ENCH - ENGINEERING, CHEMICAL

ENCH608 Research in Chemical Engineering (1 Credit)
Students gain experience in research through lab rotations and experience presenting their findings.
Restriction: Must be in the Chemical Engineering Doctoral or Master of Science program.
Repeatable to: 8 credits.

ENCH609 Graduate Seminar (1 Credit)
Seminar in Chemical and Biomolecular Engineering
Repeatable to: 4 credits.

ENCH610 Chemical Engineering Thermodynamics (3 Credits)
Advanced application of the general thermodynamic methods to chemical engineering problems. First and second law consequences; estimation and correlation of thermodynamic properties; phase and chemical reaction equilibria.
Prerequisite: CHBE301; and CHBE302. Or students who have taken courses with comparable content may contact the department.
Restriction: Permission of ENGR-Chemical & Biomolecular Engineering department.
Credit Only Granted for: ENCH610 or CHBE610.
Formerly: ENCH610.

ENCH620 Methods of Engineering Analysis (3 Credits)
Application of selected mathematical techniques to the analysis and solution of engineering problems; included are the applications of matrices, vectors, tensors, differential equations, integral transforms, and probability methods to such problems as unsteady heat transfer, transient phenomena in mass transfer operations, stagewise processes, chemical reactors, process control, and nuclear reactor physics.
Prerequisite: MATH246 and CHBE250; or students who have taken courses with comparable content may contact the department.
Credit Only Granted for: ENCH620 or CHBE620.
Formerly: ENCH620.

ENCH630 Transport Phenomena (3 Credits)
Heat, mass and momentum transfer theory from the viewpoint of the basic transport equations. Steady and unsteady state: laminar and turbulent flow; boundary layer theory, mechanics of turbulent transport; with specific application to complex chemical engineering situations.
Prerequisite: CHBE422; and ENCH424. Or students who have taken courses with comparable content may contact the department.
Restriction: Permission of ENGR-Chemical & Biomolecular Engineering department.
Credit Only Granted for: ENCH630 or CHBE630.
Formerly: ENCH630.

ENCH640 Advanced Chemical Reaction Kinetics (3 Credits)
The theory and application of chemical reaction kinetics to reactor design. Reaction rate theory; homogeneous batch and flow reactors; fundamentals of catalysis; design of heterogeneous flow reactors.
Prerequisite: CHBE640; or students who have taken courses with comparable content may contact the department.
Restriction: Permission of ENGR-Chemical & Biomolecular Engineering department.
Credit Only Granted for: ENCH640 or CHBE640.
Formerly: ENCH640.

ENCH648 Special Problems in Chemical Engineering (1-16 Credits)

ENCH672 Control of Air Pollution Sources (3 Credits)
Sources and effects of air pollutants, regulatory trends, atmospheric dispersion models, fundamentals of two-phase flow as applied to air pollution and air pollution control systems, design of systems for control of gases and particulate matter.
Restriction: Permission of ENGR-Chemical & Biomolecular Engineering department. Jointly offered with: CHBE472.
Credit Only Granted for: CHBE472, CHBE672 or ENCH672.
Formerly: ENCH672.

ENCH686 Advanced Heterogeneous Catalysis for Energy Applications (3 Credits)
Introduction to heterogeneous catalytic science and technology for energy conversion and hydrocarbon processing. Preparation and mechanistic characterization of catalyst systems, kinetics of catalyzed reactions, adsorption and diffusion influences in heterogeneous reactions.
An overview of heterogeneous catalysis in various energy-related applications, including petroleum refining, chemicals from biomass, valorization of shale gas, and CO2 utilization will be introduced.
Prerequisite: Minimum grade of C- in CHBE302, CHBE424, and CHBE440; and permission of instructor.
Restriction: Permission of instructor. Jointly offered with: CHBE486.
Credit Only Granted for: CHBE486, ENCH686 or CHBE686.
Formerly: ENCH686.

ENCH739 Modern Computing Techniques in Process Engineering (3 Credits)
Presentation of recent developments in computing techniques in the context of chemical engineering problems. Symbolic computation and artificial intelligence, neural networks, data filtering and statistical treatment of data.
Restriction: Permission of instructor.
Repeatable to: 6 credits if content differs.

ENCH751 Turbulent and Multiphase Transport Phenomena (3 Credits)
Basic equations and statistical theories for transport of heat, mass, and momentum in turbulent fluids with applications to processing equipment. Fundamental equations of multiphase flow for dilute systems with applications to particles, drops and bubbles. Current approaches for analysis of concentrated suspensions including deterministic models and population balance approaches.
Prerequisite: ENCH620 and ENCH630.

ENCH781 Polymer Reaction Engineering (3 Credits)
Advanced topics in polymerization kinetics, reactor design and analysis; addition and step-growth polymerization; homogeneous and heterogeneous polymerization; photopolymerization; reactor dynamics; optimal operation and control of industrial polymerization reactors.
Prerequisite: ENCH640; or permission of instructor.
Credit Only Granted for: ENCH781 or CHBE690.
Formerly: ENCH781.

ENCH799 Master's Thesis Research (1-6 Credits)

ENCH818 Advanced Topics in Thermodynamics (3 Credits)
Second semester.

ENCH828 Advanced Topics in Chemical Reaction Systems (3 Credits)
First semester. Offered in alternate years.
Prerequisite: ENCH640.

ENCH838 Advanced Topics in Transfer Theory (3 Credits)
First semester. Offered in alternate years.
ENCH858 Advanced Topics in Process Control (3 Credits)
Advanced topics in chemical process control – robust control, model based process control, process sensing, fault detection, expert systems, neural networks, and integration of design and control.
**Restriction:** Permission of instructor.
**Repeatable to:** 6 credits if content differs.

ENCH859 Advanced Topics in Biochemical Systems (3 Credits)
Presentation of techniques for characterizing and manipulating non-linear biochemical reaction networks. Methods are applied to current biotechnological systems, some include: recombinant bacteria; plant, insect and mammalian cells; and transformed cell lines.
**Restriction:** Permission of instructor.
**Repeatable to:** 6 credits if content differs.

ENCH868 Advanced Topics of Process Design (3 Credits)
Advanced topics in chemical process analysis and design; construction of process models, steady-state and dynamic simulation, process synthesis, heat-exchanger networks, separation systems, chemical reaction systems, and bioprocesses.
**Restriction:** Permission of instructor.
**Repeatable to:** 6 credits if content differs.

ENCH869 Advanced Computer-Aided Process Engineering (3 Credits)
Advanced topics and projects involving modern computing techniques in chemical and process engineering. Topics include but not restricted to advanced process simulation; parallel computation; symbolic, Boolean, and algebraic computation in process modelling; molecular-based modelling; connectionist systems.
**Restriction:** Permission of instructor.
**Repeatable to:** 6 credits if content differs.

ENCH898 Pre-Candidacy Research (1-8 Credits)
ENCH899 Doctoral Dissertation Research (1-8 Credits)