

# CHEMICAL ENGINEERING

Chemical engineers use knowledge of how nature works (science) and the language of science (mathematics) to create value and solve difficult problems for the benefit of society. The key skill that differentiates chemical engineering from other disciplines is the ability to understand, design and operate transformation (physical or chemical) processes. Chemical engineers literally change (transform) the world. Many in the public assume chemical engineers work only in chemical plants and petroleum refineries. The reality is that chemical engineers work in a broad range of industries including pharmaceuticals, biochemicals, semiconductor materials, foods, plastics, paper, steel, consumer goods, automotive, specialty materials, oil & gas production, renewable energy, engineering services, and the list goes on. Key to providing a benefit to society, chemical engineers are responsible for resource conservation, minimizing pollution, minimizing costs, and maximizing quality and safety of processes that make the products.

The emphasis on the molecular or chemical nature of everything people use is what makes chemical engineers different from other engineers. The emphasis on the processes that make the products is what makes chemical engineers different from chemists.

Chemical engineers often find themselves defining a problem or product, developing a process to do what is needed, and then designing the equipment to carry out the process. After the installation, chemical engineers commonly manage operations, oversee equipment maintenance and supervise control of product quality. They troubleshoot problems that hinder smooth operations, and they plan for future expansions or improvements. Their training and knowledge make them well qualified to market products and processing equipment. The varied background and experience of chemical engineers make them ideally suited for advancement into top-level managerial and executive positions. An advanced degree in chemical engineering is not required.

Many who aspire to careers in medicine or law first obtain BS degrees in chemical engineering. The rigor of the program and the emphasis on critical thinking and analytical reasoning are highly valued by professional school admission committees. A career as a research scientist or academic typically requires a PhD degree.

## Vision

1. Sustain a nationally competitive undergraduate program recognized for quality, fundamental-practice balance, and educational leadership.
2. Attain widespread recognition for contributions to professional knowledge and tools, which are useful, widely accepted, and practiced by others.
3. Sustain and create infrastructures that facilitate synergism, creativity, personal and professional growth, and productivity by students and professional personnel both within OSU and the outside world.

## Mission

The mission of the School of Chemical Engineering at Oklahoma State University is to develop human resources, professional knowledge, and the infrastructure through which chemical engineering can contribute to human welfare. We expect to maintain national recognition for our contributions.

## Program Educational Objectives

The goal of the BS degree program is to produce graduates who possess broad-based knowledge, skills and judgment that prepares them to succeed in the profession of engineering or in further studies at the graduate level, including medical school. To achieve this goal, the program is designed to progressively develop both technical and human skills. The School has three broad objectives. Within the first few years after graduation, our BS graduates will have demonstrated:

Competencies – skill in tools and techniques that are fundamental to the job and the ability and drive to be life-long learners.

Professionalism – applying technical skills in combination with business acumen, teamwork, and communication skills to advance the mission of the enterprise with ethics and integrity.

Balance – a holistic, integrated understanding of self and society to empower self-direction, wise life choices, and deployment of skills in a global context.

## Student Learning Outcomes

Graduating students possess an understanding of fundamental chemical engineering concepts, methodologies and technologies as demonstrated by:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The curriculum consists of three primary parts:

1. general education,
2. core engineering, and
3. chemical engineering topics.

In the first two years of study in the chemical engineering program, the focus is on the underlying scientific and mathematical principles of engineering, supplemented by appropriate general education courses in English, social sciences, history and humanities. Students who demonstrate proficiency in this portion of the program continue to the last two years of the program with a focus on core chemical engineering courses.

Students have the opportunity to focus in one of three options in the program:

1. the regular course prepares a graduate for a wide range of employment opportunities;
2. the pre-medical option is for those who wish preparation for medical school; and
3. the biomedical/biochemical option is for those who seek employment in bio-related professions.

Each option prepares a student for success in both employment and graduate study at OSU or other universities. A detailed description of degree requirements for the bachelor's-level curricula is given in the publication Undergraduate Programs and Requirements.

Each option builds upon the preceding chemical engineering courses to develop the ability to identify and solve meaningful engineering problems. The coursework is specifically sequenced and interrelated to provide design experience at each level, leading to progressively more complex, open-ended problems. The coursework includes sensitizing students to socially-related technical problems and their responsibilities as engineering professionals to behave ethically and protect occupational and public safety. The program culminates in the senior-year design courses in which the students integrate the analysis, synthesis and other abilities they have developed throughout the earlier portions of their study into a capstone experience. At this point, students will be able to design components, systems and processes that meet specific requirements, including such pertinent societal considerations as ethics, safety, environmental impact and aesthetics. The students will have developed and displayed the ability to design and conduct experiments essential to specific studies, and to analyze the experimental results and draw meaningful conclusions within an enterprise context.

Integral parts of this educational continuum from basic science through comprehensive engineering design are learning experiences that facilitate the students' abilities to function effectively in both individual and collaborative environments. To achieve this, the program provides every student with adequate learning experiences to develop effective written and oral communication skills. State-of-the-art computational tools are introduced and utilized as a part of their problem-solving experiences. Finally, the students' experience in solving ever-more-challenging problems gives them the ability to continue to learn independently throughout their professional careers.

Students are offered opportunities to enhance their classroom and laboratory experiences through student organizations such as the student chapter of American Institute of Chemical Engineers. Outstanding scholars are recognized by Omega Chi Epsilon, the national honor society for chemical engineering students. Additionally, opportunities for internship and co-op experiences are offered to chemical engineering students so that they can gain professional experience during their collegiate program. Please visit our Internet site <http://che.okstate.edu> (<http://che.okstate.edu/>) for more information.

