Department of Chemical Engineering

Chemical engineers contribute to society through the useful application of knowledge and understanding of chemistry, physics, biology, and mathematics. Chemical engineers traditionally have participated in many decisions crucial to the preservation and improvement of society, including energy, fuel, commodity chemical and food production, resource management, and the design of necessary pollution control measures. Emerging new areas such as biotechnology, space technology, nanofabrication technology, semiconductor devices and modern construction materials also utilize the unique capabilities of the chemical engineer. Many technologies to improve public health depend significantly on chemical engineering such as biomaterials, biomedical devices, medical diagnostics, the chemical design and synthesis of drugs, the genetic engineering of therapeutic materials, drug delivery systems and medical imaging technology. Finally, chemical engineering plays an essential role in important environmental technologies such as atmospheric chemistry, product life cycle analysis, bioremediation, environmental risk and impact analysis, environmentally friendly manufacturing technology and products, separation and conversion technologies for waste reduction and the cleanup of contaminated sites.

The instructional mission of the department is to provide its chemical engineering graduates with the tools, skills and competencies necessary to understand and apply today's technologies and, through life-long learning, successfully develop and employ tomorrow's technologies.

The Program Educational Objectives and Student Outcomes can be found at the following URL: https://eng.auburn.edu/chen/academics/undergraduate/educational-outcomes.html

Because of their broad training and education, chemical engineers contribute to society in many functions, such as pure research, development, environmental protection, process design, plant operation and manufacturing, marketing, sales, and corporate or government administration.

The program is specially designed to assure all students have demonstrated capabilities in the core chemical engineering topics including material and energy balances, thermodynamics, chemical equilibria, heat, mass and momentum transfer, chemical reaction engineering, continuous and stagewise separation operations, process dynamics, statistics and control. The design experience is interwoven throughout the curriculum from elementary design principles in material and energy balances to the capstone senior process design and process control sequence employing advanced computer process and control simulators and experimental control systems.

The curriculum is specifically designed to enable graduates to model and design chemical and physical processes, design and conduct experiments, analyze and interpret chemical engineering data, and to determine capital and operating costs for chemical and physical processes. The curriculum prepares graduates to understand the need for professional integrity and ethical decision making in the practice of chemical engineering as well as providing an understanding of contemporary issues including business practices, environmental, health, and safety and other public interests. Students are also prepared for graduate study in chemical engineering, medicine, business and law.

Because of the breadth of chemical engineering opportunities, the department offers a number of specially designed program specializations that provide unique training and course selection to those students who wish to concentrate in a particular area or technology. The current program specializations are biochemical engineering, biomedical engineering, computer-aided chemical engineering, environmental chemical engineering, pre-medicine specialization and pulp, paper and bio-resource engineering.

Biochemical Engineering Specialization

Chemical engineers trained in biochemical engineering and biotechnology are the key to successful commercialization of new biologically based processes ranging from high value pharmaceuticals to new food processes. This program specialization provides a strong biology and chemistry fundamental background for graduate work in biochemical engineering and a plan of study to meet these objectives.

Students in this specialization take CHEN 5800 and Biochemical Engineering Technical Electives (9 hours). These courses replace Technical Electives I-IV.

Biomedical Engineering Specialization

This specialization provides the necessary preparation for students wanting to do graduate work in biomedical engineering or work in a career with an emphasis of medical applications of chemical engineering.

Students in this specialization take:

Code	Title	Hours
PHIL 1030	Ethics And The Health Sciences	3
CHEN 5810	Biomedical Engineering	3
or CHEN 5970	Adv Special Tops In Chem Engr	
Biomedical Engineering Technical Electives		9

In the table above CHEN 5970 is listed as Advanced Special Topics in Chemical Engineering, which is the generic title for CHEN 5970. Students in this specialization are required to take either CHEN 5810 Biomedical Engineering or CHEN 5970 with the specific title Cell & Tissue Engineering. These courses replace Technical Electives I-IV and PHIL 1040.

Computer-Aided Chemical Engineering Specialization

Chemical engineers with expertise in the application of advanced computer-aided tools in areas like process systems engineering, process control, and advanced process technology are highly sought after by all process industries. The program specialization provides appropriate courses for an individual with interests in advanced use of computers for solving chemical and biological engineering problems.

Students in this specialization take Computer-Aided Chemical Engineering Technical Electives (12 hours). These courses replace Technical Electives I-IV.

