CHE - CHEMICAL ENGINEERING (CHE)

CHE 101 - Introduction to Chemical Engineering 2 Credits

Hours: 2R-0L-2C
Term Available: F,W
Graduate Studies Eligible: No
Prerequisites: None

Introduces career choices in chemical engineering and some foundations of problem solving that chemical engineers use. Through hands-on projects, the engineering design process, including problem definition, analysis, alternate solutions, and specifications of final solution, as well as techniques of oral and written communications are established. Emphasizes the importance of teamwork through group design efforts.

CHE 110 - Excel for Chemical Engineers 2 Credits

Hours: 2R-0L-2C
Term Available: S
Graduate Studies Eligible: No
Prerequisites: None

An introduction to problem solving and data analysis using spreadsheets. Spreadsheet applications include graphical analysis, curve-fitting, parameter estimation, numerical differentiation and integration, solution of systems of algebraic (linear and nonlinear) equations and ordinary differential equations.

CHE 199 - Professional Experience 1 Credit

Hours: 1R-0L-1C
Term Available: S
Graduate Studies Eligible: No
Prerequisites: None

The professional experiences course captures the practical work experiences related to the student's academic discipline. Students are required to submit a formal document of their reflections, which communicates how their employment opportunity reinforced and enhanced their academic studies.

CHE 201 - Conservation Principles and Balances 4 Credits

Hours: 4R-0L-4C
Term Available: F
Graduate Studies Eligible: No
Prerequisites: (MA 113 or MA FTC) and PH 111 and (CHEM 113 (may be taken concurrently) or CHEM 112 (may be taken concurrently) or CHEM 114)

An introduction to engineering calculations, the use of common process variables, and conservation and accounting of extensive properties as a common framework for engineering analysis and modeling. Applications of conservation of mass and energy in the analysis of non-reactive chemical engineering processes will be addressed. There will be an introduction to equipment, flowcharts, techniques and methodologies used by practicing chemical engineers.

CHE 202 - Basic Chemical Process Calculations 4 Credits

Hours: 4R-0L-4C
Term Available: W
Graduate Studies Eligible: No
Prerequisites: CHE 201 and (MA 211 or MA 221)

The course continues to develop concepts from CHE 201 and provides a more extensive treatment of energy balances. Applications of the principles of conservation of mass and energy to reactive and transient systems will also be addressed.

CHE 210 - Programming for Chemical Engineers 2 Credits

Hours: 2R-0L-2C
Term Available: W,S
Graduate Studies Eligible: No
Prerequisites: MA 221

Software tools and engineering programming for chemical engineers. Topics include: structured programming, data types, control structures, data visualization, ODE solvers, and other related engineering focused programming concepts.

CHE 290 - Special Topics in Chemical Engineering 0-4 Credits

Hours: (0 - 4)R-0L-(0 - 4)C
Term Available: See Department
Graduate Studies Eligible: No
Prerequisites: None

Topics of current interest in chemical engineering.

CHE 301 - Fluid Mechanics 4 Credits

Hours: 4R-0L-4C
Term Available: F,S
Graduate Studies Eligible: No
Prerequisites: CHE 201 and (MA 211 or MA 221)

Physical properties of fluids, fluid statics, laminar and turbulent flow.Design of pipe networks and pumps. Fluid flow as momentum transport. Flow through porous media. Non-Newtonian fluid flow. Flow past objects and boundary layer concept. Emphasis is placed on general methods of analysis applicable to any fluid.

CHE 303 - Chemical Engineering Thermodynamics 4 Credits

Hours: 4R-0L-4C
Term Available: F,S
Graduate Studies Eligible: No
Prerequisites: CHE 202 and CHE 110 (may be taken concurrently) and (MA 221 or MA 211)

First and second laws of thermodynamics and their application including thermodynamic cycles, closed and open systems. Thermodynamic properties of pure components. Phase equilibria of pure components. Equations of state, state diagrams. Thermodynamic analysis of processes.

