CHEMICAL ENGINEERING

CHE 201 Principles of Chem. Engg. I (3-2-3)
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 of behavior of ideal and real gases. Computer simulation will be used for material balance problems.
Prerequisite: CHEM 102, PHYS 102

CHE 202 Principles of Chem. Engg. II (2-2-2)
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 of combined mass and energy balances and applications to problems through use of enthalpy concentration charts and humidity charts. Computer simulation will be used for combined material and energy balance problems.
Prerequisite: CHE 201, MATH 201, ICS 103

CHE 204 Fluid Mechanics (3-0-3)
The course introduces principles governing fluid flow for Newtonian and non-Newtonian fluids in laminar and turbulent flows. Mass, energy, momentum balances, dimensional analysis and simulation are used as 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. Computer simulation will be used for piping and pumping problems.
Corequisite: MATH 202
Prerequisite: CHE 201 or PETE 101

CHE 300 Heat Transfer (3-0-3)
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.
Prerequisite: CHE 202, CHE 204

CHE 303 Chemical Engineering Thermodynamics (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, thermodynamics properties of pure fluids, vapor-liquid equilibria, phase diagrams, solution thermodynamics, thermodynamics properties of fluid mixtures, and chemical-reaction equilibria. Computer simulation to thermodynamic systems is applied in this course.
Prerequisite: CHE 202, MATH 202

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.
Prerequisite: CHE 204

CHE 306 Separation Processes (3-0-3)
Review vapor-liquid equilibria. Flash distillation. Column binary distillation. McCabe-Thiele and Ponchon-Savarit methods. Excat and short cut methods for multicomponent distillation. Batch distillation. Staged and packed column design. Absorption and stripping. Immiscible extraction. Computer simulation will be used to solve different type of distillation problems throughout the course.
Prerequisite: CHE 303

CHE 309 Chemical Engineering Laboratory I (0-6-2)
This laboratory emphasizes concepts presented in the transport phenomena courses. A safety session is given at the commencement of the course. Safe practices are strictly adhered to throughout the course. Students carry out selected experiments in fluid mechanics, heat transfer, thermodynamics and diffusional mass transfer. Data collected are analyzed and compared to applicable theories.
Prerequisite: CHE 300, CHE 304, ENGL 214

CHE 350 Begin Cooperative Work (0-0-0)
See contents in CHE 351.
Prerequisite: Same as in CHE 351

CHE 351 Cooperative Work (0-0-9)
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.
Prerequisite: ENGL 214, CHE 309

CHE 352 End Cooperative Work (0-0-0)
See contents in CHE 351.
Prerequisite: Same as in CHE 351

CHE 399 Summer Training (0-0-0)
A period of 12 weeks of industrial employment in appropriate industries or firms. Students are evaluated on their performance, and are required to submit a report and offer a seminar about their experience before receiving a grade of Pass or Fail for the course.
Prerequisite: ENGL 214, CHE 304

CHE 401 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.
Prerequisite: CHE 306, MATH 371

CHE 402 Kinetics and Reactor Design (3-0-3)
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. Computer simulation of reaction systems will be implemented.
Prerequisite: CHE 303, CHEM 311

CHE 404 Hydrogen production and storage (3-0-3)
The aim of this course to provide insight into the alternative resources and technologies for hydrogen production and to discuss the present options of hydrogen storage and future needs.
Prerequisite: CHE 303 or equivalent

CHE 409 Chemical Engineering Laboratory II (0-6-2)
A laboratory to complement the theoretical derivations in stagewise operations, process dynamics and control, and kinetics and reactor design. A safety session is given at the commencement of the course. Safe practices are strictly adhered to throughout the course. Two environmental engineering reaction experiments are included. Students carry out selected experiments, analyze data collected referring to applicable theories and present their findings in formal reports.
Corequisites: CHE 401, CHE 402
Prerequisite: CHE 309

CHE 422 Properties of Fluids (3-0-3)
Study on several methods for the estimation of physical, thermodynamic and transport properties of fluids commonly used in industry. Study of literature sources where property information is available. Application of these properties to process design is emphasized to give the students a complete picture of the use and importance of good property estimation.
Prerequisite: CHE 303

CHE 425 Process Design and 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.
Corequisite: CHE 402
Prerequisite: CHE 306

CHE 430 Rate-Based Separation Processes (3-0-3)
The intent of this course is to present advances separation techniques practiced in chemical and petrochemical industry. Dynamics of the distillation column involving the column internals and column diameter calculations will be covered. Emphasis will be on the unit operations of multi-component gas absorption, humidification, evaporation, adsorption and ion exchange, reverse osmosis, permeation, dialysis, electrodialysis, and pervaporation.
Prerequisite: CHE 306

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 304

CHE 432 Principles of Heat Exchanger Design (3-0-3)
Description and applications of different heat exchangers in process industries. Design of double pipe heat exchanger (including extended surfaces). Detailed design procedures for shell and tube heat exchanger for single phase flow. Detailed design procedures for air coolers. Selection criteria for heat exchangers. Descriptive discussion of condensers, evaporators and reboilers, novel heat exchangers and other types of heat exchangers.
Prerequisite: CHE 300 or ME 315

CHE 440 Catalysis & Catalytic Processes (3-0-3)
Basic definitions and classification of catalysts, nature and mechanism of catalytic reactions, adsorption processes, catalyst preparation and catalyst characterization. Mass and heat transport effects in catalysis. Catalyst deactivation. Design principles of heterogeneous catalytic reactors such as fixed- and fluidized-bed reactors. Industrial catalytic processes with emphasis on existing processes in Saudi Arabia.
Corequisite: CHE 402

CHE 444 Electrochemical Energy Conversion and Storage (3-0-3)
Fuel cell thermodynamics and electrochemistry. Charge transport in polymer and ceramic electrolytes. Gas phase transport in fuel cells (diffusion and fluid mechanics). Energy balance and heat management. Flux balance for fuel cells. Electrochemical energy storage including batteries and supercapacitors. Power management strategies for hybrid storage systems.
Prerequisite: CHE 303 or equivalent

CHE 449 Biochemical Engineering (3-0-3)
Descriptive treatment of key concepts on biochemistry. The kinetics of enzyme-catalyzed reactions and its applications. Kinetics of substrate utilization, transport phenomena in microbial systems. Design and analysis of biological reactors. Analysis of multiple interacting microbial populations in applications.
Corequisite: CHE 402
Prerequisite: CHE 304

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: CHE 300, CHE 304

CHE 455 Chemical Process Simulation (3-0-3)
The intent of this course is to emphasize the application of computer simulation and flowsheeting, 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 flowsheeting 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 feedback 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 401

CHE 458 Process Safety Engineering (3-0-3)
Applications of engineering principles to process safety and hazards analysis, mitigation, and prevention, with special emphasis on the chemical process industries. Includes source modeling for leakage rates, dispersion analysis, relief valve sizing, fire and explosion damage analysis, hazards identification, risk analysis, accident investigations, etc.
Prerequisites: PHYS 102, Senior standing

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: CHE 303

CHE 464 Refining and Petrochemicals Technology and Economics (3-0-3)
The characteristics of the industry in terms of feed stocks and products interaction, processes and technologies, and Economics are introduced. Petroleum fractionation and general review of refining processes of crude oil are introduced. Important petrochemical products are introduced with emphasis on those produced in Saudi Arabia. The basic unit processes such as hydrotreating, cracking, reforming, dehydrogenation, oxidation etc., are introduced along with

their applications in the industry. The economics and cost of production is discussed whenever relevant. The course will emphasize the basic concepts and principles of the industry and will avoid unnecessary and descriptive process details. Integration of the Petrochemical and Petroleum Refining industries will be highlighted whenever applicable.
Prerequisite: CHE 306

CHE 465 Process Integration and Optimization (3-0-3)
This course presents recent advances in chemical process integration and synthesis. The course presents systematic and state-of-the-art techniques for understanding the global insights of mass and energy flows within a process and how these integrated insights can be used to optimize process performance. A variety of mathematical and visualization tools are presented. In particular, emphasis is given to fundamental integration and synthesis methodologies along with their applications to the process industries.
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. Sustainability and minimization of environmental impact.
Prerequisite: Senior Standing

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. Analysis of chemical and physical processes for wastewater treatment in process industries. Sustainability and minimization of environmental impact.
Prerequisite: CHE 304

CHE 472 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 311

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

CHE 477 Materials Evaluation and Selection (3-0-3)
This course is designed to acquaint students with the theoretical reasoning and experimental methods used in evaluating both crystalline and non-crystalline materials covering metallic, polymeric and ceramic materials. The principles involved in their selection based on mechanical properties, resistance to degradation, and wear, and special properties are illustrated in the practical examples from process industries.
Prerequisite: ME 205

CHE 480 Energy Technology (3-0-3)
Statistics on global energy use, supply and demand of energy, energy generation from fossil and non-fossil fuels. Energy transportation and storage, energy from low-calorific value fuels, energy conservation and economics, and energy management.
Prerequisite: CHE 303

CHE 485 Fundamentals of Radioactive Waste Management and safety (3-0-3)
This course is designed to provide the students about the technology of the general management of the radioactive waste generated during the operation of nuclear power plant and nuclear fuel cycle facility including the treatment and disposal of the wastes. Background information on the sources of the gaseous, liquid and solid radioactive waste, and process and treatment facilities, solidification and volume reduction technology, packaging and transportation, storage methods of the wastes and spent nuclear fuel, design, safety and construction of the waste repositories, migration of the radionuclide at the subsurface, environmental monitoring and protection, repository safety assessment, decontamination and decommissioning, and the management of spent nuclear fuel will be covered
Prerequisite: MATH 102, PHYS 102

CHE 490 Special Topics in Chemical Engineering I (3-0-3)
Selected topics from the broad area of chemical engineering. The specific contents of the course is published one semester in advance.
Prerequisite: Departmental Approval

CHE 492 Special Topics in Chemical Engineering II (3-0-3)
Selected topics from the broad area of chemical engineering. The specific contents of the course is published one semester in advance.
Prerequisite: Departmental Approval

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.
Corequisite: CHE 402, CHE 425

CHE 497 Chemical Engineering Undergraduate Research (3-0-3)
Selection of a research topic, development of research topic, writing a successful proposal, manage and carrying out research tasks, setting up bench scale setup or prototype for lab work or software for modeling based research, communicating the research findings, writing effective reports.
Prerequisite: Departmental Approval