Chemical Engineering (CHE)

CHE 205 Chemical Process Principles (4 credit hours)
Engineering methods of treating material balances, stoichiometry, phase equilibrium calculations, thermophysics, thermochemistry and the first law of thermodynamics. Introduction to equation solving packages and spreadsheets for solving problems related to chemical engineering calculations.

Prerequisite: Grade of C or better in MA 241, PY 205, and (CH 201 or CH 221 or CH 225)
Typically offered in Fall, Spring, and Summer

CHE 225 Introduction to Chemical Engineering Analysis (3 credit hours)
Introduction of mathematical and computational tools for analyzing chemical engineering problems. Sequential modular and equation-based simulation of steady-state chemical processes using advanced spreadsheet methods and multivariate root-finding algorithms. Material and energy balances on transient processes and their solution using analytical and numerical methods. Introduction to microscopic material and energy balances using the "shell balance" approach to develop the governing differential equations. Solutions to steady-state boundary value problems in heat conduction and Fickian diffusion.

Prerequisite: C- or better in CHE 205 and MA 242; Corequisite: MA 341
Typically offered in Fall, Spring, and Summer

CHE 311 Transport Processes I (3 credit hours)
Fundamental aspects of momentum and heat transfer, and the use of these fundamentals in solving problems in transport operations.

Prerequisite: Grade of C- or better in both CHE 225 and MA 341
Typically offered in Fall and Spring

CHE 312 Transport Processes II (3 credit hours)
Fundamental aspects of mass transfer and the use of these basic principles in solving problems in transport operations.

Prerequisite: Grade of C- or better in CHE 311
Typically offered in Fall and Spring

CHE 315 Chemical Process Thermodynamics (3 credit hours)
Laws of thermodynamics and their application to chemical engineering problems, both in theory and in practice. Criteria of equilibrium in physical and chemical changes. Behavior of real fluids, including mixtures.

Prerequisite: Grade of C- or better in CHE 225
Typically offered in Fall and Spring

CHE 316 Thermodynamics of Chemical and Phase Equilibria (3 credit hours)
Systematic study of chemical reaction equilibria and phase equilibria. Use of fugacity, activity and chemical potential concepts for predicting the effect of such variables as temperature, pressure on equilibrium compositions. Methods for measuring and estimating thermodynamic properties important to equilibrium calculation in real systems.

Prerequisite: Grade of C- or better in CHE 315
Typically offered in Fall and Spring

CHE 330 Chemical Engineering Lab I (4 credit hours)
Laboratory experiments in unit operations of heat transfer and fluid flow. Laboratory safety, technical report writing, statistics, experimental design, error analysis and instrumentation.

Prerequisite: CHE 311
Typically offered in Fall and Spring

CHE 331 Chemical Engineering Lab II (2 credit hours)
Laboratory experiments in mass transfer and reaction kinetics. Experimental planning, technical report writing and oral presentations are emphasized.

Prerequisite: CHE 312, CHE 330
Typically offered in Fall and Spring

CHE 395 Professional Development Seminar (1 credit hours)
Professional development and topics of current interest in chemical engineering.

Typically offered in Fall and Spring

CHE 435/TE 435 Process Systems Analysis and Control (3 credit hours)
Dynamic analysis and continuous control of chemical and material engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques.

Prerequisite: (MA 341 and TE 205) or CHE 312
Typically offered in Spring only

CHE 446 Design and Analysis of Chemical Reactors (3 credit hours)
Characterization and measurement of the rates of homogeneous and heterogeneous reactions. Design and analysis of chemical reactors. Credit cannot be received for both CHE 446 and CHE 546.

Prerequisite: CHE 316
Typically offered in Fall only

CHE 447 Bioreactor Engineering (3 credit hours)
Design and analysis of chemical reactors with emphasis on enzyme-catalyzed reactions, microbial fermentation, and animal cell culture. Empirical kinetics of enzymatic reactions and cell growth. Design and scale-up of suspension bioreactors. Immobilized-enzyme and immobilized-cell bioreactors, including the classical Thiele reaction-diffusion analysis.

Prerequisite: CHE 312 and CHE 316; Corequisite: BCH 451
Typically offered in Fall only

CHE 448/BEC 448/BEC 548/CHE 548 Bioreactor Design (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.

