FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL ENGINEERING

Bachelor of Engineering (BE) Degree – 146 Credits

Sem	Course Code	Course Title	Credit	Pre-Req	Co-Req
1	CHEM 202	Basic Chemistry	3		
1	CHEM 203	Basic Chemistry Laboratory	1		CHEM 202
1	CHEN 206	Instrumentation Lab And Research Methods	1		
1	CHEN 212	Chemical Engineering I	3		MATH 200
1	ENGL 203	English Communication Skills III	3		
1	MATH 200	Calculus I	3		
1	MATH 211	Linear Algebra I	3		
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
2	CHEM 262	Physical and Chemical Kinetics	3	CHEM 202	
2	CHEN 290	Introduction to the Engineering Design Fundamentals	1		
2	CHEN 312	Mass Transfer	3	CHEN 212	
2	CSIS 206	Principles of Programming	3		
2	LISP 200	Information Skills and Search Techniques	1		ENGL 102
2	MATH 270	Differential Equations	3	MATH 200	
2	MECH 232 or CHEN 232	Thermodynamics	3		
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
3	CHEM 242	Organic Chemistry I	3	CHEM 202	
3	CHEN 215	Materials Science and Engineering	3		
3	CHEN 303	Unit Operations	3	CHEN 312	MECH 243
3	GENG 221	Engineering Ethics	3	CHEN 290 ENGL 203	
3	MATH 202	Calculus II	3	MATH 200	
3	MECH 243	Fluid Mechanics	3	MECH 232	
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
4	CHEM 244	Organic Chemistry II	3	CHEM 242	

4	CHEM 245	Organic Chemistry Laboratory	1	CHEM 242	
4	CHEN XXX	Option Elective	3		
4	CHEN 325	Chemical Reactions and Reactor Design	3	CHEN 312	CHEM 262
4	ENGL 2XX	English Elective	3	ENGL 203	
4	GENG 222	Sustainable Development for Engineers	3	CHEN 290 ENGL 203	
4	MATH 230	Numerical Analysis I	3	CSIS 206 MATH 200	
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
5	CHEN XXX	Option Elective	3		
5	CHEN 322	Petroleum Refinery Engineering	3		CHEN 324
5	CHEN 324	Petroleum Engineering Lab	1		CHEN 322
5	CHEN 332	Safety, Health, and Environment	3	CHEN 303	
5	CHEN 362	Chemical Process Simulation and Design	1	CHEN 303	CHEN 391
5	CHEN 377	Chemical Engineering Thermodynamics II	3	MECH 232	
5	CHEN 391	Senior Design 1	2	CHEN 290 CHEN 325 CHEN 303 MATH 202 GENG 221 GENG 222	CHEN 362
5	MATH 246	Probability For Engineers	3	MATH 200	
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
6	CHEN XXX	Option Elective	3		
6	CHEN 326	Chemical Engineering Lab	1		CHEN 392
6	CHEN 336	Separation Processes	3	CHEN 303	
6	CHEN 360	Chemical Process Control	3	MATH 270 CSIS 206	CHEN 361
6	CHEN 361	Process Control Lab	1		CHEN 360
6	CHEN 392	Senior Design 2	2	CHEN 391	CHEN 326
6	CSPR XXX	Cultural Studies	3	ENGL 203	
6	MECH 321	Heat Transfer	3	MECH 243	
		TOTAL	**109**		