CHE 304 - Multi-Component Thermodynamics 4 Credits

Hours: 4R-0L-4C
Term Available: F,W
Graduate Studies Eligible: No
Prerequisites: CHE 303 and (MA 222 or MA 212)

Properties of mixtures. Phase equilibria for mixtures. Equations of state and activity coefficient models. Chemical reaction thermodynamics. Thermodynamic analysis of processes. Study of phase equilibria involving the use of a process simulator.

CHE 310 - Numerical Methods for Chemical Engineers 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: No
Prerequisites: CHE 210 and MA 222

The objective of this course is to learn the fundamentals of several important numerical methods and how to apply them to solve chemical engineering problems. This will include the study of algorithms to solve systems of algebraic and differential equations, toperform numerical integration, to apply linear and nonlinear regression techniques, and to perform stochastic Monte Carlo simulations. Matlab and Excel will be used as the programming and computing software.

CHE 315 - Materials Science and Engineering 4 Credits

Hours: 4R-0L-4C
Term Available: F,S
Graduate Studies Eligible: No
Prerequisites: CHEM 115

Introduction to the properties and processing of metals, ceramics, polymers, and semiconductors. The influences of crystal structure, interatomic bonding, and electronic structure on physical, mechanical, and electrical properties are emphasized. Causes and mitigation of various types of corrosion are explored. Properties and design of composite materials are introduced.

CHE 320 - Fundamentals of Heat & Mass Transfer 4 Credits

Hours: 4R-0L-4C
Term Available: F,W
Graduate Studies Eligible: No
Prerequisites: CHE 202 and CHE 301 and CHE 304 (may be taken concurrently) and ((MA 222 (may be taken concurrently)) or (MA 211 and MA 212))

Discussion of fundamental heat and mass transfer principles: conduction, forced and free convection, radiation, and diffusion. Mathematical analysis and computation of heat transfer, mass transfer, temperature, and concentration profiles in systems with simple geometries. Finite difference equations. Estimation of local and overall heat and mass transfer coefficients.

CHE 321 - Applications of Heat & Mass Transfer 4 Credits

Hours: 4R-0L-4C
Term Available: W,S
Graduate Studies Eligible: No
Prerequisites: CHE 320 and CHE 304

Use, design, and selection of heat exchangers and heat exchange systems for various applications in the chemical process industries. Study of gas-liquid and liquid-liquid mass transfer operations including gas absorption, extraction, and distillation in equilibrium staged tray columns and packed columns. Quantitative treatment of mass transfer based on material and energy balances, phase equilibrium, and rates of heat and mass transfer. Applications of radiation heat transfer, boiling, and condensation.

CHE 340 - Process Control 4 Credits

Hours: 4R-0L-4C
Term Available: F,W
Graduate Studies Eligible: No
Prerequisites: CHE 202 and ((MA 211 and MA 212) or (MA 221 and MA 222))

The mathematics of process dynamics, control system design, Laplace transforms, feedback control theory, characteristics of sensors, transmitters and control elements, stability criteria, and frequency response. Use of control design software is emphasized.

CHE 404 - Reaction Engineering 4 Credits

Hours: 4R-0L-4C
Term Available: F,S
Graduate Studies Eligible: Yes
Prerequisites: CHEM 360 and CHE 304 and CHE 210

The course covers the analysis of various reactors including batch and continuous types for homogenous and heterogeneous reactions, single reactions, multiple reactions, reactor cascades, and temperature effects. Computer methods and software for chemical reaction engineering are used.

CHE 405 - Introduction to MEMS: Fabrication & Applications 4 Credits

Hours: 3R-3L-4C
Term Available: S
Graduate Studies Eligible: Yes
Prerequisites: None

Properties of silicon wafers, wafer-level processes, surface and bulk micromachining, thin-film deposition, dry and wet etching, photolithography, process integration, simple actuators. Introduction to microfluidic systems. MEMS applications: capacitive accelerometer, cantilever and pressure sensor. Cross-listed with ECE 416, NE 410, and ME 416.

CHE 409 - Professional Practice 1 Credit

Hours: 1R-0L-1C
Term Available: S
Graduate Studies Eligible: No
Prerequisites: CHE 411 (may be taken concurrently)

Topics on professional practice, ethics, and contemporary and global issues in the profession are discussed.

CHE 411 - Chemical Engineering Laboratory I 3 Credits

Hours: 2R-3L-3C
Term Available: S
Graduate Studies Eligible: No
Prerequisites: MA 223 and (RH 330 or ENGL H290) and CHE 321 (may be taken concurrently) and CHEM 225 and CHEM 252

Principles underlying momentum, mass and energy transfer and the applications of equipment used to accomplish such transfer, introduction to laboratory concepts in data collection, record keeping, interpretation and analysis, and instrumentation including experimental error analysis, regression, model formulation, experimental design, and instrumentation. Written and oral reports are required. Formal instruction on written and oral communication will be provided.

CHE 412 - Chemical Engineering Laboratory II 4 Credits

Hours: 2R-6L-4C
Term Available: F
Graduate Studies Eligible: No
Prerequisites: (CHE 325 or CHE 321) and CHE 411 and CHE 404 (may be taken concurrently)

Continuation of principles underlying momentum, mass and energy transfer with some emphasis on kinetics, applications of equipment used to accomplish such transfer.

CHE 413 - Chemical Engineering Laboratory III 4 Credits

Hours: 2R-6L-4C
Term Available: W
Graduate Studies Eligible: No
Prerequisites: CHE 412

Continuation of CHE 412 with further development of hands-on laboratory skills.

CHE 416 - Design I: Proc Econ & Equp Dsn 4 Credits

Hours: 4R-0L-4C
Term Available: F
Graduate Studies Eligible: Yes
Prerequisites: CHE 325 (may be taken concurrently) or CHE 321

Introduction to the design process; gross profit analysis; simulation to assist in process creation; synthesis of separation trains; design of separation equipment.

CHE 417 - Design II: Proc Synth & Analys 4 Credits

Hours: 4R-0L-4C
Term Available: W
Graduate Studies Eligible: Yes
Prerequisites: CHE 416 and CHE 404

Design of reactor-separator-recycle networks; heat and power integration; batch process scheduling; annual costs, earnings and profitability; preliminary work on a capstone design project.

CHE 418 - Chemical Engineering Design III: Capstone Design Project 2 Credits

Hours: 0R-6L-2C
Term Available: S
Graduate Studies Eligible: Yes
Prerequisites: CHE 417

Design of reactor-separator-recycle networks; heat and power integration; batch process scheduling; annual costs, earnings and profitability; preliminary work on a capstone design project.

CHE 420 - Consulting Engineering Seminar 2 Credits

Hours: 2R-0L-2C
Graduate Studies Eligible: No
Prerequisites: None

Discusses problems in the field of consulting engineering. Seminars presented by practicing consulting engineers. Cross-listed with CE 420, ECE 466, ME 420, and BE 400.

CHE 430 - Petrochemical Processes 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: No
Prerequisites: CHE 321

Multicomponent separation of petroleum by flash vaporization. Processes for production of lighter petroleum products from heavier derivatives. Production of petrochemicals from natural gas or other fossil fuels. Projects and presentations on refinery and petrochemical processes. Material balances and economic evaluations of refinery processes. Cross listed with CHE 530. Students cannot earn credit for both CHE 430 and CHE 530.

CHE 441 - Polymer Engineering 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 404 (may be taken concurrently) and CHEM 251

Interrelation of polymer structure, properties and processing. Polymerization kinetics. Methods for molecular weight determination. Fabrication and processing of thermoplastic and thermosetting materials. Student projects.

CHE 460 - Particle Technology 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 202 and CHE 301

Introduction to the fundamentals of particle technology including particle characterization, transport, sampling, and processing.Students will learn about the basic design and scale-up of some industrial particulate systems (including fluidized beds, mixers, pneumatic conveying systems, cyclone separators, and hoppers) as well as environmental and safety issues related to particulate handling.

CHE 462 - Membrane Separations 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 320 or CE 460

Introduction to transport mechanisms underlying membrane separations and associated industrial processes. Basic design parameters, applications, and limitations will be discussed for several membrane separation methods including reverse osmosis, ultrafiltration, microfiltration, and gas separations. Particular focus on current topics such as membrane fabrication, module design, and challenges to commercial implementation. This course will contain hands-on demonstrations and projects.