Prerequisite CHE 446 or instructor permission; Co-requisite BCH 451 or instructor permission
Typically offered in Spring only

CHE 450 Chemical Engineering Design I (3 credit hours)
Applications of cost accounting, cost estimation for new equipment, manufacturing cost and measures of profitability. Use of computer simulation design and cost programs. Procedures for sizing unit operations commonly encountered in the chemical process industry. Heuristics for selection of separation processes and heat exchanger network synthesis.

Prerequisite: CHE 312; Corequisite: CHE 446 or CHE 447
Typically offered in Fall only

CHE 451 Chemical Engineering Design II (3 credit hours)
Chemical process design and optimization. The interplay of economic and technical factors in process development, site selection, project design, and production management. Comprehensive design problems.

Prerequisite: CHE 450, and (CHE 446 or CHE 447)
Typically offered in Spring only

CHE 452/CHE 552 Biomolecular Engineering (2 credit hours)
This course will cover modern methods in biomolecule design, including gene expression regulators, RNA structure, protein structure, and metabolic networks. Current methods in genetic engineering and 'omics-based analysis will be discussed, followed by a critical review of current literature on the applications of these methods to engineering microbes, cells, and multi-species communities. Hands-on assignments involving computational design will be included.

Corequisites: CHE 448 and BCH 451
Typically offered in Spring only

CHE 460/CHE 560 Chemical Processing of Electronic Materials (3 credit hours)
This course is an introduction to electronic materials, chemical processes used in their fabrication, and basic physical principles of electronic device operation and function. The course will address how principles of chemical engineering are applied to design and fabricate current and emerging electronic systems. We will also discuss emerging areas of electronic technologies, including organic semiconductors, advanced energy conversion, and quantum computing and related systems. Credit for both CHE 460 and CHE 560 is not allowed.

Prerequisite: CHE 446 or permission of instructor
Typically offered in Spring only

CHE 461 Polymer Sciences and Technology (3 credit hours)
Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.

Prerequisite: (CH 223 or CH 227) and CHE 316
Typically offered in Fall only

CHE 462/CHE 562/BEC 462/BEC 562 Fundamentals of Bio-Nanotechnology (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.

Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

CHE 463/BEC 463/CHE 563/BEC 563 Fermentation of Recombinant Microorganisms (2 credit hours)
Students completing this course will be able to conduct small-scale fermentations of recombinant microorganisms as well as having an understanding of ways to approach optimization of such processes. One of the focus areas of this course is on protein production and factors that affect gene expression and recombinant protein yield.

P: CH 223 or CH 227; C: BIT 410 or BIT 510 or BCH 452 or MB 352 or MB 354 or BEC 425 or BEC 525
Typically offered in Fall and Spring

CHE 465 Colloidal and Nanoscale Engineering (3 credit hours)
The first part of this course will present the fundamentals of nanoscale colloidal processes, including interactions and self-assembly of particles, surfactants and biomolecules. The applications of these fundamentals to the nanotechnology and engineering on the nanoscale will be discussed. The nanoscience has led to the development of many new technologies with relevance to chemical engineering, including microfluidics, lab-on-a-chip, bioarrays and bioassays. These emerging technologies will be presented and discussed in the second half of this course.

Prerequisite: C- or better in CHE 311 and CHE 315.
Typically offered in Fall and Spring
This course is offered alternate odd years

CHE 467 Polymer Rheology (3 credit hours)
Theoretical principles and experimental techniques associated with flow and deformation of polymer systems. Systems include: meffs and solutions, suspension, gels, emulsions, and thixotropic materials.

Prerequisite: CHE 311
Typically offered in Spring only

CHE 468/CHE 568/ECE 568/ECE 468 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.

Prerequisite: E 304
Typically offered in Fall only

CHE 472/CHE 572/BEC 472/BEC 572 Drug Delivery - Theory and Modern Practices (3 credit hours)
The course discusses conventional and advanced drug delivery methods and systems and modern practices in drug delivery manufacturing.