Option Electives (9 credits from the following list)					
	CHEN 211	Fundamentals of Geology	3		
	CHEN 246	Chemical Engineering Instrumentation	3		
	CHEN 299	Introduction to Renewable Energy	3		
	CHEN 311	Petroleum Fluids	3		
	CHEN 321	Fundamentals of Petroleum Engineering	3		
	CHEN 329	Plant Economics	3		
	CHEN 333	Food Chemistry and Technology Principles	3		
	CHEN 340	Food Engineering Fundamentals	3		
	CHEN 350	Methods of Food Preservation	3		
	CHEN 378	Living Cells Engineering	3		
	CHEN 388	Biofuel Engineering	3		
Students can take only one elective course from outside the department from the following list: CIVE 212, CIVE 309, CIVE 311, GENG 311, MGMT 220 or an approved course by the department					
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
7	CHEN 400	Chemical Process Synthesis and Design	3		
7	CHEN 404	Advanced Chemical Reactor Design	3		
7	CHEN 412	Industrial Catalytic Processes	3		
7	CHEN XXX	Specialized Area Elective	3		
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
8	CHEN 413	Advanced Transport Phenomena	3		
8	CHEN XXX	Specialized Area Elective	3		
8	CHEN XXX	Specialized Area Elective	3		
8	GENG 400	Engineering Seminars	1		
8	GENG 490	Graduation Project	3		
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
9	CHEN 480	Field Training	3		
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
10	CHEN XXX	Specialized Area Elective	3		
10	CHEN XXX	Specialized Area Elective	3		
10	CHEN XXX	Specialized Area Elective	3		

10	GENG 490	Graduation Project (Reactivation)	0		
		TOTAL	**146**		
Specialized Area Elective (Based on Selected Area):					
Petroleum Engineering (18 credits from the following list)					
	CHEN 421	Advanced Petroleum Processing	3		
	CHEN 426	Reservoir Engineering	3		
	CHEN 468	Mechanisms in Petroleum Engineering	3		
	CHEN 513	Subsurface Production Engineering	3		
	CHEN 531	Oil Field Development	3		
	CHEN 532	Advanced Natural Gas Engineering	3		
	CHEN 543	Well testing	3		
	CHEN 551	Drilling Engineering	3		
	CHEN 579	Numerical Methods in Petroleum Industry	3		
Food Processing (18 credits from the following list)					
	CHEN 420	Food Process Engineering	3		
	CHEN 440	Food Creation and Development	3		
	CHEN 441	Food Sanitation	3		
	CHEN 442	Chemistry of Food and Bioprocessed Materials	3		
	CHEN 443	Food Microbial World	3		
	CHEN 444	Food Sensory Science	3		
	CHEN 517	Chemical-Process Dynamics and Control	3		
	CHEN 524	Food Laws and Regulations	3		
	CHEN 525	Powder Technology and Operating Design	3		
	CHEN 541	Quality Control in Food and Bioprocessing	3		
	CHEN 542	Food Preservation	3		
	CHEN 545	Processing Dairy Products	3		
	CHEN 546	Food Safety and Toxicology	3		
	CHEN 547	Lactation, Milk, and Nutrition	3		
	CHEN 550	Food Management and Marketing	3		
	CHEN 555	Emerging Food Technologies and Biotechnology	3		
	CHEN 566	Bioseparation Engineering	3		
	CHEN 577	Food Packing	3		
	CHEN 588	Food Analysis Techniques	3		

Industrial Processes Engineering (18 credits from the following list)					
	CHEN 418	Polymers and Polymer Engineering	3		
	CHEN 420	Food Process Engineering	3		
	CHEN 421	Advanced Petroleum Processing	3		
	CHEN 422	Surface and Colloid Chemistry	3		
	CHEN 424	Cement Manufacturing	3		
	CHEN 426	Reservoir Engineering	3		
	CHEN 427	Thermal Processes in the Heavy Industry	3		
	CHEN 430	Environmental Design and Life Cycle Assessment	3		
	CHEN 440	Food Creation and Development	3		
	CHEN 441	Food Sanitation	3		
	CHEN 442	Chemistry of Food and Bioprocessed Materials	3		
	CHEN 443	Food Microbial World	3		
	CHEN 444	Food Sensory Science	3		
	CHEN 450	Ecotoxicology for Engineers	3		
	CHEN 468	Mechanisms in Petroleum Engineering	3		
	CHEN 485	Fuel Cell Technology	3		
	CHEN 513	Subsurface Production Engineering	3		
	CHEN 514	Air-Pollution Problems and Control	3		
	CHEN 515	Dynamics of Particulate Systems	3		
	CHEN 517	Chemical-Process Dynamics and Control	3		
	CHEN 524	Food Laws and Regulations	3		
	CHEN 525	Powder Technology and Operating Design	3		
	CHEN 531	Oil Field Development	3		
	CHEN 532	Advanced Natural Gas Engineering	3		
	CHEN 541	Quality Control in Food and Bioprocessing	3		
	CHEN 542	Food Preservation	3		
	CHEN 543	Well Testing	3		
	CHEN 544	Nanofabrication	3		
	CHEN 545	Processing Dairy Products	3		
	CHEN 546	Food Safety and Toxicology	3		
	CHEN 547	Lactation, Milk, and Nutrition	3		
	CHEN 550	Food Management and Marketing	3		