The Bachelor of Science Program in Chemical Engineering Program is accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org> (<https://www.abet.org/>), under the general criteria and the Chemical Engineering Program criteria. <https://ceat.okstate.edu/che/abet-and-educational-outcomes.html>.

## Courses

### CHE 1112 Introduction to the Engineering of Coffee (LN)

**Description:** A non-mathematical introduction to the engineering aspects of roasting and brewing coffee. Simple engineering concepts are used to study methods for roasting and processing of coffee. The course will investigate techniques for brewing coffee such as a drip coffee, pour-over, French press, AeroPress, and espresso. Laboratory experiences focus on roasting and brewing coffee to teach introductory engineering concepts to both engineers and non-engineers.

**Credit hours:** 2

**Contact hours:** Lecture: 1 Lab: 2 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Chemical Engineering

**General Education and other Course Attributes:** Laboratory-Based Inquiry, Natural Science Reasoning

### CHE 2023 Introduction to Chemical Engineering Thermodynamics

**Prerequisites:** CHEM 1515, MATH 2144, and PHYS 2014 with a grade of "C" or better.

**Description:** Systems approach to modeling industrial process, application of first and second laws, properties of substances, separate strategies using thermodynamic principles, and power generation cycles. May not be used for degree credit with ENSC 2213.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

### CHE 2033 Introduction to Chemical Process Engineering

**Prerequisites:** CHEM 1515, (CHE 2023 or ENSC 2213), ENGR 1412, ENGL 1113, ENGR 1111 with grades of "C" or better and concurrent enrollment in MATH 2233 or MATH 3263.

**Description:** Application of mathematics and scientific principles to solving chemical engineering problems. Simple material and energy balances applied to process design. The nature and application of unit operations and unit processes to the development of chemical processes.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3 Other: 0

**Levels:** Undergraduate

**Schedule types:** Discussion, Combined lecture & discussion, Lecture

**Department/School:** Chemical Engineering

### CHE 2581 Chemical Engineering Seminar I

**Prerequisites:** CHE majors.

**Description:** Through guest lectures and home assignments, preparation and planning for a CHE career and success in the CHE curriculum. Professional growth topics oriented to students in the sophomore-level courses.

**Credit hours:** 1

**Contact hours:** Lecture: 1 Contact: 1

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3013 Rate Operations I**

**Prerequisites:** CHE 2033, (CHEM 3112 & CHEM 3153) OR (BIOC 3653 & BIOC 3723), ENSC 3233, and PHYS 2114 with grades of "C" or better.

**Description:** Development and application of phenomenological and empirical models to the design and analysis of fluid processing and heat transfer unit operations.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3113 Rate Operations II**

**Prerequisites:** CHE 3013, CHE 3333, CHE 3473, ENSC 3231, and CHE 3543 with grades of "C" or better.

**Description:** Development and application of phenomenological and empirical models to the design and analysis of mass transfer and separations unit operations.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3123 Chemical Reaction Engineering**

**Prerequisites:** CHE 3013, CHE 3333, CHE 3473, ENSC 3231, and CHE 3543 with grades of "C" or better.

**Description:** Principles of chemical kinetics rate concepts and data treatment. Elements of reactor design principles for homogeneous systems; introduction to heterogeneous systems. Course previously offered as CHE 4473.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3202 Interdisciplinary Design and Build for Chemical Systems I**

**Prerequisites:** CEAT major or consent of instructor.

**Description:** Interdisciplinary design course that provides independent work experience, professional development, and assigned design-build problems.

**Credit hours:** 2

**Contact hours:** Lecture: 2 Contact: 2

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3211 Interdisciplinary Design and Build for Chemical Systems II**

**Prerequisites:** CEAT major and CHE 3202 or consent of instructor.

**Description:** Continuation of CHE 3202. Interdisciplinary design course that provides independent work experience, professional development, and assigned design-build problems.

**Credit hours:** 1

**Contact hours:** Lecture: 1 Contact: 1

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3333 Introduction to Transport Phenomena**

**Prerequisites:** CHE 2033, (CHEM 3112 & CHEM 3153) OR (BIOC 3653 & BIOC 3723), ENSC 3233, and PHYS 2114 with grades of "C" or better.

**Description:** Molecular concepts of mass, momentum, and thermal energy diffusion. Theories and correlations for transport properties of viscosity, thermal conductivity, and diffusivity. Shell balance techniques to derive differential equations of change. Application of ODEs to simple transport phenomena problems. Turbulent flow analysis. Use of CFD software for analysis. Course previously offered as CHE 4333.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3473 Chemical Engineering Thermodynamics**

**Prerequisites:** CHE 2033, (CHEM 3112 & CHEM 3153) OR (BIOC 3653 & BIOC 3723), ENSC 3233, and PHYS 2114 with grades of "C" or better.

**Description:** Application of thermodynamics to chemical process calculations. Behavior of fluids, including estimation of properties by generalized methods. Study of chemical thermodynamics, including heats of reaction, chemical reaction, and phase equilibria.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3543 Introduction to Chemical Process Analytics**

**Prerequisites:** ENGR 1412, CHE 2033.

**Description:** Data generation and analysis methods from chemical processes and experiments. Model development using programming. Data interpretation.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 3581 Chemical Engineering Seminar II**

**Prerequisites:** CHE 2033, CHE 2581, ENGR 1111.

**Description:** Through guest lectures and home assignments, preparation and planning for a CHE career and success in the CHE curriculum. Professional growth topics oriented to students in the junior-level CHE courses.

