The Department of Chemical Engineering offers three graduate degrees: Doctor of Philosophy (PhD), Master of Science (MS), and Master of Engineering (MEng). The PhD and MS degree programs include a significant research component in addition to graduate coursework. Information about specific departmental requirements for coursework and examinations is available upon request from the graduate advisor and on our website: http://engineering.tamu.edu/chemical.

Some of the research areas available within the department include: advanced materials, applied fluid mechanics and transport phenomena, biochemical engineering, catalysis, environmental process engineering, kinetics and reaction engineering, microelectronics and plasma processing, nanotechnology, natural gas conversion, polymers, process modeling and control, process optimization, process safety and design, systems biology, thermodynamics, tissue engineering, and molecular simulation. Modern equipment is available in numerous laboratories to perform research in these and other areas.

There is no foreign language requirement for the PhD program in chemical engineering.

**Faculty**

Akbulut, Mustafa, Associate Professor
Chemical Engineering
PHD, University of California, Santa Barbara, 2007

Balbuena, Perla B, Professor
Chemical Engineering
PHD, The University of Texas at Austin, 1996

Cheng, Zheng Dong, Professor
Chemical Engineering
PHD, Princeton University, 1999

El-Halwaghi, Mahmoud M, Professor
Chemical Engineering
PHD, University of California, Los Angeles, 1990

Elabd, Yossef A, Professor
Chemical Engineering
PHD, Johns Hopkins University, 2001

Green, Micah, Associate Professor
Chemical Engineering
PHD, Massachusetts Institute of Technology, 2007

Harris, James E, Professor of the Practice
Chemical Engineering
PHD, The University of Texas at Austin, 1981

Hasan, M M Faruque, Assistant Professor
Chemical Engineering
PHD, National University of Singapore, 2010

Hilaly, Ahmad K, Professor of the Practice
Chemical Engineering
PHD, Colorado State University, 2009

Holtzapple, Mark T, Professor
Chemical Engineering
PHD, University of Pennsylvania, 1981

Jayaraman, Arul, Professor
Chemical Engineering
PHD, University of California, Irvine, 1998

Jeong, Hae-Kwon, Associate Professor
Chemical Engineering
PHD, University of Minnesota, Twin Cities, 2004

Kao, Katy C, Associate Professor
Chemical Engineering
PHD, University of California, Los Angeles, 2005

Karim, M. Nazmul, Professor
Chemical Engineering
PHD, University of Manchester, 1977

Khosravianghadikolaei, Homa, Research Assistant Professor
Chemical Engineering
PHD, University of Illinois at Chicago, 2013

Kravaris, Costas, Professor
Chemical Engineering
PHD, California Institute of Technology, 1984

Kuo, Yue, Professor
Chemical Engineering
PHD, Columbia University, 1980

Kwon, Joseph, Assistant Professor
Chemical Engineering
PHD, University of California, Los Angeles, 2015

Lele, Pushkar P, Assistant Professor
Chemical Engineering
PHD, University of Delaware, 2010

Lutkenhaus, Jodie L, Associate Professor
Chemical Engineering
PHD, University of Notre Dame, 2003

Mannan, Mahboobul, Professor
Chemical Engineering
PHD, University of Oklahoma, 1986

Mashuga, Chad V, Assistant Professor
Chemical Engineering
PHD, Michigan Technological University, 1999

Pistikopoulos, Efstratios, Professor
Chemical Engineering
PHD, Carnegie Mellon University, 1988
CHEN 601 Chemical Engineering Laboratory Safety and Health
Credit 1. 1 Lecture Hour.
Control of hazards associated with chemical engineering research laboratories and the chemical process industry; causes and prevention of accidents, emergency procedures, safety codes, health effects of toxic substances and experimental design for safety.
**Prerequisite:** Graduate classification.

