COURSES DESCRIPTIONS

Chemical Engineering Core Courses

CHE 201: Principles of Chemical Engineering (3-0-3)

The basic principles and techniques used for calculations of material balances in chemical engineering processes are introduced. Material balance for reactive and nonreactive processes is discussed. Simple chemical engineering processes and complex systems including recycle are covered. Study the behavior of ideal and real gases.

Prerequisites: CHEM 102

CHE 203: Chemical Engineering Thermodynamics I (2-0-2)

The first law of thermodynamics is studied in detail. Material covered includes concepts of energy, enthalpy, heat effects, conservation of energy, mechanical work, chemical energy liberation and equations of state, behavior of gases and liquids and standard heats of reaction, formation and combustion and heat effects of industrial reactions. Thermodynamics properties of materials and methods of their estimation are presented. Study the combined mass and energy balances and applications to problems through use of enthalpy concentration charts and humidity charts.

Prerequisites: CHE 201

CHE 204: Process Fluid Mechanics (3-3-4)

The course introduces principles governing fluid flow for Newtonian and non-Newtonian fluids in laminar and turbulent flows. Mass, energy, momentum balances, dimensional analysis tools to analyze flows: in pipes, in packed beds, around particles and surfaces, fluidized beds and flow meters. The course also covers: hydrostatics, exact solution of Navier-Stokes equations, constitutive equations for stresses, viscous effects and boundary layer flows. Relevant experiments (Friction losses in Pipes and Fittings, Pump Performance, Flow meters, Pressure drop)

Prerequisites: CHE 201

CHE 300: Process Heat Transfer (3-3-4)

Modes of heat transfer. Differential equations of energy transport. Steady and transient heat conduction. Free and forced convection in laminar and turbulent flows. Momentum and heat transfer analogies. Boiling and condensation. Radiation heat transfer. Application to the design of process heat transfer equipment. Relevant experiments (Thermal Conductivity, Double Pipe Heat Exchanger, Shell & Tube Heat Exchanger, Convection and Radiation Heat Transfer)
Prerequisites: CHE 203, CHE 204

CHE 303: Chemical Engineering Thermodynamics II (3-0-3)

This course presents the theory and applications of chemical engineering thermodynamics. Topics covered include: review 1st and 2nd laws of thermodynamics, equations of state, thermodynamics of flow processes, steam power plants, thermodynamic relations, thermodynamic properties of pure fluids, vapor-liquid equilibria, phase diagrams, solution thermodynamics, thermodynamics properties of fluid mixtures, and chemical-reaction equilibria.
Prerequisites: CHE 203

CHE 304: Mass Transfer (3-0-3)

This course covers fundamentals of mass transfer, differential equations of mass transfer, steady-state and unsteady-state molecular diffusion, convective mass transfer, interface mass transfer, mass transfer theories, mass transfer equipment, absorption and humidification operations.
Prerequisites: CHE 204

CHE 306: Stagewise Operations (3-3-4)

Review vapor-liquid equilibria. Flash distillation. Column binary distillation. McCabe-Thiele and Ponchon-Savarit methods. Exact and shortcut methods for multicomponent distillation. Batch distillation. Staged and packed column design. Absorption and stripping. Immiscible extraction. Relevant experiments (Packed Column, Drying, Diffusion, Solid Liquid Mass Transfer, Double Effect Evaporator, Continuous Distillation, Cooling Tower, Liquid-Liquid Extraction)
Prerequisites: CHE 303, CHE 304

CHE 307: Process Dynamics and Control (3-0-3)

The intent of this course is to present the fundamental principles in modeling and control of chemical processes. The topics covered in this course include: modeling of chemical processes, Laplace transfer and state-space models, approximation of complicated models, dynamics and simulation of different systems, feedback controllers, PID tuning, design and instrumentation of closed-loop control systems, control block diagrams, frequency response analysis, Bode and Nyquist stability criteria.