**Credit hours:** 1

**Contact hours:** Lecture: 1 Contact: 1

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4002 Chemical Engineering Laboratory I**

**Prerequisites:** CHE 3013, CHE 3333, CHE 3473, ENSC 3231, CHE 3543 with grades of "C" or better.

**Description:** Application of CHE fundamentals and unit operation principles to the analysis of bench and pilot-scale equipment. Primarily fluid processing and heat exchange. Design of experiments on non-ideal units to generate credible data useful for validation of principles and for engineering decisions. Interpretation of experimental data and presentation of results.

**Credit hours:** 2

**Contact hours:** Lab: 4 Contact: 4

**Levels:** Undergraduate

**Schedule types:** Lab

**Department/School:** Chemical Engineering

**CHE 4073 Introduction to Tissue Engineering**

**Prerequisites:** Senior standing or higher and ENSC 3233 and ENSC 3313 and MATH 2153; or by consent of instructor.

**Description:** An overview of the principles of tissue engineering and regenerative medicine, including a general understanding of tissue growth and development, and an investigation of the engineering principles needed to design tissues and organs. May not be used for degree credit with CHE 5073.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4112 Chemical Engineering Laboratory II**

**Prerequisites:** CHE 3113, CHE 3123, CHE 4002 with grades of "C" or better.

**Description:** A continuation of CHE 4002. Primary reaction and mass transfer processes.

**Credit hours:** 2

**Contact hours:** Lab: 4 Contact: 4

**Levels:** Undergraduate

**Schedule types:** Lab

**Department/School:** Chemical Engineering

**CHE 4124 Chemical Engineering Design I**

**Prerequisites:** CHE 3113, CHE 3123, CHE 4002 with grades of "C" or better.

**Description:** Economic analysis of process plants and systems of equipment; methods for estimating plant investment requirements and operating costs; economic evaluation and optimal design of chemical process systems; basic equipment and process design calculations.

**Credit hours:** 4

**Contact hours:** Lecture: 3 Lab: 2 Contact: 5

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Chemical Engineering

**CHE 4133 Introduction to Catalysis and Photocatalysis**

**Prerequisites:** Senior standing or higher and CHE 3123 or consent of instructor.

**Description:** Molecular level insight into catalysis and photocatalysis from the basics of chemistry and chemical engineering. Topics covered include homogeneous catalysis, heterogeneous catalysis, molecular photocatalysis, and photocatalysis on metals and metal oxides. The rational design of catalysts using first-principle (e.g., density functional theory) calculations is covered. Advancements made in the experimental and computational catalysis fields to convert renewable natural resources such as solar light and cellulosic biomass into electricity, fuels, valuable chemicals and pharmaceuticals. May not be used for degree credit with CHE 5133.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4183 Drug Delivery**

**Prerequisites:** Senior standing or higher; or by consent of instructor.

**Description:** The future of medicine seems focused on the technologies for drug delivery and on large, macromolecular drugs such as genes and proteins. This course is intended to give you an overview of macromolecular drugs (i.e., genes and proteins) and the methods for their delivery. May not be used for degree credit with CHE 5183.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4224 Chemical Engineering Design II**

**Prerequisites:** CHE 4112 and CHE 4124.

**Description:** A continuation of CHE 4124. Economic analysis of process plants and equipment. Design of chemical processing equipment and chemical plants. Application of computer techniques to chemical engineering design.

**Credit hours:** 4

**Contact hours:** Lecture: 3 Lab: 2 Contact: 5

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Chemical Engineering

**CHE 4283 Bioprocess Engineering**

**Prerequisites:** CHE 3123 (or instructor consent).

**Description:** Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. Same course as BAE 4283.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4293 Biomedical Engineering**

**Prerequisites:** ENSC 3233, (CHE 2023 or ENSC 2213); or consent of instructor.

**Description:** Introduction to engineering principles applied to biomedical applications. Biomaterials, drug delivery, artificial organs, transport in biological systems, tissue engineering and modeling of biological systems.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4303 Introduction to Science and Engineering Research**

**Prerequisites:** Senior level or by consent of instructor.

**Description:** This course is designed to expose senior level undergraduate students to principles and practice common to research in science and engineering, and accelerate student development towards independent and creative research prowess upon entering a graduate program. May not be used for degree credit with CHE 5303 or CHE 5302. Previously offered as CHE 4302.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4323 Electrochemical Engineering**

**Prerequisites:** ENSC 2213 or CHE 2023, ENSC 3233; or consent of instructor.

**Description:** An introduction to the fundamental principles of electrochemistry and its applications in different engineering systems for energy, chemical, biomedical, and electronics industries. May not be used for degree credit with CHE 5323.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4343 Environmental Engineering**

**Prerequisites:** CHE 3123 or consent of instructor.

**Description:** Application of science and engineering principles to minimize the adverse effects of human activities on the environment. National and state environmental regulations. Predictive movement and fate of chemicals in the geospheres. Multi-media pollution assessment, analysis and control. Consideration of safety, health and environmental issues from a process standpoint.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4483 Introduction to Spectroscopy in Engineering Research, Development, and Practice**

**Prerequisites:** Senior standing or higher; or by consent of instructor.

**Description:** This course will introduce the fundamentals and practice of spectroscopic methods that the practicing engineer will most likely encounter in fields like agriculture, aerospace, food science, chemical conversion and refining, catalysis, medicine, petroleum engineering, polymer development and production, materials science, plastics reclamation and recycling, on-line process control, pharmaceutical development, and others. May not be used for degree credit with CHE 5483.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4493 Introduction to Molecular Modeling and Simulation**

**Prerequisites:** Senior standing or higher and any one of the following courses – CHE 3473, CHEM 3433, CHEM 3553, MAE 3223, MAE 5683, MAE 5693, BIOC 3223 or consent of instructor.