	CHEN 551	Drilling Engineering	3		
	CHEN 555	Emerging Food Technologies and Biotechnology	3		
	CHEN 566	Bioseparation Engineering	3		
	CHEN 577	Food Packing	3		
	CHEN 579	Numerical Methods in Petroleum Industry	3		
	CHEN 588	Food Analysis Techniques	3		
	CHEN 589	Waste Treatment Engineering	3		

COURSE DESCRIPTIONS

CHEN 206 INSTRUMENTATION LAB AND RESEARCH METHODS 0.3: 1 cr. E
This laboratory introduces students to experimental work and the use of measurement instruments. The laboratory course also introduces the methodology of writing technical reports will be covered. Students will also learn to identify important and relevant information from different sources (books, journal papers, patents, etc.) and how to use practically use essential software tools (Microsoft Office Suite) for experimental data processing.

CHEN 211 FUNDAMENTALS OF GEOLOGY 3.0: 3 cr. E
This course provides an introduction to Earth geology. Topics include plate tectonics, the makeup of continents and mountain building. Heat flow, magnetism, gravity, rock deformation, earthquakes and the earth's interior are also covered. The course discusses surface processes including weathering, erosion, transport and deposition. Landforms, rivers, groundwater, glaciers, ocean processes, and volcanoes. Minerals and rocks.

CHEN 212 CHEMICAL ENGINEERING I 3.0: 3 cr. E
This course provides an introduction to the engineering profession in general and the discipline of chemical engineering in particular. It gives an overview of the chemical engineering profession and career choices. This course is designed to introduce chemical engineering sophomores to basic principles in chemical engineering.
The material covered builds a foundation for subsequent courses in the program (e.g., thermodynamics, reaction engineering, fluid mechanics, process design, heat and mass transfer, etc.).

Co-requisite: MATH 200

CHEN 215 MATERIALS SCIENCE AND ENGINEERING 3.0: 3 cr. E
This course introduces fundamental concepts in materials science. The main purpose of this course is to provide a good understanding of the materials science and engineering. Topics covered include: atomic structure and interatomic bonding, crystalline structure, crystal defects, diffusion, phase diagrams, mechanical properties of metals, corrosion and degradation of materials.

CHEN 232 THERMODYNAMICS 3.0: 3 cr. E
This is an introductory course which aims at providing engineering students with theoretical background necessary to perform classical engineering analysis of basic open and closed thermodynamic systems; Properties of pure substance; Heat; Work; First Law of Thermodynamics; Second Law of Thermodynamics; Entropy; Reversibility and Irreversibility; Power and Refrigeration Cycles.

CHEN 290 INTRODUCTION TO THE ENGINEERING DESIGN FUNDAMENTALS 0.3: 1cr. E
This course focuses on the engineering design process along with the utilization of standards and constraints. Students will be introduced to needs identification and solution finding, project management skills, technical writing and presenting, effective multidisciplinary teamwork, and will be exposed to the qualities and attributes of a modern day engineer as expected by professional engineering societies, including integrity, professionalism, ethical commitment and environmental requirements, as well as the role of the engineer in society.

