

# CHEMICAL ENGINEERING (ECHE)

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## ECHE 520 - Chemical Engineering Fluid Mechanics (3 Credits)

Multi-phase pressure drop, phase contacting, flow through porous media, fluidization, mixing, and turbulence.

**Prerequisites:** D or better in ECHE 320 or ENCP 360.

## ECHE 521 - Computational Fluid Dynamics for Engineering Applications (3 Credits)

Introduction to the use of computational fluid dynamics codes to analyze flow, heat, and mass transfer problems of practical engineering applications.

**Prerequisites:** D or better in ECHE 320, EMCH 360, ECIV 360, ENCP 360, or AESP 265.

## ECHE 530 - Intermediate Chemical Engineering Kinetics (3 Credits)

Intermediate concepts of chemical kinetics, batch and flow reactors, catalysts and reactor design, including non-ideal systems.

**Prerequisites:** C or better in ECHE 311.

**Prerequisite or Corequisite:** D or better in ECHE 321.

## ECHE 540 - Intermediate Separation Process Design (3 Credits)

Intermediate level design of stagewise chemical separation cascades; analysis of binary and ternary systems; multicomponent separations, plate and column specification procedures; distillation, crystallization, extraction, and leaching.

**Prerequisites:** C or better in ECHE 300.

**Prerequisite or Corequisite:** D or better in ECHE 311.

## ECHE 550 - Chemical-Process Dynamics and Control (3 Credits)

Fundamental physical and chemical principles in mathematically modeling the dynamic response of chemical processes; feedforward and feedback control systems; design of control schemes for selected chemical processes.

**Prerequisites:** C or better in ECHE 300 and MATH 242; D or better in ECHE 456.

## ECHE 567 - Process Safety, Health and Loss Prevention (3 Credits)

Reliability, availability, and fault-tree analyses, risk indices, hazard evaluation, vapor cloud modeling, toxicology, material safety classification and regulations, individual/corporate ethical responsibilities.

**Prerequisite or Corequisite:** D or better in ECHE 466.

## ECHE 571 - Corrosion Engineering (3 Credits)

Basic principles of corrosion engineering developed from a chemical engineering approach to thermodynamics, kinetics, mass transfer, and potential theory.

**Prerequisites:** D or better in ECHE 311.

## ECHE 572 - Polymer Processing (3 Credits)

Industrial polymers with emphasis on their characterization and on the modeling of the major polymer fabrication processes.

## ECHE 573 - Next Energy (3 Credits)

An examination of energy technologies that will enable society to move from an economy based on fossil fuels to one based on sustainable energy.

## ECHE 574 - Combustion (3 Credits)

Fundamental process and applications related to the broad field of combustion and energy generation including emissions control technologies.

**Prerequisites:** D or better in ECHE 430.

## ECHE 575 - Engineering of Soft Materials (3 Credits)

Introductory overview of fundamental concepts in science and engineering of soft materials; the relation between microstructure and macroscopic behavior in a variety of soft matter systems; key applications in chemical and biomedical engineering.

**Prerequisites:** D or better in ECHE 320, ENCP 360, EMCH 360 or ECIV 360.

**Cross-listed course:** BMEN 575

## ECHE 589 - Special Advanced Topics in Chemical Engineering (3 Credits)

Course content varies and will be announced in the schedule of classes by title. May be repeated as topic varies.

## ECHE 700 - Chemical Process Analysis (3 Credits)

Quantitative analysis of industrial chemical operations. Equilibrium relations, material and energy balances, and reaction kinetics principles are used to analyze a variety of chemical processes and systems.

## ECHE 709 - Selected Topics in Industrial Stoichiometry (3 Credits)

Special topics in industrial stoichiometry with emphasis on current research.

## ECHE 710 - Advanced Chemical Engineering Thermodynamics (3 Credits)

Mass, energy, and entropy balance analysis of complex systems; evaluation of thermodynamic property changes of pure materials; solution thermodynamics of single-phase multicomponent systems; phase and chemical reaction equilibrium.

**Prerequisites:** ECHE 311.

## ECHE 719 - Selected Topics in Chemical Engineering Thermodynamics (3 Credits)

Special topics in chemical engineering thermodynamics with emphasis on current research.

## ECHE 720 - Advanced Fluid Flow Analysis (3 Credits)

Theory and application of fluid flow phenomena; momentum equations, conformal mapping, empirical methods, boundary layers, dimensional analysis.

**Prerequisites:** ENCP 360 and MATH 242.

## ECHE 721 - Advanced Heat Flow Analysis (3 Credits)

Theory and application of heat flow phenomena; classical techniques and finite-difference numerical methods; conduction, convection, radiation, boiling.