CHEN 604 Chemical Engineering Process Analysis I
Credits 3. 3 Lecture Hours.
Development and analysis of chemical process models that involve systems of algebraic equations, ordinary differential equations and partial differential equations.
**Prerequisite:** MATH 308 or approval of instructor.

CHEN 605 Chemical Engineering Process Analysis II
Credits 3. 3 Lecture Hours.
Formulation of mathematical models and solution of resulting mass and energy balance equations by modern computational techniques, applications to separation processes, chemical kinetics, reaction engineering, heat and mass transfer.
**Prerequisite:** CHEN 320 or approval of instructor.

CHEN 614 Advanced Transport Phenomena I
Credits 4. 4 Lecture Hours.
First part of a two-semester sequence covering advanced transport phenomena; emphasis is placed on momentum transfer or fluid mechanics applied to chemical engineering problems.
**Prerequisite:** Approval of instructor.

CHEN 615 Advanced Transport Phenomena II
Credits 3. 3 Lecture Hours.
Advanced energy and mass transfer in chemical engineering processes.
**Prerequisite:** Approval of instructor.

CHEN 623 Applications of Thermodynamics to Chemical Engineering
Credits 3. 3 Lecture Hours.
Application of thermodynamics to chemical engineering operations and processes.
**Prerequisite:** CHEN 354 or approval of instructor.

CHEN 624 Chemical Engineering Kinetics and Reactor Design
Credits 3. 3 Lecture Hours.
Rates and mechanisms of chemical reactions. Thermal and catalytic reactions both homogeneous and heterogeneous.
**Prerequisite:** CHEN 464 or approval of instructor.

CHEN 629 Transport Phenomena
Credits 3. 3 Lecture Hours.
Principles of transfer of momentum, energy and mass studied by application to advanced chemical engineering problems. Theoretical analogy of these three modes of transfer.
**Prerequisite:** CHEN 424 or approval of instructor.

CHEN 631 Process Dynamics and Advanced Process Control
Credits 3. 3 Lecture Hours.
Modeling, analysis, and simulation of linear and nonlinear process systems; model-based control techniques for achieving desired process dynamics.
**Prerequisite:** CHEN 461 or approval of instructor.