Prerequisites: CHE 304

CHE 308: Kinetics and Reactor Design (3-3-4)

Introduction to kinetics of reactions. Techniques for experimentally determining rate laws for simple and complex chemical reactions. Design and operation of isothermal batch and flow reactors. Nonisothermal reactor design and operation. Introduction to catalysis and catalytic reactors. Relevant experiments (CSTR, Tubular Reactor, Batch Reactor; Temperature, Flow rate and Level Control, Dynamics of Stirred Tanks, Time Constants of Thermocouples)

Prerequisites: CHE 303

Corequisites: CHE 307

CHE 350: Cooperative Work (0-0-0)

See contents in CHE 351.

Prerequisites: CHE 306, ENGL 214 and Departmental Approval

CHE 351: Cooperative Work (0-0-6)

In this course the student will spend a period of 28 weeks of industrial employment in industry. Students are required to write a detailed formal report on their experience. Evaluation by the employer will be counted towards the grade given for this course.

Prerequisites: CHE 306, ENGL 214 and Departmental Approval

CHE 352: End Cooperative Work (0-0-0)

See contents in CHE 351.

Prerequisite: Same as in CHE 351

CHE 415: Computer Aided Process Design Lab (1-3-2)

Usage of commercial process simulation packages; HYSIS, Aspen One TM, CHEM CAD, Superpro or others in Process flow sheet simulation, Properties estimation, Equipment sizing, Process optimization, Process synthesis.

Prerequisite: CHE 306

CHE 425: Process Design & Economics (3-0-3)

Introducing the Process flow diagrams and plant layout, conceptual design and synthesis of process flow diagrams, understanding the process conditions, technical analysis of chemical processes and use of heuristics in design and analysis, and use of simulation in equipment design and process synthesis. Engineering economic analysis of chemical processes with particular emphasis on estimation of capital cost, estimation of cost of manufacturing, time value of money, depreciation, cash flow, profitability and financial analysis, methods for decision making among alternatives.

Prerequisites: CHE 306

Corequisites: CHE 308

CHE 495: Integrated Design Course (1-6-3)

Development of general engineering skills and judgment needed in the solution of open ended problems from a technical-economic viewpoint are the major goals of this course. The design of a project from conception to implementation including preliminary feasibility study, preparation of process, flow diagram, process design, pre-construction cost estimate, equipment sizing (design), selection of materials of construction, and analysis of project. Applications will be in areas such as petroleum, petrochemicals, emerging chemical industries and water desalination. Design topics will be assigned to teams of students.

Corequisites: CHE 425

13.2 Chemical Engineering Elective Courses

13.2.1 Polymers & Petrochemicals Module

CHE 461: Petroleum Refining (3-0-3)

General review of refining processes of crude oil. Shortcut methods for practical design calculations. Design of atmospheric, vacuum, and pressure columns for petroleum fractionation, including auxiliary furnaces and condensers. Recent developments in heavy oil processing.

Prerequisite: CHE 306

CHE 462: Petrochemical Industries (3-0-3)

Process technologies used in petrochemical industries, such as thermal and catalytic cracking will be introduced. Basic, intermediate and final petrochemicals are studied. These include synthesis gas and derivatives, ethylene, propylene, butene, BTX, and their derivatives. Competing technologies will be assessed from the chemical engineering point of view.

Prerequisite: CHE 306

CHE 463: Polymer Technology (3-0-3)

Structure and physical properties of polymers. Homogeneous and heterogeneous polymerization processes. The chemical, mechanical, and engineering properties of polymers as well as polymer processing and rheology are emphasized in this course.

Prerequisite: CHEM 312

CHE 464: Catalysis & Catalytic Processes (3-0-3)

This course presents an introduction to heterogeneous catalysis and the chemical and physical phenomena involved. This includes adsorption on and desorption from solids surfaces, kinetic description of surface reactions, pore structure and surface properties of solid catalysts and their catalytic activity and selectivity. Heat and mass transport in catalyst pellets and particles will be discussed. Moreover, methods for characterization of catalytic systems will be described. Catalyst deactivation concept will be also introduced. Important industrial catalytic processes will be as addressed well.

Corequisites: CHE 308

CHE 465: Corrosion (3-0-3)

Study of corrosion mechanisms and techniques used in prevention and control. Electrochemistry and its application to corrosion. Material selection for different environments.

Prerequisite: CHEM 312

13.2.2 Environmental Engineering Module

CHE 431: Membrane Processes Technology (3-0-3)

Membrane fundamentals and practical applications of membrane processes; membrane classifications, materials, properties and characterization, and preparation; transport through membranes, concentration polarization and membrane fouling, membrane permeability with special emphasis on membrane modules and process design; gas separation, pervaporation, ultrafiltration, reverse osmosis, and membrane reactors.

Prerequisite: CHE 306

CHE 470: Process Air Pollution Control (3-0-3)

Sources and effects of air pollution; air quality, atmospheric reactions and scavenging processes. Meteorological setting for dispersion of air pollutants. Theory of atmospheric dispersion modeling. Air pollution control concepts, selection, evaluation and application of control devices for emission and control from chemical and petrochemical industries.

Prerequisite: CHE 304

CHE 471: Process Water Pollution Control (3-0-3)

Water quality and pollution, industrial wastewater characterization, classification of wastewater processes. Modeling and design of biological waste treatment processes. Analyses of chemical and physical processes for wastewater treatment in process industries.

Prerequisite: CHE 304

CHE 473: Desalination (3-0-3)

Description of methods of water analysis and treatment. Study of properties of water and aqueous solutions. Detailed discussion and analysis of design, maintenance, energy requirements and economics of the major processes of desalination such as distillation, reverse osmosis, and electrodialysis.

Prerequisite: CHE 304, CHE 303

13.2.3 Process Simulation & Control Module

CHE 453: Mathematical Methods in Chemical Engineering (3-0-3)

This course introduces the selection, construction, solution, and interpretation of mathematical models applicable to the study of chemical engineering problems. Topics covered include introduction to mathematical modeling, analytical solution of ordinary differential equations, special functions, analytical solution of partial differential equations, numerical solution of nonlinear algebraic systems, and numerical solution of systems of first order ODE's.

Prerequisite: MATH 202, CHE 304

CHE 455: Chemical Process Simulation (3-0-3)

The intent of this course is to emphasize the application of computer simulation and flow-sheeting, optimization, and process synthesis techniques to the design and operation of chemical processes and equipment. Students will learn how to simulate various process units and processes, and what is in the black box of a simulator program. The topics covered in this course include: concepts of structure and information flow and tasks in the design and analysis of chemical processes, basic solution strategies in flow-sheeting computations, computation sequence in solving set of equations, concept of flowsheet partitioning and tearing, steady-state unit operation models in simulator packages such as Aspen Plus, HYSYS
and UniSim Design, selection of thermodynamics and physical property models, and heuristics for process synthesis. Each student will be assigned an individual process to simulate under steady-state conditions using available process simulators.

Prerequisite: CHE 306

CHE 456: Industrial Process Control (3-0-3)

Review of feed back control, cascade control, Ratio, override, selective, feed-forward, and multivariable process control. Dynamic simulation of control systems using SIMULINK and other commercial software packages. Instrumentation, design case studies and tuning case studies.

Prerequisite: CHE 307

CHE 457: Chemical Engineering Optimization (3-0-3)

The course is intended to cover: survey of continuous optimization problems. Structure and formulation of optimization problems in chemical engineering. Unconstrained optimization problems. Linear programing. Introduction to constrained optimization. Solution of constrained optimization problems. Selected applications in chemical engineering. Software package in optimization.

Perquisites: MATH 321

CHE 498: Special Topics in Chemical Engineering I (3-0-3)

This course involves a variety of selected topics in chemical engineering. The contents of course depend on the instructor specialization and/or students' needs and/or contemporary issues. The specific content of the course is published one semester in advance.

Prerequisite: Departmental Approval