Purdue University
School of Chemical Engineering

ChE Electives - Spring 2019

SPECIAL PROJECTS COURSES

CHE 41100 CHEMICAL ENGINEERING SCIENCE RESEARCH PROBLEMS
Prerequisites: Junior or senior standing in ChE. (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
Prerequisites: Junior or senior standing in ChE. (May be repeated for credit.)
Experience in chemical engineering design research or development.

CHE 49900 RESEARCH IN CHEMICAL ENGINEERING II 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 advisor.

CLASSES

CHE 44200 CHEMISTRY AND ENGINEERING OF HIGH POLYMERS
(Caruthers) Prerequisites: CHM 26200 and CHM 37000. Second semester juniors or seniors.
The objective of this course is to provide an overview of the production and use of engineering polymers. A wide range of topics will be covered in order to present a complete picture of technologies that are used in the polymer industry; consequently, the depth for a particular topic must be somewhat limited. The following course topics will be discussed: Types of polymers, polymerization reactions, molecular characterization, morphology, polymerization reactors, rheology and polymer processing, and mechanical properties and component design.

CHE 52500 BIOCHEMICAL ENGINEERING
(Morgan) Prerequisite: CHE 34800 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 55100 PRINCIPLES OF PHARMACEUTICAL ENGINEERING cr. 3
Prerequisite: Graduate student or senior standing
Survey course that provides an overview of the major issues involved in the development, manufacturing and delivery of pharmaceutical products in an integrated manner. The topics include: Introduction, Drug Discovery, Product portfolio optimization, Process synthesis and Route selection, Rational product formulation and design, Batch Process simulation and tools, Pilot plant and scale-up, Process Analytical Technology, Pharmaceutical Informatics, Process safety and control, Scheduling and planning of supply chains, cGMP and Regulatory environment and future directions.

CHE 59700 ANALYTICAL APPROACH TO HEALTHCARE DELIVERY
CHE 49700H BIOL 230 or BCHM 307 – Please see Undergraduate Office for Override
(Clark) Engineers are integral to the healthcare industry in numerous ways and a significant number of engineering graduates enter the healthcare workforce to make important contributions in numerous ways. An understanding of the dynamics of healthcare delivery can provide insights that further enhance the role that engineers play. The overall purpose of this course is to provide a “real world” overview of healthcare delivery in the United States (US). The topics initially covered include the major medical product segments, namely the pharmaceutical and medical devices industries. The structure of companies operating in these sectors along with the regulatory framework which governs them will be discussed. Health economic considerations, including product costs and reimbursement along with issues related to insurance coverage, will also be covered. Following a focused review of relevant physiology and pathophysiology, a series of critical medical conditions having the highest impact on the US healthcare system are discussed. These diseases include coronary artery disease, heart failure, diabetes, cancer, obesity, Alzheimer’s disease, chronic kidney disease, stroke, arthritis, sepsis, and acute kidney injury. The final aspect of the course is a team project, in which an engineering solution is proposed to address an unmet clinical need for one of major conditions discussed.

CHE 59700 (Siirola) INDUSTRIAL CHEMICAL TECHNOLOGY

This course will survey key sectors of the chemical processing industries and discuss the structure of the industry and the historical development and evolution of the technologies which have shaped them and the common manufacturing process and flowsheet elements which have proven to be commercially successful. Examples will be drawn from a range of industry sectors, production scales, chemistries, and enabling technologies. The process industries will be examined in light of factors which have most influenced its development including scale of demand, raw materials of choice, energy availability, and the development of new unit operations, as well as those which will influence its future course including advances in science and technology, environmental impact minimization, water availability, and sustainability concerns.

CHE 59700 (Dou) ORGANIC ELECTRONIC MATERIALS AND DEVICES

Prerequisites: CHM 26100 (Organic Chemistry I), or equivalent or permission from the instructor must be received.

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.

CHE 59700 (Pol) BATTERY SYSTEMS ENGINEERING WITH LABORATORY

Prerequisite: Consent of instructor

Battery systems are perhaps the key technology for the emerging revolution in green energy technology. Batteries are needed for electric vehicles and plug-in electric vehicles, where reducing the cost of the batteries is the key barrier to the widespread adoption of electric vehicle technology. Both wind and solar power critically depends upon low-cost, fixed power storage via batteries in order to level the load for the smart grid. This course will provide an introduction to battery systems via a weekly lecture; however, the major focus of this course is a laboratory with hands-on experiments on various aspects of battery technology including basic electrochemistry, battery characterization, battery operations and the manufacturing processes for batteries. Students should emerge from this course with practical experience in how batteries work and how they are manufactured.

CHE 59700 (Agrawal) SYSTEMS, ECONOMICS AND SUPPLY CHAIN ANALYSIS FOR FOOD, ENERGY AND WATER

This course will teach how to analyze and synthesize sustainable food, energy and water systems (SFEWS) based on thermodynamic as well as other scientific and technical analytical tools. The role of fossil resources leading to current state and a future sustainable economy based on solar energy will be discussed and analyzed. Furthermore, cost benefit analysis will be taught in detail to evaluate sustainable systems prior to their implementation. Key components will include private versus social valuation, economic valuation methods, and uncertainty. This course will teach scientific and technical methods to analyze and create sustainable food, energy and water systems as well as their analysis for economic feasibility and potential policy issues.

ABE 58000 PROCESS ENGINEERING OF RENEWABLE RESOURCES

Prerequisite: Senior standing.

Process fundamentals of biotechnology and biochemical engineering are presented in a case study approach using examples from food, bio-engineering, and pharmaceutical industries. Case studies will include: high fructose corn syrup (HFCS) and ethanol (octane booster) production using bioreactors; cellulose conversion; enzyme technology in cheese manufacture; and interferon and diagnostic monoclonal antibody (MCA) production techniques. Fundamentals oriented toward process analysis and conceptual design will be discussed in the areas of:

1. Soluble and immobilized enzyme kinetics;
2. Extraction and adsorption technology;
3. Practice and semi-empirical design of process scale liquid chromatography; and
4. Novel bioreactor configurations.

Grades will be based on two tests and a special topic assignment, in addition to homework assignments.