**Description:** Theory of statistical mechanics and its application to computing thermodynamic, transport and phase equilibria properties of fluids. Modeling of matter at molecular level and atomistic simulation methods such as Monte Carlo and molecular dynamics. Quantum calculation of thermodynamics for industrially relevant reactions. Software used: Cassandra, Gromacs, LAMMPS, and Gaussian. May not be used for degree credit with CHE 5493.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 4523 Introduction to Colloid Processing**

**Prerequisites:** MATH 2153 and CHEM 1515.

**Description:** The physics and chemistry governing the behavior of microscopic particles in dilute and concentrated suspensions. Interparticle interaction influence on viscosity, viscoelasticity, yield stress, and shear thinning. Practical applications of colloids principles in industrial practice. No credit for students with credit in CHE 5523. Same course as MSE 4523.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering



**CHE 4533 Colloidal and Interfacial Phenomena****Prerequisites:** Senior standing.**Description:** This course surveys applications and fundamental aspects of colloidal and interfacial phenomena, industrial applications include pharmaceuticals, energy, agriculture, and food/beverage, and will explore systems such as surfactants, polymers, emulsions, dispersions, foams, and particles at interfaces. The course includes explorations of emulsion stability mechanisms, interparticle interactions, surfactant behavior, and interfacial stability mechanisms. Experimental techniques used to characterize these systems such as interfacial tensiometry and dispersion sizing will be discussed. May not be used for degree credit with CHE 5533.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4543 Machine Learning for Chemical Processes****Prerequisites:** MATH 2144, CHE 3543, or Consent of Instructor.**Description:** The emphasis of the course will be to utilize concepts from statistics, calculus, and linear algebra to develop machine learning models applicable to a wide range of problems in engineering, natural and social sciences, and finance. Special emphasis will be given to the application of methods in the chemical engineering domain. However, students from other disciplines will find the methods broadly applicable to their areas of interest. Homework assignments and project will provide opportunities to apply the knowledge in a broader context. May not be used for degree credit with CHE 5543.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4581 Chemical Engineering Seminar III****Prerequisites:** Senior standing, CHE 3581.**Description:** Through guest lectures and home assignments, preparation and planning for a ChE career and success in the ChE curriculum. Professional growth topics oriented to students in the senior-level ChE courses.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4603 Introduction to Membrane Separations****Prerequisites:** Senior standing or higher and CHE 3113 or consent of instructor.**Description:** Basic principles of membrane technology: membrane synthesis processes and molecular separation mechanisms for different types of membranes. General overview of many different membrane processes. Basic transport equations and fundamental concepts with examples and industrial applications. Includes a project/discussion for a membrane reactor model. May not be used for degree credit with CHE 5603.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4753 Introduction to Applied Numerical Computing for Scientists and Engineers****Prerequisites:** Senior standing or higher, and MATH 2233 or MATH 3263, and knowledge of programming, or consent of instructor.**Description:** Practical software tools for computational problem solving in science and engineering: version control (e.g., Git), mathematical typesetting (e.g., LaTeX), graphical user interfaces, and high level program languages with libraries of solvers and visualization tools (e.g., Python and MATLAB). Application of numerical computing methods to solve systems of differential and algebraic equations and to estimate model parameters using optimization. May not be used for degree credit with CHE 5753.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4773 Introduction to Computational Fluid-Particle Dynamics****Prerequisites:** Senior standing or higher and CHE 3333 or consent of instructor.**Description:** Computational fluid-particle dynamics (CFPD) modeling strategies and simulation of multiphase flow transport phenomena such as particle tracking, deposition, reaction, and erosion. Detailed flow visualization using multiphase flow models on ANSYS CFX and Fluent platforms. Application of numerical techniques to simulate processes defined by first-principles. Application of CFPD for drug formulation optimization, lung aerosol dynamics, separation processes, reactions in stirred tanks and plug flow reactors. May not be used for degree credit with CHE 5773.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4783 Nanomaterial Synthesis and Characterization****Prerequisites:** Senior standing or consent of instructor.**Description:** Exposing students to the principles and concepts of nanoscience and nanotechnology with focus on nanomaterial synthesis and characterization, and accelerating student development towards an effective literature review on a selected topic. May not be used for degree credit with CHE 5783.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 4843 Chemical Process Instrumentation and Control****Prerequisites:** ENSC 2613, ENGR 2421 with grades of "C" or better, CHE 4112 and CHE 4124.**Description:** Process instrumentation for measurement and control. Process dynamics and modeling. Linearization. Classical control system analysis and design. Tuning. Communication through block diagrams and P&IDs.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemical Engineering