CHEN 634 Catalysis and Multiphase Reactor Design
Credits 3. 3 Lecture Hours.
Introduction and overview of catalyzed reactions; topics include heterogeneous catalysis and relevant surface science concepts, mass transport, and reactor design; discussion of industrially relevant chemistries.
**Prerequisite:** CHEN 624 or approval of instructor.
CHEN 635 Advanced Nanostructured Materials  
Credits 3. 3 Lecture Hours.  
Chemical synthesis and characterization of materials with structures and properties in the nano-scale; emphasis on the fundamental science and engineering of understanding and manipulating "bottom-up" material formation.  
Prerequisite: Approval of instructor.  
CHEN 640 Rheology  
Credits 3. 3 Lecture Hours.  
Principles of stress, deformation and flow; vector and tensor equations of fluid mechanics. Behavior of Newtonian, non-Newtonian and viscoelastic fluids.  
Prerequisite: MATH 601 or approval of instructor.  
CHEN 641 Polymer Engineering  
Credits 3. 3 Lecture Hours.  
Principles and practice of polymer structure, synthesis, reaction mechanisms and kinetics; polymer characterization, chemical and physical properties degradation and recycling, melt and solid mechanical and rheological properties. Technology of production and processing operations.  
Prerequisite: Graduate classification.  
CHEN 642 Colloidal and Interfacial Systems  
Credits 3. 3 Lecture Hours.  
Fundamental principles related to interactions, dynamic, and structure in colloidal and interfacial systems. Concepts covered include hydrodynamics, brownian motion, diffusion sedimentation, electrophoresis, colloidal forces, surface forces, polymeric forces, aggregation, deposition, equilibrium phase behavior, rheology, and experimental methods.  
CHEN 643 Applied Statistical Mechanics of Fluids  
Credits 3. 3 Lecture Hours.  
Application of molecular theories and computer simulation techniques to describe the thermodynamics and transport properties of fluids and fluid mixtures.  
Prerequisite: CHEN 623 or approval of instructor.  
CHEN 644 Nanotechnology: The Physics, Chemistry, and Engineering of Nanotechnology  
Credits 3. 3 Lecture Hours.  
Introduction to the basics and tools of nanotechnology; nanotechnology approaches and algorithms to analyze, design and simulate systems; focus on developing, modifying, adapting and creating tools to solve problems in the field.  
Prerequisite: Approval of instructor.  
CHEN 650 Introduction to Microfabrication and Microfluidics Technology  
Credits 3. 3 Lecture Hours.  
Micro Electro Mechanical Systems (MEMS Technology). To study the fundamentals of fluidics, heat and mass transfer, surface chemistry, and electrochemical interactions.  
CHEN 651 Biochemical Engineering  
Credits 3. 3 Lecture Hours.  
Integration of principles of engineering, biochemistry and microbiology; application to the design, development and improvement of industrial processes that employ biological materials. Engineering discipline directed toward creative application of interdisciplinary information to the economic processing of biological and related materials.  
Prerequisite: Approval of instructor.  
CHEN 653 Chemical Engineering in Tissue Engineering and Drug and Gene Delivery  
Credits 3. 3 Lecture Hours.  
Application of chemical engineering principles to the examination of tissue engineering systems, metabolic engineering systems, drug design and delivery, and gene delivery.  
Prerequisite: Approval of instructor.  
CHEN 655/SENG 655 Process Safety Engineering  
Credits 3. 3 Lecture Hours.  
Applications of engineering principles to process hazards analysis including source and dispersion modeling, emergency relief systems, fire and explosion prevention and mitigation, hazard identification, risk assessment, process safety management, etc.  
Prerequisite: Approval of instructor.  
Cross Listing: SENG 655/CHEN 655.  
CHEN 656 Advanced Process Chemical Optimization I  
Credits 3. 3 Lecture Hours.  
State-of-the-art optimization based techniques for process synthesis, process design and process operability; emphasis on mathematical modeling via mixed integer and continuous optimization formulations; application to heat integration problems; use of modeling/optimization software systems.  
Prerequisites: Graduate classification; or approval of instructor.  
CHEN 658 Fundamentals of Environmental Remediation Processes  
Credits 3. 3 Lecture Hours.  
Fundamental approach to various remediation technologies, topics in environmental thermodynamics and mass transfer, adsorption, desorption, ion exchange, air stripping, extraction, chemical oxidation, biodegradation.  
Prerequisite: Graduate classification in engineering.  
CHEN 660 Quantitative Risk Analysis  
Credits 3. 3 Lecture Hours.  
Fundamental concepts, techniques, and applications of risk analysis and risk-informed decision making for engineering students. Practical uses of probabilistic methods are demonstrated in exercises and case studies from diverse engineering areas.  
Prerequisites: Graduate or senior classification.  
Cross Listing: SENG 660 and ISEN 660.  
CHEN 661 Optimization of Chemical Engineering Processes  
Credits 3. 3 Lecture Hours.  
Methods of optimization applied for the design and control of chemical engineering processes.  
Prerequisite: Approval of instructor.  
CHEN 662 Computational Chemistry and Molecular Modeling for Engineers  
Credits 3. 3 Lecture Hours.  
Applications of computational chemistry and molecular modeling relevant to engineers, especially predictions for thermophysical properties and reaction rates; emphasis on the creative and intelligent use of commercial software to solve practical problems; problems relevant to process safety engineer.  
Prerequisites: CHEN 623 and 624 or approval of instructor.  
CHEN 663 Systems Biology  
Credits 3. 3 Lecture Hours.  
Introduction to experimental and computational techniques in systems biology; includes high throughput experiments, data analysis, modeling and simulation; discussion in the context of specific applications such as signal transduction.  
Prerequisite: Approval of instructor.
CHEN 664 Global Optimization of Chemical Engineering Problems
Credits 3. 3 Lecture Hours.
Advances in global optimization and applications to chemical engineering systems; modeling and formulation of optimization problems, general theories and techniques of global optimization, and applications to problems on process design and integration.
Prerequisite: Approval of instructor.

CHEN 665 Sustainable Design of Chemical Processes
Credits 3. 3 Lecture Hours.
Sustainability in chemical engineering; includes sustainable approaches to design and development of processes, products, energy usage; issues and roles of chemical engineers, service learning.
Prerequisite: Graduate and senior classification in engineering or approval of instructor.

CHEN 670 Computational Materials Science and Engineering
Credits 3. 3 Lecture Hours.
Modern methods of computational modeling and simulation of materials properties and phenomena, including synthesis, characterization, and processing of materials, structures and devices; quantum, classical, and statistical mechanical methods, including semi-empirical atomic and molecular-scale simulations, and other modeling techniques using macroscopic input.
Prerequisites: Approval of instructor; graduate classification.
Cross Listing: MSEN 670 and MEMA 670.

CHEN 675 Microelectronics Process Engineering
Credits 3. 3 Lecture Hours.
State-of-art process engineering principles on microelectronics, especially for the fabrication of very large scale integrated circuits (VLSICs); fundamental unit processes, such as thin film deposition, thermal growth, lithography, etching and doping, material structures and properties, and basic device operation principles.
Prerequisites: CHEN 623 and CHEN 624 or approval of instructor.

CHEN 676 Sustainable Design through Process Integration
Credits 3. 3 Lecture Hours.
Systematic and state-of-the-art techniques for the sustainable design of chemical processes; emphasis on holistic and systematic approaches using process integration for the conservation of natural resources and the enhancement of process performance; includes visualization, algebraic and mathematical optimization approaches.
Prerequisites: Graduate classification or approval of instructor.

CHEN 677 Advanced Process Integration and Synthesis
Credits 3. 3 Lecture Hours.
Systematic and state-of-the-art techniques of understanding the global insights of mass and energy flows within a process; use of integrated insights to optimize process performance; includes a variety of mathematical and visualization tools.
Prerequisite: Approval of instructor.

CHEN 681 Seminar
Credit 1. 1 Lecture Hour.
Presentations and discussions covering problems of current importance in chemical engineering research.

CHEN 684 Professional Internship
Credit 1. 1 Other Hour.
Engineering research experience in industrial setting away from Texas A&M campus; projects supervised jointly by faculty and industrial representative.
Prerequisites: Approval of student’s advisory committee chair and department head.

CHEN 685 Directed Studies
Credits 1 to 12. 1 to 12 Other Hours.
Limited investigations in fields other than those chosen for thesis or dissertation research and not covered by other formal courses.
Prerequisite: Approval of department head.

CHEN 689 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.
Selected topics in particular areas of chemical engineering. May be repeated for credit.
Prerequisites: Approval of department head and instructor.

CHEN 691 Research
Credits 1 to 23. 1 to 23 Other Hours.
Research for thesis or dissertation.
Prerequisite: Approval of department head.

CHEN 695 Graduate Mentoring Seminar I
Credit 1. 1 Lecture Hour.
Development of skills to compliment formal research and coursework training; includes improvement of communication and interaction skills; development of technical writing and presentation skills.
Prerequisites: Four chemical engineering core graduate courses; graduate advisor approval.

CHEN 696 Graduate Mentoring Seminar II
Credit 1. 1 Lecture Hour.
Development of a variety of skills to compliment formal research and coursework training; includes improvement to communication/interaction with students in a classroom setting, and improvement and development of teaching skills. Must be taken on a satisfactory/unsatisfactory basis.
Prerequisites: 4 CHEN core graduate courses, CHEN 695; graduate advisor approval.