
CHE 6810 (WI) Chemical Engineering Research Project Cr. 4
Application of engineering and science background to the completion of a senior research project. Methods of research and analysis and interpretation of data. Preparation of a written research paper; oral presentation of research results. Offered Winter.
Prerequisite: CHE 4200 with a minimum grade of C- and CHE 5710 with a minimum grade of C-

CHE 7100 Advanced Engineering Mathematics Cr. 3
Presentation, evaluation and use of mathematical methods within the framework of engineering problems; including ordinary and partial differential equations, transforms and vector operations. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: MSE 7100

CHE 7200 Advanced Transport Phenomena Cr. 4
Basic properties of heat, mass and momentum transfer systems; fundamental equations, transforms and vector operations; includes independent study project. Offered Winter.
Prerequisite: CHE 5200 with a minimum grade of C and CHE 7100 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CHE 7300 Advanced Thermodynamics Cr. 3
Advanced presentation of the principles of thermodynamics; application to open systems, phase diagrams and chemical equilibria. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: MSE 7300

CHE 7350 Polymer Solutions Cr. 3
Solubility of polymers, configuration of chain molecules, colligative properties of dilute polymer solutions, spectroscopy, optical activity, light and x-ray scattering of polymer solutions, frictional properties of dissolved polymers, solution properties of polyelectrolytes. Offered Biannually.
Prerequisite: CHE 5350 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CHE 7390 Tissue Engineering and Hybrid Systems Cr. 4
Seminar and project based approach to the design, development, analysis and application of organ and tissue replacement systems which incorporate processed materials and living cells. Offered Biannually.
Prerequisites: (BME 5370 with a minimum grade of C) AND (BME 5020 with a minimum grade of C) OR (CHE 7100 with a minimum grade of C)
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: BME 7390

CHE 7400 Advanced Kinetics and Reactor Design Cr. 4
Basic properties of reacting systems including the steady state approximation, the relationship of thermodynamics to kinetics, the treatment of coupled reaction problems and design of chemical reactors; includes independent study project. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.
Course Material Fees: $10

CHE 7410 Alternative Fuels: Properties, Processing, and Characterization Cr. 4
Exploration of the latest alternative fuels: their physical and chemical properties, production technologies, and standardization characterization tests. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: AET 7410

CHE 7490 Biomedical Microsystems Cr. 4
Biomedical microsystems, with a focus on microfluidics and lab-on-a-chip technologies for medical diagnostics and biological research. Broad coverage of microscale physics; microfabrication methods; separation, purification, and other on-chip processes; biosensing. Offered Fall.
Prerequisite: ECE 5575 with a minimum grade of C or ECE 6570 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: BME 7490, ECE 7590

CHE 7990 Directed Study Cr. 1-9
Library investigation of an approved project in chemical engineering. Independent study, conferences with supervisor and preparation of a comprehensive written and oral report. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

CHE 7995 Special Topics in Chemical Engineering II Cr. 1-4
A consideration of special subject matter in chemical engineering. Topics to be announced in Schedule of Classes. Offered Fall, Winter.
Restriction(s): Enrollment is limited to Graduate level students.

CHE 8510 Graduate Co-op Experience Cr. 1-3
Presentation of oral and written reports to peer group describing co-op experience. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

CHE 8996 Research Cr. 1-9
Library and laboratory investigation of an approved proposal for advanced research project. Conferences and periodic oral progress reports. Comprehensive report of entire project upon completion. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 30 Credits

CHE 8997 Chemical Engineering Graduate Seminar Cr. 0.5
Advanced concepts in chemical engineering; presentation of research results. Must attend and present evidence of attending 30 hours of seminar over two-year period, and present one seminar. Offered Every Term.
Prerequisite: CHE 7200 with a minimum grade of C and CHE 7400 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CHE 8999 Master's Thesis Research and Direction Cr. 1-8
Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Candidate Masters; enrollment is limited to Graduate level students.
Repeatable for 8 Credits

CHE 9990 Pre-Doctoral Candidacy Research Cr. 1-8
Research in preparation for doctoral dissertation. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 12 Credits

CHE 9991 Doctoral Candidate Status I: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

CHE 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9991 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.
Materials Science and Engineering

MSE 5350 Polymer Science Cr. 3
Prerequisites: CHE 3200 with a minimum grade of C-
Course Material Fees: $10
Equivalent: CHE 5350

MSE 5360 Polymer Processing Cr. 3
A detailed analysis of polymer processing. Rheology of polymers, flow in tubes, calendering, extrusion, coating and injection molding. Offered Winter.
Prerequisites: CHE 3200 with a minimum grade of C-
Course Material Fees: $10
Equivalent: CHE 5360