CHEN 299 INTRODUCTION TO RENEWABLE ENERGY 3.0: 3 cr. E
This course covers renewable energy technologies and potentials (solar, wind, hydro, biomass, tidal and geothermal energy). It introduces a general engineering audience to the basic concepts of renewable energy. Illustrated examples for each lecture are from industrial developments and real world applications.

CHEN 303 UNIT OPERATIONS **3.0: 3 cr. E**

This course covers the design and analysis of unit operations with emphasis on distillation, absorption, and extraction. Topics include: design problems of batch and continuous operations of single and multistage equilibrium distillation processes with binary and multicomponent compositions, single and multi-cascade of co current and counter current liquid-liquid extraction. Graphical and analytical design techniques, efficiency and capacity of separation processes are covered.

Pre-requisite: CHEN 312
Co-requisite: MECH 243

CHEN 311 PETROLEUM FLUIDS **3.0: 3 cr. E**

This course covers properties of natural gases; properties of crude oils; fluid phase behavior; vapor-liquid equilibria; equations of state theory and applications; petroleum fluid characterization; petroleum product specifications; surface separations; H_2O/hydrocarbon phase behavior; introduction to PVT phase behaviour; simulation software.

CHEN 312 MASS TRANSFER **3.0: 3 cr. E**

This course provides an introduction to the basic principles of mass transfer and applications. The principal topics covered include principles of molecular diffusion, Fick's law, molecular diffusion in fluids, diffusion in solids, convective mass transfer, interfacial mass transfer, mass transfer coefficient and fluxes, correlation of mass transfer coefficients, interphase mass transfer, theories of mass transfer, individual gas and liquid phase mass transfer coefficient, overall mass transfer coefficient, design and operation of equipment for absorption, mechanism of absorption, Kremser equation, packed tower design, height of column based on conditions in the gas film, height of column based on conditions in the liquid film, height of column based on overall coefficients, calculation of number of plates by graphical methods, total and minimum reflux ratio.

Pre-requisite: CHEN 212

CHEN 321 FUNDAMENTALS OF PETROLEUM ENGINEERING **3.0: 3 cr. E**

This course provides an overview of petroleum engineering systems including: uses of petroleum products, exploration, exploitation subjects such as drilling, production, reservoir and formation evaluation, transportation and refining; design of the reservoir management plan; performance prediction; marketing; government regulation.

CHEN 322 PETROLEUM REFINERY ENGINEERING **3.0: 3 cr. E**

This course introduces fundamental concepts in petroleum refinery processes. An overview of petroleum refinery, its feedstocks, and the processes employed to convert crude oil and intermediate streams into finished products are presented. Crude oil composition and classification, hydrocarbon chemistry, crude oil properties and preparation, refinery products quality and test methods are discussed. Every refining process is presented, including operating conditions and description, feedstock composition and catalyst selection, product yields, and the relationship between process parameters, unit performance and product output/properties. This course delivers major insights into several processes such as Atmospheric Distillation (CDU), Vacuum Distillation (VDU), Cracking, Hydrocracking, Catalytic Reforming, Coking, Visbreaking.

Co-requisite: CHEN 324

CHEN 324 PETROLEUM ENGINEERING LAB **3.0: 3 cr. E**

The purpose of this lab course is to provide students with an understanding of Petroleum Chemistry.

The lab course addresses the chemical composition and properties of petroleum (oil and gas), and provide knowledge of petroleum products and alternative fuels. Minimum of 20 experiments is to be conducted, testing of petroleum and its analysis. All experiments are demonstrated and manipulated by the students.

Co-requisite: CHEN 322

CHEN 325 CHEMICAL REACTIONS AND REACTOR DESIGN 3.0: 3 cr. E
This course explains the principles of chemical reactions and isothermal reactor design. Batch, continuous stirred-tank, plug flow and packed-bed reactors are introduced in addition to semi-batch and membrane reactors. Multiple reactions, enzymatic reactions and bioreactors are also studied.