P: CH 221 or CH 225 AND MA 131 or MA 141
Typically offered in Spring only

CHE 475/CHE 575 Advances in Pollution Prevention: Environmental Management for the Future (3 credit hours)
Design of industrial processes which minimize or eliminate wastes. Regulations and the corporate organization of current pollution prevention efforts. Current pollution prevention research. Product life cycle analysis and the application to design of more efficient processes.

Prerequisite: PY 208, MA 341
Typically offered in Spring only

CHE 488/BEC 588/CHE 588/BEC 488 Animal Cell Culture Engineering (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.

Prerequisite: BEC 463 or CHE 563 or BEC 363 or BEC 440/540 or BEC 441/541 or equivalent; or consent of instructor.
Typically offered in Spring only

CHE 495 Honors Thesis Preparation (1 credit hours)
Development and presentation of Honors Thesis in Chemical Engineering and discussion of graduate school selection and preparation.

Prerequisite: CHE 497, Senior standing
Typically offered in Spring only

CHE 497 Chemical Engineering Projects I (3 credit hours)
Introduction to chemical engineering research through experimental, theoretical and literature studies. Oral and written presentation of reports.

Prerequisite: Junior standing
Typically offered in Fall, Spring, and Summer

CHE 498 Chemical Engineering Projects II (1-3 credit hours)
Projects in research, design or development in various areas of chemical engineering.

Prerequisite: Junior standing
Typically offered in Fall, Spring, and Summer

CHE 525 Process System Analysis and Control (3 credit hours)
Dynamic analysis and continuous control of chemical engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques. Credit for both CHE 425 and CHE 525 is not allowed.

Prerequisite: CHE 312
Typically offered in Spring only

CHE 531 Chemical Engineering Core Concepts I (3 credit hours)
This online/hybrid chemical engineering bridging course is part of a comprehensive two-course sequence (three credits each) consisting of core undergraduate level chemical engineering topics. This homework-intensive course is designed to prepare students with backgrounds in chemistry, biology and other non-chemical engineering subjects for graduate study in chemical engineering. It is not equivalent to a four-year degree in chemical engineering, but the proposed course is designed to help students obtain the additional knowledge and skills to successfully undertake graduate classes offered by a chemical engineering program.

Prerequisite: Graduate Standing
Typically offered in Fall and Spring

CHE 532 Chemical Engineering Core Concepts II (3 credit hours)
This online/hybrid chemical engineering bridging course is part of a comprehensive two-course sequence (three credits each) consisting of core undergraduate level chemical engineering topics. This homework-intensive course is designed to prepare students with backgrounds in chemistry, biology and other non-chemical engineering subjects for graduate study in chemical engineering. It is not equivalent to a four-year degree in chemical engineering, but the proposed course is designed to help students obtain the additional knowledge and skills to successfully undertake graduate classes offered by a chemical engineering program.

Prerequisite: Graduate Standing
Typically offered in Spring and Summer

CHE 543 Polymer Science and Technology (3 credit hours)
Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.

Prerequisite: CHE 223, CHE 316
Typically offered in Fall and Summer
This course is offered alternate years

CHE 546 Design and Analysis of Chemical Reactors (3 credit hours)
Characterization and measurement of rates of homogeneous and heterogeneous reactions. Design and analysis of chemical reactors. Credit for both CHE 446 and CHE 546 is not allowed.

Prerequisite: CHE 316
Typically offered in Fall only

CHE 548/CHE 448/BEC 448/BEC 548 Bioreactor Design (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.

Prerequisite CHE 446 or instructor permission; Co-requisite BCH 451 or instructor permission
Typically offered in Spring only

CHE 551 Biochemical Engineering (3 credit hours)
Enzyme and microbial kinetics and reactor designs for processes involving enzymes and single and mixed cultures. Samples drawn from full range of applications: food processing, single cell proteins, tissue culture and vaccines, monoclonal antibodies, recombinant DNA and hybridomas, artificial organs, biological waste treatment and environmental processes.

Prerequisite: CHE 312 and (CHE 446 or CHE 447)
Typically offered in Spring only

CHE 552/CHE 452 Biomolecular Engineering (2 credit hours)
This course will cover modern methods in biomolecule design, including gene expression regulators, RNA structure, protein structure, and metabolic networks. Current methods in genetic engineering and 'omics-based analysis will be discussed, followed by a critical review of current literature on the applications of these methods to engineering microbes, cells, and multi-species communities. Hands-on assignments involving computational design will be included.

