Chemical Engineering (CHME)

CHME 1990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

CHME 2308. Conservation Principles in Chemical Engineering. (4 Hours)
Examines the applications of fundamental laws of mass and energy conservation to chemical and physical processes. Emphasizes material and energy balances on chemical processes. Offers students an opportunity to develop skills in applying chemistry, physics, and mathematics to identify and solve chemical engineering problems.

Prerequisite(s): CHEM 1151 with a minimum grade of D- or CHEM 1161 with a minimum grade of D- or CHEM 1211 with a minimum grade of D-

CHME 2310. Transport Processes 1. (4 Hours)
Covers the fundamentals of transport of incompressible and compressible fluids (fluid flow) along with energy transport. Concepts are continued in CHME 3312 with emphasis on heat transport. The methods taught are relevant to the analysis of engineering processes in a number of industries, including chemical, pharmaceutical, food, energy, biotechnology, and materials.

Prerequisite(s): MATH 2321 with a minimum grade of D- ; CHME 2308 with a minimum grade of D- ; MATH 2341 (may be taken concurrently) with a minimum grade of D-

CHME 2320. Chemical Engineering Thermodynamics 1. (4 Hours)
Covers the first and second laws of thermodynamics and their application to batch and flow systems, heat effects in chemicals, and physical properties/real fluids. Applies basic principles and mathematical relations to the analysis and solution of engineering problems.

Prerequisite(s): CHME 2308 with a minimum grade of D- ; MATH 2321 with a minimum grade of D-

CHME 2949. Introductory Directed Research in Chemical Engineering. (4 Hours)
Offers first- and second-year students an opportunity to pursue project and other independent inquiry opportunities under faculty supervision. The course is initiated with a student-developed proposal, including expected learning outcomes and research products, which is approved by a faculty member in the department. Requires permission of instructor.

CHME 2990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

CHME 2991. Research in Chemical Engineering. (1-4 Hours)
Offers an opportunity to conduct introductory-level research or creative endeavors under faculty supervision.

CHME 3312. Transport Processes 2. (4 Hours)
Continues CHME 2310. Presents the fundamentals and applications of energy transport, mass transport, and simultaneous energy/mass transport. The methods taught are relevant to the analysis of engineering processes in a number of industries, including chemical, pharmaceutical, food, energy, biotechnology, and materials.

Prerequisite(s): CHME 2310 with a minimum grade of D- ; MATH 2341 with a minimum grade of D-

CHME 3315. Chemical Engineering Experimental Design 1. (4 Hours)
Offers students an opportunity to obtain hands-on laboratory experience and to develop safety, teamwork, problem-solving, organizational, technical writing, and oral presentation skills. Focuses on fundamental momentum transport principles and skills to develop and design engineering solutions through experiments in the context of the current fields of chemical engineering. Emphasizes the hazards associated with those chemical engineering experiments.

Prerequisite(s): CHME 2310 with a minimum grade of D- ; (ENGW 3302 (may be taken concurrently) with a minimum grade of D- or ENGW 3315 (may be taken concurrently) with a minimum grade of D-)
Corequisite(s): CHME 3316
Attribute(s): NUpath Analyzing/Using Data

CHME 3316. Recitation for CHME 3315. (0 Hours)
Accompanies CHME 3315. Presents discussions related to laboratory safety, experimental design, data analysis, data presentation, and report writing strategies.

Corequisite(s): CHME 3315

CHME 3322. Chemical Engineering Thermodynamics 2. (4 Hours)
Continues CHME 2320. Covers thermodynamic properties of mixtures; fugacity and the fugacity coefficients from equations of state for gaseous mixtures; liquid phase fugacities and activity coefficients for liquid mixtures; phase equilibriums; the equilibrium constant for homogeneous gas-phase reactions; and extension of theory to handle simultaneous, heterogeneous, and solution reactions.