**CHE 4880 Special Topics****Prerequisites:** Senior standing.**Description:** Training in independent work, study of relevant literature, and experimental investigation of an assigned problem. Offered for variable credit, 1-5 credit hours, maximum of 5 credit hours.**Credit hours:** 1-5**Contact hours:** Contact: 1-5 Other: 1-5**Levels:** Undergraduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 4990 Special Problems****Prerequisites:** Senior standing.**Description:** Training in independent work, study of relevant literature, and experimental investigation of an assigned problem. Offered for variable credit, 1-5 credit hours, maximum of 5 credit hours.**Credit hours:** 1-5**Contact hours:** Contact: 1-5 Other: 1-5**Levels:** Undergraduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 5000 Master's Thesis****Prerequisites:** Approval of major professor.**Description:** Methods used in research and thesis writing. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 5030 Professional Practice****Prerequisites:** Senior standing and consent of instructor.**Description:** Application of chemical engineering principles to the solution of real-life engineering problems in an actual or simulated industrial environment. Includes application of design and testing procedures, economic evaluation and reporting on one or more assigned projects. Offered for variable credit, 2-6 credit hours, maximum of 8 credit hours.**Credit hours:** 2-6**Contact hours:** Contact: 2-6 Other: 2-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 5073 Tissue Engineering****Prerequisites:** Graduate standing and permission of instructor.**Description:** Tissue engineering (TE) and the material strategy for different tissue constructs in bone TE, liver TE, neural TE, intestine TE, etc. will be discussed in this course. Same as MSE 5073. May not be used for degree credit with CHE 4703.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5110 Special Topics in Chemical Engineering****Prerequisites:** Consent of instructor.**Description:** Small group and individual projects in unit operations, unit procedures, chemical kinetics, computer applications, process modeling, or any of a wide range of chemical engineering topics. May be repeated for credit if subject matter varies. Offered for variable credit, 2-3 credit hours, maximum of 6 credit hours.**Credit hours:** 2-3**Contact hours:** Contact: 2-3 Other: 2-3**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 5123 Advanced Chemical Reaction Engineering****Prerequisites:** CHE 4473.**Description:** Advanced principles and applications of chemical kinetics in catalysis, heterogeneous systems, non-ideal reactions, polymerization, and biological reactions.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5133 Catalysis and Photocatalysis****Prerequisites:** Graduate standing or CHE 3123 or consent of instructor.**Description:** Molecular level insight into catalysis and photocatalysis from the basics of chemistry and chemical engineering. Topics covered include homogeneous catalysis, heterogeneous catalysis, molecular photocatalysis, and photocatalysis on metals and metal oxides. The rational design of catalysts using first-principle (e.g., density functional theory) calculations is covered. Advancements made in the experimental and computational catalysis fields to convert renewable natural resources such as solar light and cellulosic biomass into electricity, fuels, valuable chemicals and pharmaceuticals. May not be used for degree credit with CHE 4133.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5183 Drug Delivery****Prerequisites:** Graduate standing or consent of instructor.**Description:** The future of medicine seems focused on the technologies for drug delivery and on large, macromolecular drugs such as genes and proteins. This course is intended to give you an overview of macromolecular drugs (i.e., genes and proteins) and the methods for their delivery. May not be used for degree credit with CHE 4183.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering

**CHE 5213 Advanced Transport Phenomena**

**Prerequisites:** CHE 3333 (or equivalent), or graduate student standing in the School of Chemical Engineering, or a closely related, calculus-based STEM discipline, or consent of instructor.

**Description:** Mechanisms and modeling of mass, momentum and heat transport with an emphasis on chemical, petroleum, and biomedical engineering applications.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5233 Bioseparations**

**Prerequisites:** BAE 3013 or CHE 3013.

**Description:** Study of separations important in food and biochemical engineering such as leaching, extraction, expression, absorption, ion exchange, filtration, centrifugation, membrane separation, and chromatographic separations. Course available online only through AG\*IDEA consortium.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5263 Advanced Biomaterials Science and Engineering**

**Prerequisites:** Graduate standing or consent of instructor.

**Description:** Engineering issue that are implicit in understanding the interactions of living tissue and processed materials will be introduced. Emphasis is on identifying the processes in which cells interact with surfaces and particulate matter and the outcome of these interactions. Highlighted biological responses will include inflammation and coagulation. Also, biomaterial issues related to drug delivery and tissue engineering will be discussed. Same course as MAE 5003.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5273 Basic Physiology and Physiological System Analysis for Engineers**

**Prerequisites:** Graduate standing or consent of instructor.

**Description:** The goals of this class are: 1) to introduce the basic physiology concepts used widely in biomedical engineering research; 2) to introduce and develop engineering concepts and approaches for quantitative analysis of physiological systems. Engineering principles will be applied to study mechanical properties of various tissue and organ systems under normal and diseased conditions. Knowledge obtained from this class can help engineers to apply engineering principles to the design and development of medical devices for disease treatments. Same course as MAE 5013.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5283 Advanced Bioprocess Engineering**

**Prerequisites:** Consent of instructor.

**Description:** Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up, and downstream processing. Same course as BAE 5283.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5293 Advanced Biomedical Engineering**

**Prerequisites:** Consent of instructor.

**Description:** Principles and engineering analysis of biomedical processes. Artificial organs, biomaterials, tissue engineering, transport in biological systems, biomedical imaging and drug delivery systems. Same course as MAE 5033.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5303 Introduction to Science and Engineering Research**

**Prerequisites:** Graduate level or by consent of instructor.

**Description:** This course is designed to expose new graduate students to principles and practice common to research in science and engineering, and accelerate student development towards independent and creative research prowess. May not be used for degree credit with CHE 4302, CHE 4303, and PETE 6813.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5323 Electrochemical Engineering**

**Prerequisites:** Graduate standing.

**Description:** An introduction to the fundamental principles of electrochemistry and its applications in different engineering systems for energy, chemical, biomedical, and electronics industries. May not be used for degree credit with CHE 4323.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5343 Advanced Environmental Engineering**

**Prerequisites:** Consent of instructor.

**Description:** Science and engineering principles to minimize the adverse effects of human activities on the environment. National and state regulations. Predictive movement and fate of chemicals in the geospheres. Multi-media pollution assessment, analysis, and control. Consideration of safety, health, and environment issues from a process standpoint. Special project required. Credit not allowed if CHE 4343 was taken.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering



**CHE 5373 Process Simulation**

**Prerequisites:** CHE 5843 or concurrent enrollment or with professor's consent.

**Description:** Computer-aided process synthesis, simulation, analysis and optimization. Systematic tools for developing and screening potential chemical process flow sheets. Use of commercial process simulators to aid in evaluating process designs. Practical problems will be used as examples and case studies.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5483 Spectroscopy in Engineering Research, Development, and Practice**

**Prerequisites:** Graduate standing or consent of instructor.

**Description:** This course will introduce the fundamentals and practice of spectroscopic methods that the practicing engineer will most likely encounter in fields like agriculture, aerospace, food science, chemical conversion and refining, catalysis, medicine, petroleum engineering, polymer development and production, materials science, plastics reclamation and recycling, on-line process control, pharmaceutical development, and others. May not be used for degree credit with CHE 4483.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5493 Molecular Modeling and Simulation**

**Prerequisites:** Graduate standing and any one of the following courses: CHE 3473, CHEM 3433, CHEM 3553, MAE 3223, MAE 5683, MAE 5693, BIOC 3224 or consent of instructor.