Corequisites: CHE 448 and BCH 451
Typically offered in Spring only

CHE 560/CHE 460 Chemical Processing of Electronic Materials (3 credit hours)
This course is an introduction to electronic materials, chemical processes used in their fabrication, and basic physical principles of electronic device operation and function. The course will address how principles of chemical engineering are applied to design and fabricate current and emerging electronic systems. We will also discuss emerging areas of electronic technologies, including organic semiconductors, advanced energy conversion, and quantum computing and related systems. Credit for both CHE 460 and CHE 560 is not allowed.

Prerequisite: CHE 446 or permission of instructor
Typically offered in Spring only

CHE 562/BEC 462/BEC 562/CHE 462 Fundamentals of Bio-Nanotechnology (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.

Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

CHE 563/BEC 563/CHE 463/BEC 463 Fermentation of Recombinant Microorganisms (2 credit hours)
Students completing this course will be able to conduct small-scale fermentations of recombinant microorganisms as well as having an understanding of ways to approach optimization of such processes. One of the focus areas of this course is on protein production and factors that affect gene expression and recombinant protein yield.

P: CH 223 or CH 227; C: BIT 410 or BIT 510 or BCH 452 or MB 352 or MB 354 or BEC 425 or BEC 525
Typically offered in Fall and Spring

CHE 568/ECE 568/ECE 468/CHE 468 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.

Prerequisite: E 304
Typically offered in Fall only

CHE 572/BEC 472/BEC 572/CHE 472 Drug Delivery - Theory and Modern Practices (3 credit hours)
The course discusses conventional and advanced drug delivery methods and systems and modern practices in drug delivery manufacturing.

P: CH 221 or CH 225 AND MA 131 or MA 141
Typically offered in Spring only

CHE 575/CHE 475 Advances in Pollution Prevention: Environmental Management for the Future (3 credit hours)
Design of industrial processes which minimize or eliminate wastes. Regulations and the corporate organization of current pollution prevention efforts. Current pollution prevention research. Product life cycle analysis and the application to design of more efficient processes.

Prerequisite: PY 208, MA 341
Typically offered in Spring only

CHE 577/BEC 577 Advanced Biomanufacturing and Biocatalysis (3 credit hours)
Overview of biomanufacturing using microorganisms (bacteria, yeast, fungi), eukaryotic cells (hybridomas, insect, plant, CHO) and recombinant enzymes focusing on methods used in industry. Course will emphasize process design for optimization of heterologous protein expression, metabolic/cell line engineering, metabolomics, protein engineering to alter enzymes and antibodies. Pathway engineering strategies include developing microbes to produce new therapeutic compounds or overproduce primary metabolites, antibiotics, biotherapeutics, therapeutic enzymes, diagnostics, recombinant vaccines, and biopharmaceuticals. Utilization of immobilized biocatalysts, and microbial kinetics are covered.

Graduate standing in engineering or life-science graduate program
Typically offered in Spring only

CHE 588/BEC 488/CHE 488/BEC 588 Animal Cell Culture Engineering (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.

Prerequisite: BEC 463 or CHE 563 or BEC 363 or BEC 440/540 or BEC 441/541 or equivalent; or consent of instructor.
Typically offered in Spring only

CHE 596 Special Topics in Chemical Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CHE 597 Chemical Engineering Projects (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

CHE 601 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

CHE 610 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

CHE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall only

CHE 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall and Spring

CHE 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall only

CHE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Spring and Summer

CHE 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CHE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

CHE 697 Advanced Chemical Engineering Projects (1-12 credit hours)
Independent study of some phase of chemical engineering or related field.

Prerequisite: Graduate standing in CHE
Typically offered in Summer only

CHE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Summer only

CHE 701 Introduction to Chemical Engineering Research (2 credit hours)
Introduction to graduate research guidelines and practices. Topics include research ethics, electronic literature searching, research proposal structure, technical writing styles, research problem identification, advisor expectations, intellectual property and patents, laboratory notebooks, proposal creation and oral presentation. Graduate standing in chemical engineering or permission of instructor.