Environmental Chemical Engineering Specialization

The environmental specialization in chemical engineering prepares students for careers in the expanding environmental arena. Students specializing in this area learn about the chemical processes and reactions that affect the environment, pollution prevention, the latest standards for air, water and land quality, as well as hazardous materials management. This specialization prepares students for environmental positions in a broad range of manufacturing and service industries all of which must comply with increasingly complex environmental standards, and in various state and federal agencies.

Students in this specialization take Environmental Chemical Engineering Technical Electives (12 hours). These courses replace Technical Electives I-IV.

Pre-Medicine Specialization

This specialization provides the necessary preparation for students wanting to go to medical school. A Pre-Med series of courses, when completed, provides a chemical engineering degree while simultaneously meeting medical school requirements.

Students in this specialization take:

Code	Title	Hours
PHIL 1030	Ethics And The Health Sciences	3
CHEM 2081	Organic Chemistry II Lab	1
BCHE 5180	Biochemistry I	3
CHEN 5810	Biomedical Engineering	3
or CHEN 5970	Adv Special Tops In Chem Engr	
Pre-Medicine Technical Electives		5

In the table above CHEN 5970 is listed as Advanced Special Topics in Chemical Engineering, which is the generic title for CHEN 5970. Students in this specialization are required to take either CHEN 5810 Biomedical Engineering or CHEN 5970 with the specific title Cell & Tissue Engineering. These courses replace Technical Electives I-IV and PHIL 1040. Students in this program specialization who are interested in medical school must also work with the director for Pre-Health Professions in the College of Science and Mathematics.

Pulp, Paper and Bio-Resource Engineering Specialization

This specialization prepares students for challenging and rewarding careers in the pulp, paper and bio-resource industries. These industries are unique in being capable of sustainable development with a renewable raw material base, recyclable products, and processing technology able to achieve energy self-sufficiency and environmental compatibility. This specialization prepares students for a broad range of career paths in process engineering, product development, biotechnology and sustainable engineering.

Students in this specialization take:

Code	Title	Hours
CHEM 2081	Organic Chemistry II Lab	1
CHEN 4100	Pulp And Paper Processing Lab	2
CHEN 5090	Pulp and Paper Technology	3
CHEN 5110	Pulp And Paper Engineering	3
CHEN 5800	Biochemical Engineering	3

These courses replace Technical Electives I-IV.

Majors

- Chemical Engineering (http://bulletin.auburn.edu/undergraduate/samuelginncollegeofengineering/departmentofchemicalengineering/chemicalengineering_major/)

Undergraduate Certificates

- Pulp, Paper, and Bio-Resources Engineering (http://bulletin.auburn.edu/undergraduate/samuelginncollegeofengineering/departmentofchemicalengineering/pulp_paper_bio-resources_eng_ucrt/)

Courses

CHEN 1000 CONCEPTS OF CHEMICAL ENGINEERING: THE DESIGN OF COFFEE (3) LEC. 2. LAB. 2. This course is an introduction to chemical engineering concepts and approaches to innovation and problem solving. Qualitative overviews are presented for principles and practices of engineering analysis and design, with corresponding hands-on laboratories applying the concepts to processes for roasting and brewing coffee. The course is intended as a free elective for all majors.

CHEN 1007 HONORS CONCEPTS OF CHEMICAL ENGINEERING: THE DESIGN OF COFFEE (3) LEC. 2. LAB. 2. This course is an introduction to chemical engineering concepts and approaches to innovation and problem solving. Qualitative overviews are presented for principles and practices of engineering analysis and design, with corresponding hands-on laboratories applying the concepts to processes for roasting and brewing coffee. The course is intended as a free elective for all majors.

CHEN 2100 PRINCIPLES OF CHEMICAL ENGINEERING (4) LEC. 3. LAB. 3. Pr. (CHEM 1110 or CHEM 1117 or CHEM 1030 or CHEM 1033) and (MATH 1610 or MATH 1613 or MATH 1617) and (P/C CHEM 1120 or P/C CHEM 1127 or P/C CHEM 1040 or P/C CHEM 1043) and (P/C MATH 1620 or MATH 1623 or P/C MATH 1627) and (P/C PHYS 1600 or P/C PHYS 1607). Application of multicomponent material and energy balances to chemical processes involving phase changes and chemical reactions.

CHEN 2110 CHEMICAL ENGINEERING THERMODYNAMICS (3) LEC. 3. Pr. (CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117) and (MATH 1620 or MATH 1623 or MATH 1627) and (CHEN 2100) and (P/C PHYS 1600 or P/C PHYS 1607) and (P/C CHEN 2650). This course is intended to comprehensively introduce the thermodynamics of single- and multi-phase, pure systems, including the first and second laws of thermodynamics, equations of state, simple processes and cycles, and their applications in chemical engineering. CHEN 2100 requires a grade of C or better.

CHEN 2610 TRANSPORT I (3) LEC. 3. Pr. (PHYS 1600 or PHYS 1607) and CHEN 2100 and (P/C MATH 2630 or P/C MATH 2637) and (P/C ENGR 2010 or P/C CHEN 2110). CHEN 2100 requires a grade of C or better. Introduction to fluid statics and dynamics; dimensional analysis; compressible and incompressible flows; design of flow systems, introduction to fluid solids transport including fluidization, flow through process media and multiphase flows.

CHEN 2650 CHEMICAL ENGINEERING APPLICATIONS OF MATHEMATICAL TECHNIQUES (3) LEC. 3. Pr. CHEN 2100 and P/C CHEN 2610 and (P/C MATH 2630 or P/C MATH 2637) and P/C MATH 2650 and (COMP 1200 or COMP 1220 or COMP 1230). CHEN 2100 requires a grade of C or better. CHEN 2610 and MATH 2650 are Prerequisites with Concurrency. Application of a broad range of mathematical techniques to chemical engineering problems. Emphasis on engineering significance and interpretation of mathematical operations.

CHEN 2AA0 CHEMICAL ENGINEERING PROGRESS ASSESSMENT I (0) LAB. SU. Pr. CHEN 2100. Progress assessment examination in basic science, general chemistry, physics, basic math principles (geometry, algebra), multivariable calculus, chemical engineering process principles (mass and energy balances). CHEN 2100 requires a grade of C or better. Course may be repeated with change in topics.

CHEN 3370 PHASE AND REACTION EQUILIBRIA (3) LEC. 3. Pr. (MATH 2630 or MATH 2633 or MATH 2637) and (ENGR 2010 or CHEN 2110) and CHEN 2100 and P/C CHEN 3600 and P/C CHEN 2650. Molecular thermodynamics of phase and chemical reaction equilibria including non-ideal thermodynamics and multicomponent applications. ((ENGR 2010 or CHEN 2110) and CHEN 2100 require a grade of C or better.)

CHEN 3600 COMPUTER-AIDED CHEMICAL ENGINEERING (3) LEC. 2. LAB. 3. Pr. (COMP 1200 or COMP 1220 or COMP 1230) and MATH 2650 and CHEN 2610 and P/C CHEN 2650 and (MATH 2630 or MATH 2637) and (ENGR 2010 or CHEN 2110) and CHEN 2100. CHEN 2650 is prerequisite with concurrency. General and structured programming concepts, numerical methods, and introductory probability and statistics concepts. Application to chemical engineering problems involving material and energy balances and transport process, data validation, and analysis. (CHEN 2100 and (CHEN 2110 or ENGR 2010) and CHEN 2610 all require a grade of C or better.)

CHEN 3620 TRANSPORT II (3) LEC. 3. Pr. (MATH 2630 or MATH 2633 or MATH 2637) and (ENGR 2010 or CHEN 2110) and CHEN 2610 and P/C CHEN 3600 and MATH 2650 and P/C CHEN 2650. Fundamentals and applications of heat and mass transfer in chemical processes including conduction, convection, and radiation, heat exchange, evaporation, chemical reaction gas absorption, drying and humidification. ((ENGR 2010 or CHEN 2110) and CHEN 2610 require a grade of C or better.)

CHEN 3650 CHEMICAL ENGINEERING ANALYSIS (3) LEC. 2. LAB. 3. Pr. CHEN 2650 and CHEN 3600 and CHEN 3620 and CHEN 2AA0 and MATH 2650 and P/C CHEN 3700. CHEN 2650, CHEN 3600 and CHEN 3620 all require a grade of C or better. Mathematical modeling, analytical, numerical and statistical analysis of chemical processes.

CHEN 3660 CHEMICAL ENGINEERING SEPARATIONS (3) LEC. 3. Pr. CHEN 3370 and CHEN 3620 and CHEN 3600. Separations processes including distillation, extraction, membrane separation, and other separation operations. (CHEN 3370, CHEN 3600, and CHEN 3620 all require a grade of C or better.)