**Description:** Theory of statistical mechanics and its application to computing thermodynamic, transport and phase equilibria properties of fluids. Modeling of matter at molecular level and atomistic simulation methods such as Monte Carlo and molecular dynamics. Quantum calculation of thermodynamics for industrially relevant reactions. Software used: Cassandra, Gromacs, LAMMPS, and Gaussian. May not be used for degree credit with CHE 4493.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5523 Colloid Processing**

**Prerequisites:** Graduate standing in engineering, physics, or chemistry or consent of instructor.

**Description:** The physics and chemistry governing the behavior of microscopic particles in dilute and concentrated suspensions. Interparticle interaction influence on viscosity, viscoelasticity, yield stress, and shear thinning. Practical application of colloids principles in industrial practice.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5533 Colloidal and Interfacial Phenomena**

**Prerequisites:** Consent of instructor.

**Description:** Individual report topics in chemical engineering involving operations, processes, equipment, experiments, literature search, theory, computer use or combinations of these. May not be used for degree credit with CHE 4533.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5543 Machine Learning for Chemical Processes**

**Prerequisites:** Graduate standing, MATH 2144, and CHE 3543; or Consent of Instructor.

**Description:** The emphasis of the course will be to utilize concepts from statistics, calculus, and linear algebra to develop machine learning models applicable to a wide range of problems in engineering, natural and social sciences, and finance. Special emphasis will be given to the application of methods in the chemical engineering domain. However, students from other disciplines will find the methods broadly applicable to their areas of interest. May not be used for degree credit with CHE 4543. Previously offered as CHE 5990.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5603 Membrane Separations**

**Prerequisites:** Graduate standing and CHE 3113 or consent of instructor.

**Description:** Basic principles of membrane technology: membrane synthesis processes and molecular separation mechanisms for different types of membranes. General overview of many different membrane processes. Basic transport equations and fundamental concepts with examples and industrial applications. Includes a project/discussion for a membrane reactor model. May not be used for degree credit with CHE 4603.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5633 Stagewise Operations**

**Description:** Stagewise separation in binary and multicomponent systems. Development of theoretical techniques with application to typical situations in vapor-liquid, liquid-liquid and solid-liquid systems. Use of digital and analog techniques.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemical Engineering

**CHE 5703 Optimization Applications****Prerequisites:** Graduate standing.**Description:** A survey of various methods of unconstrained and constrained linear and non-linear optimization. Applications of these methodologies using hand-worked examples and available software packages. Intended for engineering and science students. Same course as ECEN 5703, IEM 5023 & MAE 5703.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5723 Plasmonic Photocatalysis****Prerequisites:** CHE 5123; or by consent of instructor.**Description:** The field of plasmonic photocatalysis grew tremendously in the last decade. In this course, the current state of the art plasmonic photocatalysis are reviewed through the rigorous collection of literature. The advantages of the visible-light-driven plasmonic photocatalysis over the conventional thermal energy-driven heterogeneous catalysis will be discussed. The fundamental insight into photocatalytic mechanisms by which the charge carriers (electrons and holes) are formed and transferred to adsorbates to drive chemical transformations on the surface of plasmonic nanocatalysts will also be discussed. The computational methods used to predict and understand the photocatalytic activity and selectivity in plasmonic photocatalysis will also be reviewed. Finally, the current challenges, new opportunities, and future outlook for plasmonic photocatalysis will be presented.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5733 Neural Networks****Prerequisites:** Graduate standing.**Description:** Introduction to mathematical analysis of networks and learning rules and on the application of neural networks to certain engineering problems, image and signal processing and control systems. Same course as ECEN 5733 & MAE 5733.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5743 Chemical Engineering Process Modeling****Description:** Chemical engineering systems and process models.

Analytical and numerical methods of solution of resulting equations with computer methods in a chemical engineering context.

**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5753 Applied Numerical Computing for Scientists and Engineers****Prerequisites:** Graduate standing, and MATH 2233 or MATH 3263, and knowledge of programming, or consent of instructor.**Description:** Practical software tools for computational problem solving in science and engineering: version control (e.g., Git), mathematical typesetting (e.g., LaTeX), graphical user interfaces, and high level program languages with libraries of solvers and visualization tools (e.g., Python and MATLAB). Application of numerical computing methods to solve systems of differential and algebraic equations and to estimate model parameters using optimization. May not be used for degree credit with CHE 4753.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5773 Computational Fluid-Particle Dynamics****Prerequisites:** Graduate standing and CHE 3333 or consent of instructor.**Description:** Computational fluid-particle dynamics (CFPD) modeling strategies and simulation of multiphase flow transport phenomena such as particle tracking, deposition, reaction, and erosion. Detailed flow visualization using multiphase flow models on ANSYS CFX and Fluent platforms. Application of numerical techniques to simulate processes defined by first-principles. Application of CFPD for drug formulation optimization, lung aerosol dynamics, separation processes, reactions in stirred tanks and plug flow reactors. May not be used for degree credit with CHE 4773.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5783 Nanomaterial Synthesis and Characterization****Description:** Exposing students to the principles and concepts of nanoscience and nanotechnology with focus on nanomaterial synthesis and characterization, and accelerating student development towards an effective literature review to come up with novel idea on a selected topic. May not be used for degree credit with CHE 4783.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5843 Principles of Chemical Engineering Thermodynamics****Description:** Principles of thermodynamics. Properties of fluids and prediction of thermodynamic properties. Phase and chemical equilibrium. Thermodynamics in unit operations.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering

**CHE 5850 Advanced Process Control Laboratory****Prerequisites:** Graduate standing and permission of instructor.**Description:** Instrumentation systems and control strategies on pilot-scale chemical processes. Calibration, filtering, dynamic modeling, tuning, advanced control, and method evaluation. Students will learn industrial practices and cope with many non-idealities. Offered for variable credit, 2-3 credit hours, maximum of 6 credit hours.**Credit hours:** 2-3**Contact hours:** Lecture: 1 Lab: 2-4 Contact: 3-5**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Chemical Engineering**CHE 5853 Advanced Chemical Process Control****Prerequisites:** CHE 4843 or equivalent.**Description:** General concepts and approaches of model-based control. Studies in the application of process-model-based control and model-predictive control on multivariable, nonlinear, nonstationary, noisy processes.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5873 Air Pollution Control Engineering****Description:** Causes, effects and control of atmosphere pollution. Same course as CIVE 5873.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 5880 Special Problems****Prerequisites:** Consent of instructor.**Description:** Individual report topics in chemical engineering involving operations, processes, equipment, experiments, literature search, theory, computer use or combinations of these. Offered for variable credit, 1-3 credit hours, maximum of 9 credit hours.**Credit hours:** 1-3**Contact hours:** Contact: 1-3 Other: 1-3**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 5990 Special Problems****Prerequisites:** Consent of instructor.**Description:** Individual report topics in chemical engineering involving operations, processes, equipment, experiments, literature search, theory, computer use or combinations of these. Offered for variable credit, 1-4 credit hours, maximum of 9 credit hours.**Credit hours:** 1-4**Contact hours:** Contact: 1-4 Other: 1-4**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 6000 Doctoral Thesis****Prerequisites:** Consent of major professor.**Description:** The doctoral candidate registers for a minimum of 1 semester credit hour to a maximum of 15 semester credit hours in each semester during which dissertation work is in process. Methods used in research and thesis writing. An original investigation of a problem in chemical engineering and its report in a dissertation. Offered for variable credit, 1-15 credit hours, maximum of 54 credit hours.**Credit hours:** 1-15**Contact hours:** Contact: 1-15 Other: 1-15**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 6010 Chemical Engineering Seminar****Prerequisites:** Consent of major professor.**Description:** Advanced research and development topics. Offered for variable credit, 1 credit hour, maximum of 10 credit hours.**Credit hours:** 1**Contact hours:** Contact: 1 Other: 1**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 6223 Advanced Chemical Engineering Thermodynamics****Prerequisites:** CHE 5843.**Description:** Phase equilibrium in multicomponent systems. Irreversible processes. Properties of fluids and the prediction of properties by statistical methods. Application of thermodynamics to unit operations.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering**CHE 6440 Advanced Topics in Chemical Engineering****Description:** Topics in chemical engineering unit operations in design. Advanced mathematical techniques in chemical engineering problems. May be repeated for credit if subject matter varies. Offered for variable credit, 3-6 credit hours, maximum of 9 credit hours.**Credit hours:** 3-6**Contact hours:** Contact: 3-6 Other: 3-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemical Engineering**CHE 6703 Research Methods in Chemical Engineering****Prerequisites:** MS or PhD candidacy in chemical engineering or consent of instructor.**Description:** Methods and skills required to successfully conduct chemical engineering research projects. Maintaining research records, experiment design, data validation, results presentation and research ethics.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemical Engineering

## Undergraduate Programs

- Chemical Engineering, BSCH (<http://catalog.okstate.edu/engineering-architecture-technology/chemical-engineering/bsch/>)

- Chemical Engineering: Biomedical/Biochemical, BSCH (<http://catalog.okstate.edu/engineering-architecture-technology/chemical-engineering/biomedical-biochemical-bsch/>)
- Chemical Engineering: Pre-Medical, BSCH (<http://catalog.okstate.edu/engineering-architecture-technology/chemical-engineering/pre-medical-bsch/>)

## Graduate Programs

The School of Chemical Engineering offers programs leading to the Master of Science and Doctor of Philosophy. A program of independent study and research on a project under the direction of a member of the Graduate Faculty will be satisfactorily completed by all graduate students. For the Master of Science candidate, the project will result in a thesis. For the Doctor of Philosophy candidate, the project will result in a dissertation.

## Admission Requirements

Admission to either the Master of Science or Doctor of Philosophy degree program requires graduation from a chemical engineering curriculum approved by the ABET or a recognized equivalent from any international program.

Students with undergraduate degrees in other engineering disciplines or closely-related fields, such as chemistry, physics, mathematics, or biological sciences, are evaluated on an individual basis and a specific plan of study is developed for each student. This plan may include an additional 10 – 15 semester credit hours of undergraduate courses in Chemical Engineering. Admission is competitive based on undergraduate GPA, GRE and TOEFL (for international students), statement of background and goals, research experience and interests, and recommendations.

## The Master of Science Degree

A MS degree in Chemical Engineering from Oklahoma State University signifies that the recipient has demonstrated advanced knowledge of fundamental chemical engineering topics. In addition, an MS graduate has exhibited the ability to integrate this knowledge to solve complex quantitative problems in a logical manner.

