Purdue University
School of Chemical Engineering

# ChE Electives - Fall 2014

The 500-level courses that have less than ten students may be cancelled. Students affected by the cancellation will be notified. (S-Science type course, D-Design type course)

## SPECIAL PROJECTS COURSES

CHE 41100 CHEMICAL ENGINEERING SCIENCE RESEARCH PROBLEMS. (S)
Prerequisites: Junior or senior standing in ChE and consent of Undergraduate Counselor. (May be repeated for credit.)
Experience in chemical engineering science research or development; either directed or independent work which can be experimental theoretical.

CHE 41200 CHEMICAL ENGINEERING DESIGN RESEARCH PROBLEMS. (D)
Prerequisites: Junior or senior standing in ChE and consent of Undergraduate Counselor. (May be repeated for credit.)
Experience in chemical engineering design research or development.

CHE 49800 RESEARCH IN CHEMICAL ENGINEERING I. Class, 1 Lab 6, cr. 3.
Prerequisite: Honors classification
Individual research projects for students with honors classification. Requires prior approval of, and arrangement with, a faculty research adviser.

## CLASSES

CHE 46300 APPLICATIONS OF CHEMICAL ENGINEERING PRINCIPLES Cr. 3
(Houze) Prerequisites: Senior standing and CHE378
The objective of this course is to provide students with opportunities to apply chemical engineering principles to practical situations to design, analyze operations, or predict operability of systems. Course Outcomes: Apply principles of chemical engineering to design practical systems. Participate in team-based projects to understand team operation and decision-making. Gain experience in and appreciation of the need for individual learning about new systems, equipment, etc. Understand the role of the engineer in promoting safe operation and consideration of environmental issues in technical decisions.

CHE 52500 BIOCHEMICAL ENGINEERING.
(Morgan) Prerequisite: CHE 348 or equivalent or consent of instructor
This course presents an introduction to the area of biochemical engineering. The utilization of enzymes and whole cells in free and immobilized systems as biocatalysts will be analyzed. Mathematical modeling of microbial cell growth and analysis of gas-liquid mass transfer will be applied for the design of fermenters. Additionally, the operation, instrumentation and control strategies for bioreactors will be examined. An overview of bioseparation processes will be presented with emphasis on protein purification. Special topics such as molecular biotechnology, plant and animal cell culture will be presented.

CHE 53800 PARTICLE DESIGN AND PROCESS
(Litster) Prerequisite: Graduate student or senior standing
Particle design is the production of new particles with specific attributes including the size, morphology and surface properties. To control these attributes, both the particle formation processes and the feed formulation properties need to be controlled. There are many particle design processes including crystallisation and precipitation; granulation; jet break up and spray drying; aerosol processes; chemical vapour deposition; suspension polymerisation; and comminution. This course will study a series of particulate design processes with special emphasis on quantitative design and operation to control particle attributes.

CHE 54000 TRANSPORT PHENOMENA. Sem. 1. Class 3.
(Caruthers) Prerequisites: CHE 378 and Senior standing or consent of instructor. Required for honor students.
Topics in fluid mechanics, heat transfer and mass transfer, including unsteady state transport problems, stream functions, potential flow, hydrodynamic and thermal layers, turbulence, and multicomponent diffusion. This course will attempt to give students a strong BSL background in transport phenomena and thus prepare them well for graduate school and to become more adept in the use of basic principles of transport in various chemical engineering applications.

CHE 54400 (Won) STRUCTURE AND PHYSICAL BEHAVIOR OF POLYMER SYSTEMS
Prerequisite: CHM 262 and 370 or consent of instructor.
Statistical mechanics of chain molecules, thermodynamics of polymer solutions, phase separations, experimental methods of molecular weight determination, crystallization of polymers, polymer physics, rubber elasticity, viscoelasticity.

CHE 55500 (Reklaitis) COMPUTER INTEGRATED PROCESS OPERATIONS
Computer aided process operations management includes tasks such as process monitoring, regulatory control, data reconciliation, unit and plant-wide optimization, process fault diagnosis, supervisory control, planning and scheduling. Dealing with integration requires a careful choice of problem-solving paradigms, knowledge representation, search and reasoning techniques so as not to burden the individual tasks and at the same time providing a unified framework. In this course, we will address the nature of these operational tasks, the character of integration, the use of artificial intelligence, math programming and nonlinear modeling techniques.

CHE 55800 (Wang) RATE-CONTROLLED SEPARATION PROCESSES Sem. 2. Class 3, cr. 3.
Prerequisite: CHE 306 and 378.
Rate-controlled separation processes based on solute movement (adsorption, chromatography, and ion exchange), membranes (reverse osmosis, ultrafiltration, and gas permeation), and crystallization.

CHE 59700 (Wu) INTRODUCTION TO ENERGY STORAGE SYSTEMS
This survey course will examine the basic physics, chemistry, and engineering issues of energy storage devices, such as batteries, thermoelectric convertors, fuel cells, supercapacitors and connect with the power electronic applications in electric vehicles. The format of the course will consist of lectures, tutorials, demonstrations, site visits, computer simulations, assignments, discussion periods, and term paper.

CHE 59700 (Agrawal) SYSTEMS ANALYSIS OF ENERGY PRODUCTION
Even though our goal is to accelerate the use of renewable energy, it is a reality that the use of renewable resources will coexist with fossil fuel for a reasonable foreseeable time period. The impact of environmental and energy policies and interrelationship between various energy sources and use habits of the consumers also must be understood by students interested in the grand challenge of energy. This course will deal with the past, current and future production and use of all forms of energy (coal, petroleum, natural gas, renewable resources such as wind, hydro, biomass, solar etc.) along with their availability and environmental footprint. The thermodynamic limits for use of energy in various forms (as heat, mechanical work, electricity etc) will be discussed. How the common use habits influence the end inefficiencies and hence the rate at which energy is consumed. The complex interaction scenarios that may exist during the transition period from fossil resources to renewable resources will be highlighted in detail. This course will enable the students get an overall view of energy Production, Transformation, Distribution and Use based on thermodynamic principles. Therefore, this course will be an integral part of the unique systems approach and expose the students to the extreme complexity of the subject.

CHE 59700 (Boudouris) ORGANIC ELECTRONIC MATERIALS AND DEVICES
Prerequisites: CHM 261 (Organic Chemistry I), or equivalent. Or permission from the instructor must be received.
Course Description: This course gives an introduction to the synthesis, optical properties, transport physics, and device operation of organic electronics. *These modules will be the next-generation of electronics that will allow for the realization of fully-foldable mobile phones and tablet devices, paper-thin televisions, and solar cells that have a conformal coating on entire rooftops.* As such, this course will review how the molecular architecture of small molecule and polymer semiconductors can be tuned to alter the optoelectronic properties of the materials in solution and in the solid state. A number of relevant materials interactions will be covered, including: photoexcitation and recombination, intermolecular charge transport mechanisms, and energy transfer processes. Additionally, we will see how these processes are relevant to applications such as organic field-effect transistors (OFETs), organic light-emitting diodes (OLEDs), organic photovoltaic (OPV) devices (*i.e.*, flexible solar cells), and organic memory elements.