Pre-requisite: CHEN 312
Co-requisite: CHEM 262

CHEN 326 CHEMICAL ENGINEERING LAB 3.0: 1 cr. E
This course covers experiments in the area of unit operations and chemical engineering reactor design including fluid-flow phenomena through various media such as: friction in conduits, filtration, pressure drop in packed towers and, fluidization of solids/drying. Moreover, basic chemical engineering concepts regarding heat and mass transfer processes in evaporation, absorption, extraction and distillation operations are covered.

Co-requisite: CHEN 392

CHEN 329 PLANT ECONOMICS 3.0: 3 cr. E
This course introduces concepts of design of equipment, systems and plants; discussion of factors important in chemical plant design such as: economics, cost estimation, profitability, process selection, materials of construction, process control, plant location and safety. Introduction to optimization and computer-aided design. Principles are illustrated with short industrial-type problems. Recommended background: thermodynamics; heat, mass and momentum transfer; inorganic and organic chemistry; chemical kinetics and reactor design.

CHEN 332 SAFETY, HEALTH, AND ENVIRONMENT 3.0: 3 cr. E
The course is designed to acquaint students to topics of the safety , health and environment (SHE) in the chemical plants like: temperature and pressure hazards, fire and explosion hazards, radioactive wastes hazards, equipment, energy and electrical hazards, construction and tool hazards, personal protective equipment hazards, engineering controls, administrative controls, vehicle and transportation hazards, working area and height hazards, hearing and noise hazards, fire, rescue, and emergency response equipment.

Pre-requisite: CHEN 303

CHEN 333 FOOD CHEMISTRY AND TECHNOLOGY PRINCIPLES 3.0: 3 cr. E
This course aims to provide an introduction to the chemistry of the major food constituents carbohydrates, proteins, lipids, water, and minor components. This course introduces students to nutrition, food preservation, and different food processing technologies (wine fermentation, dairy products processing, poultry, meat, and seafood products processing, etc.).

CHEN 336 SEPARATION PROCESSES 3.0: 3 cr. E
This course involves the analysis and design of separation processes involving adsorption, chromatography, membrane separation, and crystallization techniques. The basic mechanisms and the

mathematical description of mass and heat transfer rates, and phase equilibria used for the design of these separation processes are addressed.

Pre-requisite: CHEN 303

CHEN 340 FOOD ENGINEERING FUNDAMENTALS 3.0: 3 cr. E
This course covers the multidisciplinary field of applied physical sciences which combines science, microbiology, and engineering education for food and related industries; the application of agricultural engineering and chemical engineering principles to food materials; many challenges to employ modern tools, knowledge and technology to develop new products and processes.

CHEN 350 METHODS OF FOOD PRESERVATION 3.0: 3 cr. E
This course covers the common methods of preservation and techniques used in commercial food processing methods. These methods are used to treat and handle food to stop or greatly slow down microbial growth in order to preserve the foods quality and nutritive value.

CHEN 360 CHEMICAL PROCESS CONTROL 3.0: 3 cr. E
This course covers continuous-time signal transformations and system classifications; Fourier series and transform, Laplace transform, block diagram algebra and signal flow graph, stability analysis techniques (Routh-Hurwitz Criterion), root locus, state space analysis, modern control design (State Feedback Control) and classical control design (PID and phase compensation).

Pre-requisites: MATH 270, CSIS 206
Co-requisite: CHEN 361

CHEN 361 PROCESS CONTROL LAB 0.3: 1 cr. E
This laboratory complements the theoretical concepts of chemical process control. The course involves extensive use of computer software such as MATLAB and Simulink. Topics include: dynamic simulation of linear and nonlinear mathematical models of chemical processes, design of PID controllers, tuning of controller to accommodate process model uncertainty.