Typically offered in Fall only

CHE 702 Chemical Engineering Research Proposition (2 credit hours)
Preparation of a professional quality chemical engineering research proposal. Includes selecting a novel research topic, drafting and finalizing the proposal according to NSF formats, and orally presenting and defending the proposal to a faculty advisory committee. Ethics in proposal preparation.

Prerequisite: CHE 701
Typically offered in Spring only

CHE 711 Chemical Engineering Process Modeling (3 credit hours)
Applications of methods of mathematical analysis to formulation and solution of problems in transport phenomena, process dynamics and chemical reaction engineering.

Prerequisite: (CHE 312, MA 301 or MA 341) or equivalent
Typically offered in Fall only

CHE 713 Thermodynamics I (3 credit hours)
In-depth coverage of chemical engineering thermodynamics principles. Application of non-ideal fluid-phase chemical potentials to problems in phase and chemical reaction equilibria. Relations of molecular structure and intermolecular forces to macroscopic thermodynamic properties.

Prerequisite: CHE 316 or equivalent
Typically offered in Fall only

CHE 715 Transport Phenomena (3 credit hours)
A theoretical unified study of transport of momentum, energy and matter. Introduction to diffusional operations including coupled heat and mass transfer in light of the theory.

Prerequisite: CHE 311 or equivalent
Typically offered in Spring and Summer

CHE 717 Chemical Reaction Engineering (3 credit hours)
Rates and mechanisms of homogeneous and heterogeneous reactions. Design, analysis and scale-up of batch and continuous chemical reactors.

Prerequisite: CHE 446 or CHE 447 or equivalent
Typically offered in Fall only

CHE 718 Advanced Chemical Reaction Engineering (3 credit hours)
Topics relating to design, analysis and operation of homogeneous and heterogeneous chemical reactors.

Prerequisite: CHE 717
This course is offered alternate years

CHE 719 Electrochemical Systems Analysis (3 credit hours)
Electrochemical thermodynamics, electrochemical kinetics and catalysis, coupled charge and material transport in an electric field and electrophoretic effects. Design and analysis of electrochemical reactors. Survey of electrochemical industry.

Prerequisite: CHE 715, 717
Typically offered in Spring only
This course is offered alternate years

CHE 752 Separation Processes For Biological Materials (3 credit hours)
Definition and engineering analysis of major bioseparation techniques useful in product isolation and purification. Solid-liquid separation, crystallization, filtration, extraction, chromatography, membrane processes, distillation, drying, combined operations and process economics.

Prerequisite: CHE 721 or CHE 551
This course is offered alternate years

CHE 761/MSE 761 Polymer Blends and Alloys (3 credit hours)
Thermodynamics, morphological characteristics and properties of multiphase polymer systems composed of homopolymers or copolymers. Interfacial characteristics and modification of multicomponent polymer blends through emulsification and reactive blending. Microphase ordering in block copolymers, and emerging technolgies employing these nanostructured materials. Conformational properties and dynamics of macromolecules constrained near an interface.

Prerequisite: CHE 316 or MAT 301
Typically offered in Fall only
This course is offered alternate odd years

CHE 775 Multi-Scale Modeling of Matter (3 credit hours)
Current methods for modeling liquids, soft matter (polymers, surfactant solutions, colloids, liquid crystals, etc), nano-structured materials (nanoparticles, nano-composites, nano-porous materials, etc.), biomolecular systems, and reacting systems at the electronic, atomistic, meso-scale and continuum levels. Graduate level thermodynamics and differential and integral calculus required.

Prerequisite: Graduate level thermodynamics, and differential and integral calculus
Typically offered in Spring only
This course is offered alternate even years

CHE 796 Special Topics In Chemical Engineering (1-6 credit hours)
Directed reading of chemical engineering literature, introduction to research methodology, and lectures and seminar discussion on topics which vary from term to term.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

CHE 797 Chemical Engineering Projects (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.

Prerequisite: Graduate standing
Typically offered in Fall only

CHE 798 Advanced Chemical Engineering Projects (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.

Prerequisite: Graduate standing in CHE
Typically offered in Fall, Spring, and Summer

CHE 801 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

CHE 810 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

CHE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

CHE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Spring only

CHE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CHE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CHE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CHE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer