CHEMICAL ENGINEERING (CHE)

CHE 100
Introduction to the Profession I
Introduction to chemical engineering and engineering productivity software. Communication skills development, technical reporting and presentation, engineering ethics, and a variety of topics are discussed.
Lecture: 1 **Lab:** 2 **Credits:** 2
Satisfies: Communications (C)

CHE 101
Introduction to the Profession II
A continuation of CHE 100. Advanced engineering applications of productivity software. Engineering graphics and technical flow sheeting. Team project research and project management skills. Internet publishing.
Prerequisite(s): CHE 100 or MMAE 100
Lecture: 1 **Lab:** 2 **Credits:** 2
Satisfies: Communications (C)

CHE 202
Material Energy Balances
Material and energy balances for engineering systems subjected to chemical and physical transformations. Calculations on industrial processes.
Prerequisite(s): (MATH 152 and CHEM 100-499) and (CS 105 or CS 115 or CS 104)
Lecture: 3 **Lab:** 0 **Credits:** 3
Satisfies: Communications (C)

CHE 239
Mathematical and Computational Methods
Utilization of numeric and analytic methods to find solutions to a variety of chemical engineering problems. Emphasis placed on development of computer code, and interpretation of results. Topics covered include systems of algebraic equations, initial value differential equations, and boundary value differential equations.
Prerequisite(s): CHE 202 and MATH 252* and CHE 301*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 296
Introduction to IPRO
Introduction to process design. Principles and techniques in effective teamwork. Performance of selected design tasks in project groups integrated with CHE/IPRO 496. Practice with process design software. First part of CHE/IPRO 296-CHE/IPRO 496 project package. Only CHE students should register for this course.
Prerequisite(s): CHE 202 and CHE 101
Lecture: 0 **Lab:** 2 **Credits:** 1
Satisfies: Communications (C)

CHE 301
Fluid Mechanics
Flow of fluids. Fundamentals of fluid flow design equations as applied to selected unit operations.
Prerequisite(s): MATH 252 and CHE 202
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 302
Heat and Mass Transfer Operations
Fundamentals of heat and mass transfer. Heat and mass transfer design equations as applied to selected unit operations. Mass transfer in stage-wise and continuous contacting equipment. Unsteady state operations in mass transfer equipment.
Prerequisite(s): CHE 301
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 311
Foundations of Biological Science for Engineering
This introductory course will introduce engineering students to basic principles of Biological Sciences, which will enable them to understand more advanced courses on the topic and provide a solid base for further study in all life sciences-related topics required in their individual programs.
Prerequisite(s): CHEM 125
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 317
Chemical and Biological Engineering Laboratory I
Laboratory work in the unit operations of chemical engineering, fluid flow, heat transfer, and other selected topics.
Prerequisite(s): CHE 301
Lecture: 1 **Lab:** 3 **Credits:** 2
Satisfies: Communications (C)

CHE 351
Thermodynamics I
Laws of thermodynamics and their application to chemical engineering operations.
Prerequisite(s): CHEM 343 and CHE 202
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 406
Transport Phenomena
The equations of change in different coordinate systems (mass, momentum, and energy transport). Velocity distribution in laminar and turbulent flow. Formulation and analytical solutions to the problems of viscous flow, molecular diffusion, heat conduction and convection.
Prerequisite(s): CHE 301 and CHE 302 and MATH 252
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 412
Foundations of Biological Science for Engineering
This introductory course will introduce graduate engineering students to basic principles of Biological Sciences, which will enable them to understand more advanced courses on the topic and provide a solid base for further study in all life sciences-related topics required in their individual programs.
Prerequisite(s): CHEM 125
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 416
Technologies for Treatment of Diabetes
Study of physiological control systems and engineering of external control of biological systems by focusing on an endocrine system disorder -- diabetes. The effects of type 1 diabetes on glucose homeostasis and various treatment technologies for regulation of glucose concentration. Development of mathematical models describing the dynamics of glucose and insulin concentration variations, blood glucose concentration measurement and inference techniques, insulin pumps, and artificial pancreas systems.
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 418
Chemical and Biological Engineering Laboratory II
Laboratory work in distillation, humidification, drying, gas absorption, filtration, and other areas.
Prerequisite(s): CHE 302 and CHE 317
Lecture: 1 **Lab:** 3 **Credits:** 2
Satisfies: Communications (C)