CHEN 3700 CHEMICAL REACTION ENGINEERING (3) LEC. 3. Pr. MATH 2650 and CHEN 2610 and (ENGR 2010 or CHEN 2110) and P/C CHEN 3620 and P/C CHEN 3600. Design of chemical reactors with homogeneous reaction systems. CHEN 2610 and (ENGR 2010 or CHEN 2110) require a grade of C or better.

CHEN 3820 CHEMICAL ENGINEERING LABORATORY I (2) LEC. 1. LAB. 3. Pr. CHEN 3600 and CHEN 3620 and MATH 2650. Experimental study of chemical thermodynamics, heat and momentum transfer with analytical, numerical, and statistical analysis. CHEN 3600 and CHEN 3620 require a grade of C or better.

CHEN 3AA0 CHEMICAL ENGINEERING PROGRESS ASSESSMENT II (0) LAB. SU. Pr. CHEN 2AA0 and P/C CHEN 3370 and P/C CHEN 3650 and P/C CHEN 3700 and P/C CHEN 3660 and CHEN 2650. Progress assessment examination in thermodynamics, linear differential equations, organic chemistry, transport phenomena (fluid mechanics, heat, mass transfer), phase and reaction equilibria, reaction engineering, design and conduction of experiments, analysis and interpretation of data, professional, ethical, societal and contemporary issues. CHEN 2650 requires a grade of C or better. Course may be repeated with change in topics.

CHEN 4100 PULP AND PAPER PROCESSING LABORATORY (2) LAB. 6. Pr. CHEN 5090 or Departmental approval. Experimental study of pulping and papermaking operations.

CHEN 4170 DIGITAL PROCESS CONTROL (3) LEC. 3. Pr. (CHEN 3650 or CHEN 3653) and CHEN 3600 and CHEN 3660. Introduction of basic concepts and principles for control system. Analysis of open loop and closed-loop processes using transfer functions. CHEN 3600, CHEN 3650, and CHEN 3660 all require a grade of C or better.

CHEN 4450 PROCESS ECONOMICS AND SAFETY (3) LEC. 2. LAB. 3. Pr. (CHEM 2080 or CHEM 2087) and CHEN 3370 and (CHEN 3650 or CHEN 3653) and CHEN 3660 and CHEN 3700 and CHEN 3600. Fundamentals and applications of process economics and design, computer-aided cost estimation, profitability analysis and process improvement. Application of chemical process safety, risk assessment and management, hazard and operability analysis, chemical engineering principles for risk reduction. (CHEN 3370, CHEN 3600, CHEN 3650, CHEN 3660 and CHEN 3700 require a grade of C or better).

CHEN 4460 PROCESS SIMULATION SYNTHESIS AND OPTIMIZATION (2) LEC. 1. LAB. 3. Pr. (CHEM 2080 or CHEM 2087) and CHEN 3370 and CHEN 3650 and CHEN 3660 and CHEN 3700 and CHEN 3600. Fundamentals of computer-aided simulation and synthesis. Process integration and optimization principles including their applications in design, retrofitting and operation of chemical processes. (CHEN 3370, CHEN 3600, CHEN 3650, CHEN 3660 and CHEN 3700 require a grade of C or better).

CHEN 4470 PROCESS DESIGN PRACTICE (3) LEC. 2. LAB. 3. Pr. CHEN 3AA0 and CHEN 4450 and CHEN 4460 and CHEN 3650 and CHEN 3660 and CHEN 3700 and PHYS 1610. Flow sheet simulation and techno-economic analysis applied to complex, open-ended chemical processes. Screening of alternatives and economic optimizations. Capstone design course. CHEN 3650, CHEN 3660, and CHEN 3700 all require a grade of C or better.

CHEN 4860 CHEMICAL ENGINEERING LABORATORY II (2) LEC. 1. LAB. 3. Pr. CHEN 3660 and CHEN 3820 and P/C CHEN 3700 and CHEN 3650 and P/C CHEN 4170 and PHYS 1610. Experimental study of mass transfer, separations and reaction engineering. Emphasis is on open-ended laboratory projects with electronic instrumentation; experimental design with numerical and statistical analysis of data. CHEN 3650 requires a grade of C or better.

CHEN 4970 SPECIAL TOPICS IN CHEMICAL ENGINEERING (1-10) AAB. Departmental approval. Topical courses in special areas. Topic must be arranged with instructor during pre-registration. Course may be repeated for a maximum of 10 credit hours.