CHE 465 - Energy and the Environment 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 303 or CHEM 361 or ME 201 or ME 301

This course surveys traditional and renewable energy generation techniques and their environmental impacts. Topics include the history, current usage, and projected trends of various energy technologies and humanity's energy demands, power plants and energy efficiency, criteria pollutants and regulations, climate change, and tools for assessing environmental impact and sustainable design.

CHE 470 - Safety, Health, and Loss Prevention 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 303 or CHE 320

Fundamentals of chemical process safety including toxicology, industrial hygiene, toxic release and dispersion models, fires and explosions, designs and procedures to prevent fires and explosions. Overview of federal regulations governing the chemical process industries.

CHE 490 - Special Topics in Chemical Engineering 1-4 Credits

Hours: (1 - 4)R-0L-(1 - 4)C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: None

Topics of current interest in chemical engineering.

CHE 499 - Directed Research 0-8 Credits

Hours: 0R-0L-(0 - 8)C
Term Available: F,W,S
Graduate Studies Eligible: Yes
Prerequisites: None

A special project is assigned to or selected by the student. The publication of research is encouraged. Variable credit. May be repeated up to a maximum of eight credits.

CHE 502 - Transport Phenomena 4 Credits

Hours: 4R-0L-4C
Term Available: S
Graduate Studies Eligible: Yes
Prerequisites: CHE 320

Most of the course focuses on the derivation, simplification, and solution of the equations of change for momentum, energy, and mass transport. Mathematical determination of velocity profiles and momentum flux for isothermal, laminar flows in both steady and unsteady systems will be covered. Mathematical determination of temperature profiles and heat flux, and concentration profiles and mass flux both in solids and in laminar flows will also be covered. Boundary layer theory will be discussed. Turbulent flow theories may also be addressed.

CHE 504 - Advanced Reaction Engineering 4 Credits

Hours: 4R-0L-4C
Term Available: W
Graduate Studies Eligible: Yes
Prerequisites: CHE 404

The course covers strategies for modeling non-ideal reactors and more complex reaction systems.Advanced topics in chemical reactions are analyzed with computer methods and software for reaction engineering.

CHE 505 - Introduction to MEMS: Fabrication & Applications 4 Credits

Hours: 3R-3L-4C
Term Available: S
Graduate Studies Eligible: Yes
Prerequisites: None

Properties of silicon wafers; wafer-level processes, surface and bulk micromachining, thin-film deposition, dry and wet etching, photolithography, process integration, simple actuators. Introduction to microfluidic systems. MEMS applications: capacitive accelerometer, cantilever and pressure sensor. Cross-listed with BE 516, ECE 516, NE 510, and ME 516.

CHE 513 - Advanced Chemical Engineering Thermodynamics 4 Credits

Hours: 4R-0L-4C
Term Available: F
Graduate Studies Eligible: Yes
Prerequisites: CHE 304

Review of thermodynamic principles including fundamental equations and the laws of thermodynamics. Investigation of property relationships based on the fundamental equations. Advanced analysis of topics related to gas, liquid, solid, and multi-phase systems and statistical thermodynamics.

CHE 515 - Nanomaterials Science & Engineering 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 315 or ME 328 or BE 233 or (EP 280 or NE 280)

Current research trends and industrial activity in the field of nanotechnology.Contains an overview of nanoscale characterization and production methods and emphasizes the roles that chemical functionality, thermodynamics, and physics play in determining the unique properties of nanoscale materials systems.Independent student reviews of current research literature form an integral part of the course.

CHE 525 - Process Analytics 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 411 (may be taken concurrently)

Introduction to methodologies used to collect, process, and store data from highly connected systems for applications in making informed engineering decisions. Students will learn about modern industrial control system architecture, data storage and time series databases, asset management, processing of streaming data, and decision making over various time scales.