**Prerequisites:** ECHE 321 and ECHE 720.

## ECHE 722 - Advanced Mass Transfer (3 Credits)

Diffusive and convective mass transfer. Applications of the Stefan-Maxwell equations, prediction of diffusion coefficients, convective mass transport, correlations for mass transfer coefficients, and combined mass transfer and reaction modeling.

**Prerequisite or Corequisite:** ECHE 720.

## ECHE 725 - Rheology (3 Credits)

Rheological characteristics of viscous, elastic, viscoelastic, and plastic substances; non-Newtonian fluid flow, viscometry, and rheogoniometry; rheological equations of state; engineering applications.

**ECHE 728 - Selected Topics in Fluid Mechanics (3 Credits)**

Special topics in fluid mechanics with emphasis on current research.

**ECHE 729 - Selected Topics in Heat and Mass Transfer (3 Credits)**

Special topics in heat and mass transfer with emphasis on current research.

**ECHE 730 - Chemical Reactor Design (3 Credits)**

Optimum temperature sequencing. Modeling of non-ideal reactors. Theories of catalysis with emphasis on the rate of diffusion. Interpretation of experimental catalytic data and use of these data in reactor design.

**ECHE 735 - Heterogeneous Catalysis - Fundamentals (3 Credits)**

Fundamentals of heterogeneous catalysis, with emphasis on computational catalysis.

**ECHE 736 - Heterogeneous Catalysis – Synthesis, Characterization and Evaluation (3 Credits)**

Catalyst synthesis methods; experimental characterization approaches; correlating synthesis/characterization with catalytic performance.

**ECHE 737 - Industrial Catalysis (3 Credits)**

History of catalysis; industrial applications of catalysis; development of catalytic reactions from lab to pilot to production scale.

**ECHE 739 - Selected Topics in Kinetics and Reactor Design (3 Credits)**

Special topics in kinetics and reactor design with emphasis on current research.

**ECHE 740 - Distillation (3 Credits)**

Analytical, shortcut, and computer techniques for plate contacting of multicomponent systems. Review of binary separations, V-L-E models, azeotropic and extractive distillation, effects of non-key components, computational schemes, and convergence criteria.

**ECHE 741 - Liquid-Liquid Extraction (3 Credits)**

Principles of modeling liquid-liquid extraction cascades. Evaluation of L-L-E, ternary systems, design applications for hydrometallurgical systems, interlinked cascade structures for multiple solute systems, efficiency of process equipment, and synergism.

**ECHE 742 - Adsorption Fundamentals and Processes (3 Credits)**

Advanced principles of adsorption and adsorption processes including adsorbents, thermodynamics, kinetics, fixed bed adsorption and cyclic adsorption processes.

**ECHE 749 - Selected Topics in Separations (3 Credits)**

Special topics in separations with emphasis on current research.

**ECHE 750 - Process Dynamics and Control (3 Credits)**

Advanced topics in chemical process dynamics and control. Multivariate analysis, system identification, sampling, optimal process control.

**Prerequisites:** ECHE 550.

**ECHE 759 - Selected Topics in Process Control (3 Credits)**

Special topics in process control with emphasis on current research.

**ECHE 769 - Selected Topics in Chemical Engineering Design (3 Credits)**

Special topics in chemical engineering design with emphasis on current research.

**ECHE 770 - Electrochemical Engineering (3 Credits)**

Electrochemical engineering principles developed from thermodynamic, kinetic, mass transfer, and potential theory. Numerical analysis and design of electrochemical systems. Statistical analysis of experimental data and industrial experimental designs.

**ECHE 771 - Corrosion Engineering (3 Credits)**

Corrosion engineering principles developed from thermodynamic, kinetic, mass transfer, and potential theory. Numerical analysis of corroding systems, statistical analysis of experimental data, and industrial experimental designs.

**ECHE 772 - Principles of Polymer Systems (3 Credits)**

Theory and applications of polymer systems. Structure, physical properties, rheological, and mechanical behavior of polymers. Polymerization reactions and industrial polymerization processes. Fabrication techniques.

**ECHE 789 - Selected Topics in Chemical Engineering (3 Credits)**

Approved for special topic offerings.

**ECHE 797 - Research (1-12 Credits)**

Individual research to be arranged with instructor.

**ECHE 798 - Graduate Seminar in Chemical Engineering (1-2 Credits)**

Seminar on current topics in chemical engineering. Includes oral presentations by students on research projects.

**ECHE 799 - Thesis Preparation (1-12 Credits)**

To be arranged by candidates for the master's degree with the thesis advisor.

**ECHE 865 - Chemical Process Safety and Loss Prevention (3 Credits)**

Chemical process quantitative risk analysis, consequence modeling, risk estimation, and hazards assessment; design principles including inherent safety and mitigation techniques; elements of process safety management.

**Prerequisites:** ECHE 720.

**ECHE 899 - Dissertation Preparation (1-12 Credits)**