CHEN 4980 UNDERGRADUATE RESEARCH (1-3) IND. Pr. 3.00 GPA. Departmental approval. GPA of 3.0 or higher and junior standing. Individual and small group projects. Topic must be arranged with instructor during preregistration. Research Report. Course may be repeated for a maximum of 3 credit hours.

CHEN 4997 HONORS THESIS (1-6) IND. Pr. Honors College. Departmental approval.. Course may be repeated for a maximum of 6 credit hours.

CHEN 5090 PULP AND PAPER TECHNOLOGY (3) LEC. 3. Pr. (ENGR 2010 or CHEN 2110) and (CHEM 1030 or CHEM 1033 or CHEM 1110 or CHEM 1117) and MATH 2650. An introductory course on the technology of pulp and paper manufacturing with emphasis on raw materials, pulping, bleaching, paper making, coating and environmental control. For students with no previous formal pulp and paper background.

CHEN 5110 PULP AND PAPER ENGINEERING (3) LEC. 3. Pr. CHEN 3620 and CHEN 3700 and P/C CHEN 4450. Chemical and engineering principles in the manufacturing of pulp and paper. (CHEN 3620 and CHEN 3700 require a grade of C or better.)

CHEN 5120 SURFACE AND COLLOID SCIENCE (3) LEC. 3. Pr. CHEN 3620 and CHEN 4100. Fundamentals of surface and colloid science with applications in pulping and papermaking, including sizing, retention and drainage, charge measurements, dry/wet strength additives, fillers, colorants, foams, pitch and deposits. (CHEN 3620 and CHEN 4100 require a grade of C or better).

CHEN 5130 INTEGRATED BIOREFINERIES (3) LEC. 3. Pr. CHEN 5090 or CHEN 6090. Departmental approval. Chemical and engineering principles in biomass conversion processes with emphasis on producing value-added materials and chemicals. By the end of the semester students should understand the principles and reasoning behind emerging biorefinery processes integrated to the pulp and paper manufacturing.

CHEN 5410 MACROMOLECULAR SCIENCE AND ENGINEERING (3) LEC. 3. Pr. (CHEM 2080 or CHEM 2087) and CHEN 3370. Statistical mechanics of chain molecules; thermodynamics of polymer solutions; dilute, semi-dilute, and concentrated solutions and gels; polymer physics; scaling concepts in polymer physics; reputation theory (deGennes, Doi, Edwards) and molecular dynamics; phase separations; crystallization of polymers; rubber elasticity theory; mechanical analysis; viscoelasticity; diffusion theory of polymers; surface properties of polymers. (CHEN 3370 requires a grade of C or better.)

CHEN 5420 POLYMER CHEMICAL ENGINEERING (3) LEC. 2. LAB. 3. Pr. (CHEM 2070 or CHEM 2077) and CHEN 3620 and CHEN 5410. Polymer rheology, transport phenomena, thermodynamics, membranes, conducting polymers, surfaces, interfaces and processing. (CHEN 3620 and CHEN 5410 require a grade of C or better).

CHEN 5430 BUSINESS ASPECTS OF CHEMICAL ENGINEERING (3) LEC. 3. Pr., Departmental Approval. The procession of activities required to successfully commercialize and market new chemical-engineering-based technologies to the consumer and process industries.

CHEN 5660 MACROSCALE ASSEMBLY AND APPLICATIONS OF NANOMATERIALS (3) LEC. 3. Departmental approval. Production of macroscopic assemblies and structures from nanomaterials. Processing and applications of inorganic, organic, biological and hybrid nanomaterials.

CHEN 5800 BIOCHEMICAL ENGINEERING (3) LEC. 3. Pr. P/C CHEN 3700. Bioreactor design. Analysis of enzyme and microbial processes. (CHEN 3700 requires a grade of C or better).

CHEN 5810 BIOMEDICAL ENGINEERING (3) LEC. 3. Pr. (CHEM 2080 or CHEM 2087) and P/C CHEN 3620. Application of chemical engineering principles to the study of medical physiology. Human biochemistry, anatomy and physiology, rheological properties of blood and synovial fluid, rheology of cell membranes. Biomedical fluid mechanics and heat and mass transfer.

CHEN 5970 ADVANCED SPECIAL TOPICS IN CHEMICAL ENGINEERING (1-6) LEC. Departmental approval. Topical courses in areas for advanced undergraduate and graduate students. Topics must be arranged with instructor during preregistration. Course may be repeated for a maximum of 24 credit hours.