Prerequisite(s): CHME 2320 with a minimum grade of D- or CHME 2322 with a minimum grade of D-

CHME 3990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

CHME 4315. Chemical Engineering Experimental Design 2. (4 Hours)
Offers students an opportunity to obtain hands-on laboratory experience and to develop safety, teamwork, problem-solving, organizational, technical writing, and oral presentation skills. Focuses on the discovery of fundamental heat and mass transport principles. Those fundamentals are used to develop and design engineering solutions through experiments in the context of the current fields of chemical engineering. Focuses on the hazards associated with these chemical engineering experiments and the materials handled during laboratory.

Prerequisite(s): (CHME 3312 (may be taken concurrently) with a minimum grade of D- ; (CHME 3315 with a minimum grade of D- or CS 2510 with a minimum grade of D-)); (ENGL 1102 with a minimum grade of C or ENGL 1111 with a minimum grade of C or ENGW 1101 with a minimum grade of C or ENGW 1111 with a minimum grade of C)
Corequisite(s): CHME 4316
Attribute(s): NUpath Analyzing/Using Data, NUpath Writing Intensive

CHME 4316. Recitation for CHME 4315. (0 Hours)
Accompanies CHME 4315. Presents discussions related to laboratory safety, experimental design, data analysis, data presentation, and report writing strategies.

Corequisite(s): CHME 4315

CHME 4510. Chemical Engineering Kinetics. (4 Hours)
Covers fundamental theories of the rate of chemical change in homogeneous reacting systems, integral and differential analysis of kinetic data; design of batch and continuous-flow chemical reactors; and an introduction to heterogeneous reactions and reactor design.

Prerequisite(s): CHME 3312 with a minimum grade of D- ; CHME 3322 with a minimum grade of D-

CHME 4512. Chemical Engineering Process Control. (4 Hours)
Covers Laplace transform and its use in solving ordinary differential equations; modeling liquid-level, temperature, and composition dynamics; linearization of nonlinear systems; first- and second-order system transfer functions; and PID control; computer simulation of open- and closed-loop systems; control system stability; and feed-forward and cascade control.

Prerequisite(s): CHME 3312 with a minimum grade of D- ; CHME 3322 with a minimum grade of D-

CHME 4701. Separations and Process Analysis. (4 Hours)
Focuses on the design of a chemical process with a particular emphasis on separation technologies. Topics include computer simulation of steady-state processing conditions, selecting process operations, reactor design, preparing flow sheets and stream tables, and evaluating the economics of a chemical process design.

Prerequisite(s): CHME 3312 with a minimum grade of D- ; CHME 3322 with a minimum grade of D- ; CHME 4510 (may be taken concurrently) with a minimum grade of D-

CHME 4703. Chemical Process Design Capstone. (4 Hours)
Offers students an opportunity to participate in an open-ended, project-based design course where teams design innovative solutions of a comprehensive chemical process. Considers public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Students apply engineering knowledge from their undergraduate academic studies to design a chemical process that handles mass and energy balances. Requires proof of concept data from prototypes, experiments, or simulations of the process to show the design is feasible and that use of the data improves the design. Team presentations, in multiple formats, are shared with the chemical engineering community for feedback and evaluation. Requires multiple progress reports, submitted by the team, which results in the final design report at the end of the semester.

Prerequisite(s): CHME 4701 with a minimum grade of D- ; (CHME 4512 (may be taken concurrently) with a minimum grade of D- or PHYS 3600 (may be taken concurrently) with a minimum grade of D-)
Corequisite(s): CHME 4705
Attribute(s): NUpath Capstone Experience, NUpath Creative Express/Innov, NUpath Writing Intensive

CHME 4705. Recitation for CHME 4703. (0 Hours)
Accompanies CHME 4703. Provides a common meeting platform for all students in individual sections of CHME 4703 to meet on a weekly basis. Guest speakers and common lectures will be delivered during this recitation.

Corequisite(s): CHME 4703

CHME 4990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

CHME 4991. Research. (4 Hours)
Offers an opportunity to conduct research under faculty supervision. May be repeated up to two times.