MSE 5385 Biocompatibility Cr. 4
Wound healing and the tissue response to foreign materials. The organization activation, and mechanisms of the immune system. Bioactive materials and the molecular basis for surface recognition Y masking. Biocompatibility testing. Offered Biannually.
Equivalent: BME 5380

MSE 5650 Surface Science Cr. 3
An introduction to the science and technology of surface phenomena, including surface structure, surface energy, surface diffusion, crystal growth and selected applications of technological importance. Offered Irregularly.
Prerequisites: (IEE 1300 with a minimum grade of D-) AND (CHM 5440 with a minimum grade of D-)

MSE 7100 Advanced Engineering Mathematics Cr. 3
Presentation, evaluation and use of mathematical methods within the framework of engineering problems, including ordinary and partial differential equations, transforms and vector operations. Offered Fall.
Restriction(s): Enrollment is limited to graduate level students.
Equivalent: CHE 7100

MSE 7180 Advanced Topics in Biomaterials and Tissue Biomechanics Cr. 4
Seminar format: advanced topics presented to the class; lectures by the instructor and by the participants based on literature reviews. Topics determined by student interest. Offered Biannually.
Restriction(s): Enrollment is limited to graduate level students.
Equivalent: BME 7300, ME 7180

MSE 7300 Advanced Thermodynamics Cr. 3
Advanced presentation of the principles of thermodynamics; application to open systems, phase diagrams and chemical equilibria. Offered Fall.
Restriction(s): Enrollment is limited to graduate level students.
Equivalent: CHE 7300

MSE 7400 Mechanical Behavior of Materials Cr. 3
Analysis of elastic and plastic deformation of single crystals and polycrystalline materials, emphasizing the relations between metallurgical microstructure and material properties. Offered Irregularly.
Restriction(s): Enrollment is limited to graduate level students.

MSE 7990 Directed Study Cr. 1-6
Library investigation of an approved project in materials science and engineering. Independent study, conferences with supervisor and preparation of a comprehensive report. Offered Every Term.
Restriction(s): Enrollment is limited to graduate level students.

MSE 7995 Special Topics in Materials Science II Cr. 1-4
A consideration of special subject matter in materials science. Topics to be announced in Schedule of Classes. Offered Irregularly.
Restriction(s): Enrollment is limited to graduate level students.

MSE 8996 Research Cr. 1-10
Library and laboratory investigation of an approved proposal for advanced research project. Conferences and periodic oral progress reports. Comprehensive report of entire project upon completion. Offered Every Term.
Restriction(s): Enrollment is limited to graduate level students.
Repeatable for 12 Credits

MSE 8997 Seminar Cr. 0.5
Preparation for doctoral dissertation. Offered Fall, Winter.
Restriction(s): Enrollment is limited to graduate level students.

MSE 8999 Master's Thesis Research and Direction Cr. 1-8
Library and laboratory investigation of an approved proposal for advanced research project. Conferences and periodic oral progress reports. Comprehensive report of entire project upon completion. Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Candidate Masters; enrollment is limited to graduate level students.
Repeatable for 8 Credits

MSE 9990 Pre-Doctoral Candidacy Research Cr. 1-8
Research in preparation for doctoral dissertation. Offered Every Term.
Restriction(s): Enrollment is limited to graduate level students.
Repeatable for 12 Credits

MSE 9991 Doctoral Candidate Status I: Dissertation Research and Direction Cr. 7.5
Enrollment is limited to graduate level students.

MSE 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 7.5
Enrollment is limited to graduate level students.

CHE 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9992 with a minimum grade of S
Restriction(s): Enrollment is limited to graduate level students.

CHE 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9993 with a minimum grade of S
Restriction(s): Enrollment is limited to graduate level students.

CHE 9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction Cr. 0
Offered Every Term.
Restriction(s): Enrollment is limited to graduate level students.
Course Material Fees: $348.67
Repeatable for 0 Credits

CHE 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9993 with a minimum grade of S
Restriction(s): Enrollment is limited to graduate level students.

CHE 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9992 with a minimum grade of S
Restriction(s): Enrollment is limited to graduate level students.

CHE 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CHE 9991 with a minimum grade of S
Restriction(s): Enrollment is limited to graduate level students.
MSE 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
**Prerequisite:** MSE 9992 with a minimum grade of S
**Restriction(s):** Enrollment is limited to Graduate level students.

MSE 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
**Prerequisite:** MSE 9993 with a minimum grade of S
**Restriction(s):** Enrollment is limited to Graduate level students.

MSE 9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction Cr. 0
Offered Every Term.
**Restriction(s):** Enrollment is limited to Graduate level students.
**Course Material Fees:** $348.67
**Repeatable for 0 Credits**