Purdue University
School of Chemical Engineering

ChE Electives - Spring 2020

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
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
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 53600 PARTICULATE SYSTEMS
Prerequisite: ChE 37700 or equivalent or consent of instructor
A broad overview of the fundamental concepts in particulate systems including particle characterization, particle size measurement, sedimentation, fluidization, gas and liquid conveying, particle storage, fluid-particle separation, particle size enlargement and reduction, particle mixing and hazards associated with the handling of particulate solids. Practical applications are emphasized, with a focus on how particles behave differently than fluids.

CHE 54000 TRANSPORT PHENOMENA
Prerequisites: CHE 37800 or consent of instructor
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 55300 PHARMACEUTICAL PROCESS DEVELOPMENT AND DESIGN
Prerequisite: Senior standing or consent of instructor
The development and design of processes for the production of pharmaceutical products involves three important tasks: translation of the recipe for the drug substance that was developed at the laboratory stage to a recipe usable in production, selection and preliminary design of the equipment used to carry out the steps of the recipe, and selection and preliminary design of the equipment used to make the formulation (e.g., tablet or capsule) that is the vehicle for delivery to the patient. The primary lecture for the course will be Prof. G. V. Reklaitis (ChE) and Dr. P. Basu (Discovery Park). A number of guest lecturers from the Department of Industrial Pharmacy and from industry will be engaged.

CHE 59700 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 ENERGY PRODUCTION AND PROCESSES FROM SHALE HYDROCARBONS

While there are specific courses on sustainability, there are none that focus on light hydrocarbons and none that include substantial technical content on the industrial sector itself. This course will blend catalysis/reaction engineering, separations, process engineering, process optimization/modeling, life-cycle/impact assessment, and policy to examine how light hydrocarbons are currently used and how they are being deployed as a bridge to a net-zero carbon economy.

CHE 59700 PRINCIPLES OF TISSUE ENGINEERING

Prerequisite: Graduate student or senior standing

This course will address the design strategies for engineering tissues such as bone, cartilage, skin, blood vessels, and the liver. In particular, we will address the underlying principles for the design of an appropriate scaffold, selection and comparison of cell sources, and the use of exogenous (growth) factors. Topics include cell-material interactions, *in vitro* cell culture techniques, degradation kinetics of the materials, and transport properties throughout the material.

CHE 59700 CRYSTALLIZATION SYSTEMS ENGINEERING

This course describes advanced but industrially relevant concepts of crystallization process engineering, including population balance modeling, model-based dynamic optimization and control, process analytical technology (PAT) and quality-by-design techniques for crystallization process and product design. The topics will cover approaches and tools for the mathematical modeling and control of crystallization systems as well as provide hands on experience with simulation software packages as well as a variety of PAT technologies. A series of invited lectures from industrial speakers will also be included on industrial crystallization topics.

CHE 59700 RECENT DEV. & METHODS FOR ENERGY EFFICIENT DISTILLATION & SEPARATIONS

Prerequisite: CHE 30600

This course is designed to equip students with advanced concepts and state-of-the-art techniques developed in the past two decades. The course begins with a brief description of the basics of distillation. Subsequently, students are introduced to advanced concepts including the theory of multicomponent distillation, exergy analysis, intermediate heat exchangers, feed preconditioning, double and multieffect distillation, heat pumps, systematic synthesis of separation trains for multicomponent mixtures, heat and mass integration in distillation and so forth. The latter part of the course deals with membrane models and design of energy-efficient cascades for high purity separations. An important learning outcome from this course is to systematically develop novel energy-efficient distillation and/or membrane solutions for a given application.

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.