Prerequisite(s): CHME 2311 with a minimum grade of D- or CHME 3315 with a minimum grade of D-
Attribute(s): NUpath Integration Experience

CHME 4992. Directed Study. (1-4 Hours)
Offers independent work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated without limit.

Prerequisite(s): CHME 2311 with a minimum grade of D-

CHME 5101. Fundamentals of Chemical Engineering Analysis. (4 Hours)
Offers graduate students from undergraduate studies outside of traditional chemical engineering an opportunity to obtain a practical understanding of the core principles behind the chemical engineering discipline. Topics include vector and tensor calculus, continuum mechanics and thermodynamics, macroscopic and microscopic analyses of mass, momentum, and energy conservation; the fundamental principles of processes in which mass, energy, and momentum are transported; consequences of the Second Law of Thermodynamics, the principles governing phase and chemical reaction equilibrium; the fundamental theories of chemical reaction kinetics and reactor design; and the mathematical formulation and solution of the underlying equations involved in all these topics.

CHME 5105. Materials Characterization Techniques. (4 Hours)
Covers the fundamentals and applications of materials characterization techniques. Major techniques include electron microscopy imaging, microbeam analysis, diffraction techniques, and near-field scanning probe techniques. Offers students an opportunity to learn transmission electron microscopy, scanning electronmicroscopy, electron and X-ray beam analysis, scanning tunneling microscopy, atomic force microscopy, and scanning near-field optical microscopy. Covers the applications of these techniques on both solid-state materials, such as metal and ceramics, and soft materials and biomaterials, such as polymers and nanostructured materials. Incorporates lab sessions on scanning electron microscopy and microanalysis.

CHME 5137. Computational Modeling in Chemical Engineering. (4 Hours)
Builds on chemical engineering fundamentals to introduce computer programming to allow simulation of physical, chemical, and biological systems. Covers numerical experiments (e.g., Monte Carlo, global sensitivity analysis) to analyze the significance of parameters and model assumptions. Offers students an opportunity to work on a research or design project throughout the course.

Prerequisite(s): (CHME 3312 with a minimum grade of D- ; CHME 3322 with a minimum grade of D-) or graduate program admission

CHME 5160. Drug Delivery: Engineering Analysis. (4 Hours)
Focuses on engineering analysis of drug delivery systems, demonstrating the application of classic engineering principles to a nontraditional field for chemical engineers. Presents quantitative analysis of transport of a drug through the body and its control by physical and chemical drug and drug delivery device properties. Emphasizes the influence of biological tissue composition and structure on these processes.

CHME 5179. Complex Fluids and Everyday Materials. (4 Hours)
Introduces intra- and intermolecular forces and moves on to material deformation in response to external stress, including polymeric elasticity. Covers topics in colloidal science and biological physics: the microscopic origins of suspension stability and biological self-assembly. Additional topics include “molecular gastronomy,” personal care and cleaning products, active materials, and experimental techniques. Studies of complex fluids and soft materials are highly interdisciplinary. Many everyday materials are combinations of the three phases of matter—solid, liquid, and gas—with unique material properties. “Complex fluids” and “soft matter” refer to suspensions, emulsions, foams, and gels, which include personal care items, household cleaners, and even food. Nearly all biological material can be described as a soft material.

CHME 5185. Design of Experiments and Ethical Research (DOEER). (4 Hours)
Designed to provide a comprehensive approach to introducing interdisciplinary biochemical engineering research and design of experiments. Through immersion in a collaborative classroom, offers students an opportunity to develop the thought processes, skills, and strategies required for originating and performing high-impact research that broadens scientific knowledge. Emphasizes design of experiments, statistics, and considerations in conducting ethical research. Topics include case studies in conflict of interest, bioethics, laboratory safety, scientific misconduct, authorship and publication, literature and peer review, data visualization and integrity, statistical analysis, and contemporary issues. Students complete online and training modules in laboratory safety and apply their knowledge as they study applications for experiments, including power analysis and rigor, to design scientific aims with peer review. Meets NIH for RCR.