CHE 423
Chemical Reaction Engineering
Introduction to the fundamentals of chemical kinetics. The design, comparison, and economic evaluation of chemical reactors. Emphasis on homogeneous systems.
Prerequisite(s): CHE 302 and CHE 351 and CHE 433
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 426
Statistical Tools for Engineers
Descriptive statistics and graphs, probability distributions, random sampling, independence, significance tests, design of experiments, regression, time series analysis, statistical process control, and introduction to multivariate analysis.
Prerequisite(s): MATH 151
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 433
Process Modeling and System Theory
Principles of process modeling. Modeling of non-reactive and reactive dynamic processes. Transfer functions. Modeling of multistage and non-linear processes. Discrete-event processes, Markov processes, and automata theory.
Prerequisite(s): CHE 302 and CHE 351
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 435
Process Control
Dynamic process models, stability assessment, feedback, and feed forward control strategies, design and tuning of closed-loop controllers, time domain and frequency domain design and performance assessment methods. Multivariable systems, interaction, multi-loop control. Software for process simulation and controller design.
Prerequisite(s): CHE 302 and CHE 433
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 439
Numerical and Data Analysis
Utilization of numerical methods to find solutions to a variety of chemical engineering problems. Emphasis placed on problem formulation, development of computer code, and interpretation of results. Techniques covered include: systems of algebraic equations, linear regression, and statistics. Numerical differentiation and integration, solution of ordinary and partial differential equations.
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 451
Thermodynamics II
Second law analysis of cooling, separation, combustion, and other chemical processes. Chemical reaction equilibrium and processing applications.
Prerequisite(s): CHE 351
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 455
Polymer Processing
Considerations of transport processes in the polymer industry. Analysis of heat, mass, and momentum transfer in molten polymers and polymer solutions. The polymer flow processes to be discussed will include: extrusion, calendaring, fiber spinning, injection molding, mixing, and polymerization reaction.
Prerequisite(s): CHE 302 and CHE 301
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 465
Electrochemical Energy Conversion
Thermodynamics, kinetic and mass-transfer fundamentals of electrochemical devices. Potential and potential measurement. Batteries and fuel cells. Fundamentals of corrosion and corrosion prevention.
Prerequisite(s): CHE 302
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 467
Fuel Cell System Design
System or chemical reactor perspective of fuel cell design. Macro-scale modeling of fuel cell applications. Description of electrode/electrolyte assemblies and the three phase region, polarization curve characterization, analysis of continuous flow systems, typical fuel cell stack configurations, analysis of spatial non-uniformities in stacks, and balance of plant design.
Prerequisite(s): CHE 423
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 470
Introduction to Polymer Science
An introduction to the basic principles that govern the synthesis, processing and properties of polymeric materials. Topics include classifications, synthesis methods, physical and chemical behavior, characterization methods, processing technologies and applications. Same as CHEM 470 and MMAE 470.
Prerequisite(s): CHEM 124 and MATH 251 and PHYS 221
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 489
Fluidization
Regimes of fluidized beds, rheology behavior of fluidized beds, particle classification, properties of the bubble, emulsion, elutriation, and jet. Fluid mechanic theory and heat and mass transfer in fluidized beds. Design aspects of fluidized beds and pneumatic conveying. Industrial applications of fluidized beds (catalytic reactors, drying, coal conversion, waste treatment).
Prerequisite(s): CHE 302
Lecture: 3 **Lab:** 0 **Credits:** 3

CHE 491
Undergraduate Research
Students undertake an independent research project under the guidance of a chemical and biological engineering faculty member.
Credit: Variable

CHE 494
Process Design I
Introduction to design techniques and economic aspects of chemical processes. The technical and economic aspects of equipment selection and design, and alternative methods of operation.
Prerequisite(s): CHE 423* and CHE 435* and CHE 451 and CHE 433, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 2 **Lab:** 3 **Credits:** 3
Satisfies: Communications (C)

CHE 496
Process Design II
Group project in process design. Integration of technical, safety, environmental, economic, and societal issues in process development and design. Final part of the IPRO project package. Project teams consist of chemical engineering students and students from other disciplines and professions. Students from other academic units should register for designated section of IPRO 497 (three credits) and their contribution to the project tasks will be defined accordingly.
Prerequisite(s): CHE 494 and CHE 423* and CHE 435*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 2 **Lab:** 2 **Credits:** 3
Satisfies: Communications (C)

CHE 497
Special Projects
Special projects.
Credit: Variable

CHE 498
Chemical Process Safety Design
The purpose of the course is to apply process design disciplines to integrate safety as a principal of the design process. Typical subjects are: thermodynamics of explosions, identification of process hazards, chemical reactivity hazards, dispersion models of release of toxic materials, fires and fire protection, and HAZOP and Fault Tree analysis.
Prerequisite(s): CHE 494
Lecture: 3 **Lab:** 0 **Credits:** 3