CHEN 6090 PULP AND PAPER TECHNOLOGY (3) LEC. 3. An introductory graduate level course on the technology of pulp and paper manufacturing with emphasis on raw materials, pulping, bleaching, paper making, coating and environmental control. For students with no previous formal pulp and paper background.CHEN Department Approval and Alabama Center for Paper and Bioresource Engineering Director approval.

CHEN 6110 PULP AND PAPER ENGINEERING (3) LEC. 3. Chemical and engineering principles in the manufacturing of pulp and paper.

CHEN 6130 INTEGRATED BIOREFINERIES (3) LEC. 3. Pr. CHEN 5090 or CHEN 6090. Departmental approval. Chemical and engineering principles in biomass conversion processes with emphasis on producing value-added materials and chemicals. By the end of the semester students should understand the principles and reasoning behind emerging biorefinery processes integrated to the pulp and paper manufacturing.

CHEN 6410 MACROMOLECULAR SCIENCE AND ENGINEERING (3) LEC. 3. Statistical mechanics of chain molecules; thermodynamics of polymer solutions; dilute, semi-dilute, and concentrated solutions and gels; polymer physics; scaling concepts in polymer physics; reptation theory (deGennes, Doi, Edwards) and molecular dynamics; phase separations; crystallization of polymers; rubber elasticity theory; mechanical analysis; viscoelasticity; diffusion theory of polymers; surface properties of polymers.

CHEN 6660 MACROSCALE ASSEMBLY AND APPLICATIONS OF NANOMATERIALS (3) LEC. 3. Production of macroscopic assemblies and structures from nanomaterials. Processing and applications of inorganic, organic, biological and hybrid nanomaterials. Or departmental approval. May count either CHEN 6660 or CHEN 6666.

CHEN 6800 BIOCHEMICAL ENGINEERING (3) LEC. 3. Bioreactor design. Analysis of enzyme and microbial processes.

CHEN 6810 BIOMEDICAL ENGINEERING (3) LEC. 3. Application of chemical engineering principles to the study of medical physiology. Human biochemistry, anatomy, and physiology, rheological properties of blood and synovial fluid, rheology of cell membranes. Biomedical fluid mechanics and heat and mass transfer.

CHEN 6970 ADVANCED SPECIAL TOPICS IN CHEMICAL ENGINEERING (1-6) DSL. Departmental approval. Topical courses in areas for advanced undergraduate and graduate students. Topics must be arranged with instructor during preregistration. Course may be repeated for a maximum of 24 credit hours.

CHEN 7100 TRANSPORT PHENOMENA (3) LEC. 3. Principles of heat, mass and momentum transport in application of intermediate complexity. Mathematical analysis of transport problems.

CHEN 7110 CHEMICAL ENGINEERING ANALYSIS AND ADVANCED TRANSPORT PHENOMENA (3) LEC. 3. Pr. CHEN 7100 or CHEN 7106. Analytical solutions of ordinary and partial differential equations pertaining to transport phenomena and other areas of chemical engineering.

CHEN 7200 CHEMICAL ENGINEERING THERMODYNAMICS (3) LEC. 3. Chemical reaction and phase equilibrium applied to chemical engineering problems. Properties of multicomponent real gases, liquids, and solids and property relationships. Criteria for thermodynamic equilibrium and stability, molecular thermodynamics.

CHEN 7250 CHEMICAL REACTION ENGINEERING (3) LEC. 3. Pr. P/C CHEN 7100 or P/C CHEN 7106. Analysis and design of homogeneous and heterogeneous chemical reactors. Physicochemical factors and analysis of non-ideal chemical reactor behavior.

CHEN 7900 INDEPENDENT STUDY (1-10) DSL/IND. SU. Departmental approval. Supervised study in specialized areas of chemical engineering. Topic must be arranged with instructor during pre-registration. Course may be repeated for a maximum of 20 credit hours.

CHEN 7950 GRADUATE SEMINAR (1) SEM. 1. SU. Seminar. Course may be repeated for a maximum of 12 credit hours.

CHEN 7970 ADVANCED SPECIAL TOPICS IN CHEMICAL ENGINEERING (1-6) DSL. Departmental approval. Topical courses for graduate students. Topics must be arranged with instructor during preregistration. Course may be repeated for a maximum of 12 credit hours.

CHEN 7990 RESEARCH AND THESIS (1-20) MST. Credit hours to be arranged. Course may be repeated with change in topics.

CHEN 8990 RESEARCH AND DISSERTATION (1-20) DSR. Credit hours to be arranged. Course may be repeated with change in topics.