CHME 5510. Fundamentals in Process Safety Engineering. (4 Hours)
Introduces the basic concepts in process safety engineering as applied to the process industries as well as various terms and lexicon. Reviews the fundamentals involved in the prediction of scenarios and covers the assumptions involved as well as the range of these predictions. Emphasizes toxicology, industrial hygiene, sources models, toxic releases, and dispersion models, as well as fire and explosion prevention.

CHME 5515. Process Safety Engineering for Biotechnology and Pharmaceutical Industries. (4 Hours)
Examines process safety engineering considerations for the biotechnology and pharmaceutical industries. Considers clean-in-place methods, the handling of flammables within the production area, the keeping of material in pipes and vessels, basic ventilation requirements, how to handle flammable and reactive chemicals, the process safety involved in spray dryers, and how to assess hazards by hazard analysis techniques.

CHME 5520. Process Safety Engineering—Chemical Reactivity, Reliefs, and Hazards Analysis. (4 Hours)
Reviews chemical reactivity hazards. Introduces relief methods and sizing estimation to prevent overpressurization vessel damage. Covers methods of hazards identification and risk assessment. Offers students an opportunity to obtain the ability to lead hazards analysis in any organization at any level.

CHME 5621. Electrochemical Engineering. (4 Hours)
Introduces fundamental concepts of electrochemical thermodynamics, kinetics, and mass transport and places them in context for applications such as batteries, fuel cells, and electrochemical sensors. Additional topics include porous electrode theory, cyclic voltammetry, Pourbaix diagrams, and the structure of the electrochemical double layer.

Prerequisite(s): (MATH 2321 with a minimum grade of C- ; MATH 2341 with a minimum grade of C-) or graduate program admission

CHME 5630. Biochemical Engineering. (4 Hours)
Focuses on topics relevant to the design of cell culture processes for the production of pharmaceuticals. Topics include an overview of prokaryotic vs. eukaryotic cells; enzyme kinetics; overview of cellular processes (DNA replication, transcription, translation, primary metabolism, and regulation of protein synthesis at the transcriptional, posttranslational, and metabolic levels); overview of genetic engineering methods (for bacteria, mammalian, and plant cells); kinetics of cell growth (growth models, growth kinetic parameters); kinetics of product formation; bioreactor design and optimum operating conditions; scale-up; and overview of product recovery and purification methods.

Prerequisite(s): CHME 3312 with a minimum grade of D- or (BIOE 3310 with a minimum grade of D- ; BIOE 3380 with a minimum grade of D-) or graduate program admission

CHME 5631. Biomaterials Principles and Applications. (4 Hours)
Offers a broad overview of the field of biomaterials (materials used in medical devices that interact with living tissues). Begins with introductory lectures on biomaterials and their translation from the laboratory to the medical marketplace and progresses to discussions of important biomaterials terminology and concepts. Basic materials science lectures then emphasize material structure-property-function-testing relationships. Concludes with introductions to topics in the field such as biomaterials-tissue interactions, tissue engineering, regulatory requirements, etc. Considers principles of device design as related to the selection and application of biomaterials throughout this course.

CHME 5632. Advanced Topics in Biomaterials. (4 Hours)
Addresses several important topics in biomaterials, specifically, materials used in medical devices that communicate with living tissues. Topics that may be addressed include biomaterials: past, present, and future; tissue engineering: scope, status, promise, challenges; biomaterials-tissue interactions; regulated medical device design, fabrication, and testing; strategies for translating medical products from concept to the marketplace; and medical device disasters. Some topics are covered in more depth than others depending on their value and interest to the students.

CHME 5683. Introduction to Polymer Science. (4 Hours)
Introduces basic concepts of polymers and polymer properties. Covers macromolecular structure from both theoretical and experimental viewpoints, polymerization processes and kinetics, polymer/solvent thermodynamics, crosslinking and network dynamics, thermal and phase behavior of polymers, viscoelasticity and mechanical behavior, diffusion in polymers, and selected advanced topics. Designed for both undergraduate and graduate students. No prior knowledge of polymers is required.

CHME 5699. Special Topics in Chemical Engineering. (4 Hours)
Focuses on topics related to chemical engineering to be selected by the instructor. May be repeated up to two times.

CHME 5984. Research. (1-4 Hours)
Offers an opportunity to conduct research under faculty supervision. May be repeated without limit.

CHME 6610. Computational Programs in Process Safety for Relief and Scenario Modeling. (4 Hours)
Focuses on the use of process safety software that is available to perform hazard analysis, relief and flare system evaluation, and scenario analysis. The software may include use of Process Safety Office (ioMosaic), Aspen Process Simulator (Aspen Technologies), and FLACS (Flame Acceleration Simulator by GexCon). These programs are dedicated to predicting relief sizing for vessels and processes; flare system sizing; chemical reactivity analysis; and dispersion modeling, should a release occur, and its damage potential either as an explosive or toxic cloud.

CHME 6962. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

CHME 7240. Polymer Science. (4 Hours)
Covers basic concepts of polymers, thermodynamics of polymer solutions, and measurement of molecular weight. Topics include physical and chemical testing of polymers, crystallinity in polymers and rheology of polymers, physical and chemical properties of polymers, and mechanisms and conditions for polymerization of polymers including step reaction, addition, and copolymerization. Discusses carbon-chain polymers, fibers, and fiber technology. Requires BS in chemical engineering or chemistry.

CHME 7262. Special Topics in Process Safety. (4 Hours)
Covers topics of interest to the staff member conducting this class for advanced study. Current topics relevant in process safety are considered, such as a focus on layers of protection analysis, qualitative risk analysis, and specific process safety challenges. Process safety challenges from industrial settings may also serve as problems tackled in the course. A student may not take more than one special topics course with any one instructor.

CHME 7320. Chemical Engineering Mathematics. (4 Hours)
Focuses on the formulation and solutions of problems involving advanced calculus as they arise in chemical engineering systems. Covers ordinary differential equations, series solutions, and complex variables. Also studies applications involving Laplace transforms, partial differential equations, matrix operations, vectors and tensors, and optimization methods. Emphasis is on methods for formulating the problems.

Prerequisite(s): (CHME 4510 with a minimum grade of C- or CHME 5101 with a minimum grade of B- or CHME 5101 with a minimum grade of B-) or graduate program admission

CHME 7330. Chemical Engineering Thermodynamics. (4 Hours)
Offers a graduate-level introduction to the fundamental principles relating molecular structure and bulk material properties. Begins with classical thermodynamics laws that govern macroscopic conservation, equilibrium stability, and irreversible processes, including open processes, multicomponent phase equilibrium, and reaction equilibrium. Introduces relationships between microscopic states and macroscopic properties, applied to understand systems such as non ideal fluids, crystalline solids, polymers, and electrolytes. Statistical thermodynamics concepts may also be applied through the use of analytical theory and computational molecular modeling.

Prerequisite(s): (CHME 3322 with a minimum grade of C- or CHME 5101 with a minimum grade of B- or CHME 5101 with a minimum grade of B-) or graduate program admission

CHME 7340. Chemical Engineering Kinetics. (4 Hours)
Covers fundamental theories of the rate of chemical change in homogeneous reacting systems, integral and differential analysis of kinetic data. Examines the theoretical foundations for the analysis of elementary chemical reaction rates. Comprises analysis and modeling of batch and ideal flow reactors, axial and radial dispersion in flow tubular reactors, and design principles of gas solid catalytic reactors. Builds on undergraduate chemical engineering kinetics concepts. Requires proficiency in calculus and differential equations.

Prerequisite(s): (CHME 4510 with a minimum grade of C- or CHME 5101 with a minimum grade of B- or CHME 5101 with a minimum grade of B-) or graduate program admission

CHME 7350. Transport Phenomena. (4 Hours)
Explores analytical and approximate solutions of equations of momentum, energy, and mass transport and their analogies. Covers heat and mass transfer at a fluid-solid interface. Introduces creeping, potential, and boundary layer flows. Examines macroscopic balances for isothermal systems and interphase transport of multicomponent systems.

Prerequisite(s): (CHME 3312 with a minimum grade of C- or CHME 5101 with a minimum grade of B- or CHME 5101 with a minimum grade of B-) or graduate program admission

CHME 7390. Seminar. (0 Hours)
Presents topics of an advanced nature by staff, outside speakers, and students in the graduate program. All seminars by outside speakers must be attended by all full-time graduate students; all other seminars must be attended when required by the instructor. May be repeated without limit.

CHME 7391. Professional Development and Communication in Chemical Engineering 1. (1 Hour)
Focuses on communication and integrates tightly with the graduate seminar series (CHME 7390). Offers students an opportunity to learn how to articulate scientific accomplishments to the scientific community, write high-quality manuscript outlines, develop proposals for graduate fellowships, give high-quality short and long seminar presentations, and critique and peer-review research manuscripts and proposals. Students also have an opportunity to learn about ongoing research projects in the Department of Chemical Engineering, professional workplace behaviors, and ethical conduct in a research environment. This is the first of four required courses (CHME 7392, 7393, and 7394).

CHME 7392. Professional Development and Communication in Chemical Engineering 2. (1 Hour)
Focuses on communication and integrates tightly with the graduate seminar series (CHME 7390). Offers students an opportunity to learn how to give high-quality short and long seminar presentations, write a high-quality research proposal, assemble all the components of a research proposal, and develop research strategies to realize their own research projects.

CHME 7393. Professional Development and Communication in Chemical Engineering 3. (1 Hour)
Focuses on communication and integrates tightly with the graduate seminar series (CHME 7390). Offers students an opportunity to write and submit high-quality graduate fellowship proposals, develop high-quality outlines of research proposals related to their dissertation proposal, critique and peer-review publications and proposals, and learn about the latest development in ongoing research in the Department of Chemical Engineering.

CHME 7394. Professional Development and Communication in Chemical Engineering 4. (1 Hour)
Focuses on communication and integrates tightly with the graduate seminar series (CHME 7390). All PhD students that have successfully completed their closed-door proposal defense give a 25-minute public podium presentation of their research. Students prepare a two-page detailed abstract and a presentation, attend and critique presentations given by their peers, and also submit the final version of a research or review article.

CHME 7395. Mentoring in Chemical Engineering. (1 Hour)
Offers graduate students an opportunity to connect theoretical concepts learned in the classroom to real-life innovations, identify the conceptual framework of existing technological innovations, identify the conceptual aspects of their own research activities, propose innovative strategies to connect them to real-life applications, and to learn the basics of mentoring to be able to transfer their knowledge and expertise to their peers or to undergraduate students. Students may attend workshops on effective teaching and mentoring and mentor undergraduate students under the supervision of experienced academic and/or industrial mentors.

CHME 7600. Pharmaceutical Engineering I. (4 Hours)
Introduces the fundamental principles of chemical engineering as applied to biopharmaceutical manufacturing. Emphasizes quantitative problem solving. Covers conservation principles (mass and energy balances), kinetics (enzyme kinetics and cell growth kinetics), and heat transfer (sterilization, reactor heat management). Focuses on bioprocess economics and upstream unit operations, principally bioreactor design. The application of computer programming and numerical methods to solve these problems is interwoven throughout the course.This is the first of a two-semester course series.

CHME 7601. Pharmaceutical Engineering II. (4 Hours)
Continues a two-semester course series to introduce the fundamental principles of chemical engineering as applied to biopharmaceutical manufacturing, with an emphasis on quantitative problem solving. Covers critical aspects of fluid flow (e.g., pipe/pump sizing, centrifugation); mass transfer (diafiltration, oxygen sparging, membrane fouling); and thermodynamics (partitioning of analytes in chromatography). Focuses on downstream separation unit operations within biopharmaceutical production. Applies computer programming and numerical methods to solve these problems.

Prerequisite(s): CHME 7600 with a minimum grade of C-

CHME 7602. Pharmaceutical Engineering Laboratory. (2 Hours)
Offers students an opportunity to apply and reinforce the theory they have learned in their pharmaceutical engineering coursework in a hands-on laboratory setting by producing and purifying a recombinant protein from cell culture. In a series of lab modules, teams of students set up, operate, and analyze bioreactors for bacterial and mammalian cell culture, as well as harvest and lyse cells, and finally purify and analyze protein using state-of-the-art filtration and chromatography processes. Requires submission of interim laboratory reports, documentation of experimental work, and a final report and presentation with a detailed proposal for how to improve upon the results obtained.

Prerequisite(s): CHME 7601 with a minimum grade of C-

CHME 7901. Journal Club in Chemical Engineering. (1 Hour)
Offers students an opportunity to critically read, interpret, and present published data; to discuss the strengths and weaknesses of publications; and to interpret and critically evaluate published scientific data in a student-led journal club that cover topics related to chemical engineering.

CHME 7962. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

CHME 7973. Special Topics in Chemical Engineering. (1-4 Hours)
Focuses on topics related to chemical engineering to be selected by the instructor.

CHME 7978. Independent Study. (1-4 Hours)
Offers theoretical or experimental work under individual faculty supervision. May be repeated without limit.

CHME 7986. Research. (0 Hours)
Offers students an opportunity to conduct full-time research under faculty supervision.

CHME 7990. Thesis. (1-4 Hours)
Offers analytical and/or experimental work conducted under the direction of the faculty in fulfillment of the requirements for the degree. First-year students must attend a graduate seminar program that introduces the students to the methods of choosing a research topic, conducting research, and preparing a thesis. Successful completion of the seminar program is required. May be repeated without limit.

CHME 7996. Thesis Continuation. (0 Hours)
Continues thesis work conducted under the supervision of a departmental faculty.

CHME 8960. Candidacy Preparation—Doctoral. (0 Hours)
Offers students an opportunity to prepare for the PhD qualifying exam under faculty supervision. Intended for students who have completed all required PhD course work and have not yet achieved PhD candidacy; students who have not completed all required PhD course work are not allowed to register for this course. May be repeated once.

CHME 8984. Research. (1-4 Hours)
Offers an opportunity to conduct research under faculty supervision. May be repeated without limit.

CHME 8986. Research. (0 Hours)
Offers an opportunity to conduct full-time research under faculty supervision. May be repeated without limit.

CHME 9000. PhD Candidacy Achieved. (0 Hours)
Indicates successful completion of program requirements for PhD candidacy.

CHME 9984. Research. (1-4 Hours)
Offers an opportunity to conduct research under faculty supervision. May be repeated without limit.

CHME 9986. Research. (0 Hours)
Offers an opportunity to conduct full-time research under faculty supervision. May be repeated without limit.

CHME 9990. Dissertation Term 1. (0 Hours)
Offers theoretical and experimental work conducted under the supervision of a departmental faculty.

Prerequisite(s): CHME 9000 with a minimum grade of S

CHME 9991. Dissertation Term 2. (0 Hours)
Offers dissertation supervision by members of the department.

Prerequisite(s): CHME 9990 with a minimum grade of S

CHME 9996. Dissertation Continuation. (0 Hours)
Continues thesis work conducted under the supervision of a departmental faculty.

Prerequisite(s): CHME 9990 with a minimum grade of S or Dissertation Check with a score of REQ