CHE 530 - Petrochemical Processes 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 321

Multicomponent separation of petroleum by flash vaporization. Processes for production of light petroleum products from heavier derivatives. Production of petrochemicals from natural gas or other fossil fuels. Projects, presentations on refinery and petrochemical processes. Material balances and economic evaluations of refinery processes. Projects and other assignment requirements will be adjusted to the course level. Students must do additional independent work. Cross listed with CHE 430. Students cannot earn credit for both CHE 430 and CHE 530.

CHE 540 - Advanced Process Control 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CHE 440

Control topics beyond those covered in CHE 440. Topics will be selected from among the following: advanced control using cascade, feed forward, nonlinear, and adaptive control; multivariable systems including RGA analysis and decoupling; a major control system design and implementation project using a modern distributed control system.

CHE 545 - Introduction to Biochemical Engineering 4 Credits

Hours: 4R-0L-4C
Term Available: W
Graduate Studies Eligible: Yes
Prerequisites: (AB 110 or BIO 110) and CHEM 330 and (CHE 404 or ES 201 or BE 132)

Survey course introducing biochemical terminology and processes. Enzyme kinetics, cellular genetics, biochemical transport phenomena, and design and operation of biochemical reactors. Emphasis on applying engineering principles to biochemical situations.

CHE 546 - Bioseparations 4 Credits

Hours: 4R-0L-4C
Term Available: S
Graduate Studies Eligible: Yes
Prerequisites: (BIO 110 or AB 110) and (CHE 325 or CHE 321 or ES 201)

An analysis of bioseparation processes. Filtration, centrifugation, adsorption, electrophoresis, and chromatography are the primary topics of the course. Applications are emphasized.

CHE 562 - Advanced Wastewater Treatment 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: None

Covers the theory, design and analysis of biological processes for the treatment of wastewater. Treatment processes include suspended and attached growth processes, aerobic and anaerobic processes, biological nutrient removal, aeration and gas transfer, and biosolids processing. Cross-listed with CE 562.

CHE 563 - Advanced Water Treatment 4 Credits

Hours: 4R-0L-4C
Term Available: See Department
Graduate Studies Eligible: Yes
Prerequisites: CE 460

Covers the theory, design and analysis of physical and chemical processes for the treatment of drinking water. Treatment processes include coagulation and flocculation, gravity separation, granular and membrane filtration, disinfection, air stripping, adsorption, ion exchange, and disinfection. Cross listed with CE 563.

CHE 590 - Special Topics in Chemical Engineering 4 Credits

Hours: 4R-0L-4C
Term Available: F,W,S
Graduate Studies Eligible: Yes
Prerequisites: None

Topics of current interest in chemical engineering. May be repeated.

CHE 597 - Special Projects in Chemical Engineering 0-8 Credits

Hours: 0R-0L-(0 - 8)C
Term Available: F,W,S
Graduate Studies Eligible: Yes
Prerequisites: None

A special project, or series of problems, or research problem is assigned to or selected by the student. A comprehensive report must be submitted at the conclusion of the project. Not to be used as a substitute for CHE 599, Thesis Research. Variable credit. May be repeated up to a maximum of eight credits.

CHE 598 - Graduate Seminar 0 Credits

Hours: 1R-0L-0C
Term Available: F,W,S
Graduate Studies Eligible: Yes
Prerequisites: None

Selected topics in chemical engineering are discussed by graduate students, faculty, and guest speakers.

CHE 599 - Thesis Research 0-12 Credits

Hours: 0R-0L-(0 - 12)C
Term Available: F,W,S
Graduate Studies Eligible: Yes
Prerequisites: None

Graduate students only. Credits as assigned; however, not more than 12 credits will be applied toward the requirements of the M.S. degree.

CHE 699 - Professional Experience 1 Credit

Hours: 1R-0L-1C
Term Available: S
Graduate Studies Eligible: Yes
Prerequisites: None

The professional experiences course captures the practical work experiences related to the student's academic discipline. Students are required to submit a formal document of their reflections, which communicates how their employment opportunity reinforced and enhanced their academic studies. The work experiences should be informative or integral to the advancement or completion of the student's program requirements.