## Course Requirements

The general credit requirement is 30 credit hours beyond the BS degree, including 24 credit hours of classwork and six credit hours of thesis research. Students must be enrolled in CHE 6010, Chemical Engineering Seminar, during the Fall and Spring semesters. The courses taken must include:

Code	Title	Hours
CHE 5123	Advanced Chemical Reaction Engineering	3
CHE 5213	Advanced Transport Phenomena	3
CHE 5743	Chemical Engineering Process Modeling	3
CHE 5843	Principles of Chemical Engineering Thermodynamics	3
CHE 5303	Introduction to Science and Engineering Research	3

## The Doctor of Philosophy Degree

A PhD in Chemical Engineering from Oklahoma State University signifies that the recipient has demonstrated a breadth of advanced knowledge

in the subjects that form the foundation of chemical engineering. In addition, the graduate will have demonstrated the ability to independently and efficiently make creative, relevant, significant contributions at the forefront of knowledge in traditional or emerging fields within the Chemical Engineering discipline. The program is designed to prepare the graduate with the widest possible career opportunities as a leader in industry and academia.

Breadth of advanced knowledge is demonstrated primarily by completion of a carefully prescribed “core” of class work. Additional courses may be selected by the candidate and/or prescribed by the Advisory Committee to assist in improving the candidate’s fundamental knowledge base or to allow the candidate to acquire specialized knowledge for the completion of a dissertation research project. A “Qualifying Examination” is used to show that a student has the necessary core knowledge and the potential to carry out independent research to successfully complete a PhD in chemical engineering.

The PhD experience allows the candidate to develop and demonstrate the independent, self-directed, and creative productivity of an accomplished professional. As such, the PhD experience must go well beyond directed classroom instruction, in which the professor chooses the content, assigns specific homework and grades short-term projects. Personal attributes developed during the PhD program include curiosity, perseverance, creativity, productivity, leadership, effective communication, interpersonal skills, and the ability to develop a comprehensive understanding of a study and its relation to societal needs. Accordingly, qualifications for undertaking the PhD degree are predicated on attributes such as the above, plus indications that the candidate can meet the expectations of independent, accomplished, and creative engineering work. A formal “Preliminary Examination” is administered to determine the student’s readiness to undertake the research component of the PhD program.

From the Preliminary Examination through the Final Defense of the Dissertation, the candidate develops and demonstrates the ability to: independently identify an area in which research is needed; assemble the relevant existing knowledge; develop the requisite experimental, computational, or theoretical skills; synthesize the existing knowledge, available skills and facilities into a scientifically defensible research plan; pursue the plan in an efficient and timely manner to realize a significant result; and organize and communicate his/her ideas and results in a professionally acceptable manner.

## Course Requirements

The general credit requirement is 60 credit hours beyond the BS degree, including 24 credit hours of research and 36 credit hours of classwork. Students must be enrolled in CHE 6010, Chemical Engineering Seminar, during the Fall and Spring semesters. The courses must include:

Code	Title	Hours
CHE 5123	Advanced Chemical Reaction Engineering	3
CHE 5213	Advanced Transport Phenomena	3
CHE 5743	Chemical Engineering Process Modeling	3
CHE 5843	Principles of Chemical Engineering Thermodynamics	3
CHE 5303	Introduction to Science and Engineering Research	3

The emphasis in coursework during a graduate degree is on depth of understanding of subject matter and on preparing students for careers

in the areas of interest. Depth is obtained through “core” courses that address knowledge that is expected of all chemical engineers, while other courses are targeted toward a student’s research and specific career interests. The core areas include fundamentals and applications of mathematical modeling, thermodynamics, chemical reaction engineering, and transport phenomena. The courses are structured to expand and add depth to a students’ undergraduate knowledge.

The Introduction to Science and Engineering Research course is designed to accelerate student development towards the ability to define a research problem and develop a plan for its solution. Additional “elective” courses must be selected from graduate-approved courses in any department, with the advice and consent of a student’s Research Advisor. During the Fall and Spring semesters, students will participate in a seminar class that will give them an overview of – and appreciation for – the wide range of chemical engineering knowledge and applications. Students also complete “research” courses, which includes working with their research advisors on their MS thesis or PhD dissertation research projects.

## Minors

- Petroleum Engineering (PETE), Minor (<http://catalog.okstate.edu/engineering-architecture-technology/chemical-engineering/petroleum-engineering-minor/>)

## Faculty

Heather Gappa-Fahlenkamp, PhD—**Professor and Head and Edward Bartlett Chair**

**Professor and Continental Resources Chair in Petroleum**

**Engineering:** Geir Hareland, PhD, PEng

**Professor and BP (Amoco) Chair in Chemical Engineering:** Jeffery L. White, PhD

**Professor and Robert N. Maddox Professorship:** Joshua D. Ramsey, PhD, PE

**Professor and Lew & Myra Ward Chair:** Clint P. Aichele, PhD, PE

**Professors:** D. Alan Tree, PhD; Sundar V. Madhally, PhD

**Associate Professor and Anadarko Petroleum Chair in Chemical Engineering:** Jindal Shah, PhD

**Associate Professor and Harold Courson Chair in Petroleum Engineering:** Prem Bikkina, PhD

**Associate Professor and Samson Investment Chair in Petroleum Engineering:** Mileva Radonjic, PhD

**Associate Professors:** Yu Feng, PhD; SeokJhin Kim, PhD

**Assistant Professors:** Mohammed Al Dushaishi, PhD; Marimuthu Andiappan, PhD; Hong Je Cho, PhD; Zheyu Jiang, PhD; Hunjoo Lee, PhD

**Clinical Assistant Professor (ENDEAVOR):** Brad Rowland, PhD