Co-requisite: CHEN 360

CHEN 362 CHEMICAL PROCESS SIMULATION AND DESIGN 0.3: 1 cr. E
This course introduces students to process simulation and design of various chemical and related process industries. Major emphasis is placed on the simulation of chemical engineering units (reactors, distillation columns, heat exchangers, etc.) used for plant design on Aspen Plus software. Proper unit sizing and cost analysis are covered to understand how various costs affect the process economics involved in industrial processes.

Pre-requisite: CHEN303
Co-requisite: CHEN 391

CHEN 377 CHEMICAL ENGINEERING THERMODYNAMICS II 3.0: 3 cr. E
This course covers the second law of thermodynamics, entropy, thermodynamic properties of fluids and thermodynamic diagrams. Topics of application of thermodynamics to flow processes, power production, and refrigeration are also covered. Vapor-liquid equilibrium, solution thermodynamics, fugacity, and chemical reaction equilibria are explained.

Pre-requisite: MECH 232

CHEN 378 LIVING CELLS ENGINEERING **3.0: 3 cr. E**

This course covers concepts of engineering of the living systems, biomolecules, biological catalysers, living cells, basic concepts and applications related to chemical engineering. The course also includes the topics of structure and role of the cellular components in bioprocesses, cell and enzyme types, kinetics of enzymatic reactions, cell growth, operating conditions, selection of bioreactors, and metabolic pathways and regulation. The course includes examples of bioprocesses using different types of cells and applications in biotechnology, environmental engineering, pulp and paper, food technology and energy.

CHEN 388 BIOFUEL ENGINEERING **3.0: 3 cr. E**

This course emphasizes the importance of biofuel engineering process technology. It will cover the following topics: the harvesting of energy from biochemical reactions, the modeling of biofuel production, the biofuel feedstocks, the ethanol production, the different kinds of biodiesel, the microbial fuel cell, and the methane production.

CHEN 391 SENIOR DESIGN 1 **3.0: 2 cr. E**

This course covers the first part of a capstone design project, for which teams of students are formed and real-world engineering problems are chosen. Students should identify the problem(s), scope, relevance, and objectives. Throughout this course, they conduct extensive research and literature review and learn to analyze and understand the design requirements, with consideration of different factors (i.e., public health, safety, ethics, and environment).

Pre-requisites: CHEN 290, CHEN 303, CHEN 325, GENG 221, GENG 222, LISP 200, MATH 202
Co- requisite: CHEN 362

CHEN 392 SENIOR DESIGN 2 **3.0: 2 cr. E**

This course constitutes the second semester of a year-long culminating senior project. In this course, the teams of students must complete the capstone project selected in CHEN391 to finish the second phase of the design process namely, (1) carry on the culminating design by selecting different case studies, (2) build, test, and evaluate the physical/virtual model and (3) optimize the final design by improving the process parameters (T, P, flowrate, etc.) and the topology of the process flowchart. At the end of the semester, teams will present/demonstrate their final design process/prototype/product and convey to the public their findings through a comprehensive report and presentation that synthesizes all steps of the simulation and design process and exhibits individual team members' contributions.

Pre-requisite: CHEN 391
Co-requisite: CHEN 326

CHEN 400 CHEMICAL PROCESS SYNTHESIS AND DESIGN **3.0: 3 cr. E**

This course provides an introduction to the core technical skills and professional responsibilities common to all chemical processes and operations. The course also covers process synthesis, process flows and diagrams, chemical product design, process thermodynamics, chemical process reactions, process mass transfer, heat transfer and fluid flow, economic effectiveness and operations safety.

CHEN 404 ADVANCED CHEMICAL REACTOR DESIGN **3.0: 3 cr. E**

This course deals with the interpretation of rate data and development of performance equations for single and multiple reactor systems. Course topics include: design of ideal reactors and deviations from ideality, multiple chemical reactions, steady state and unsteady-state operation, optimization of reactors, collection and analysis of rate law data and bioreactors. This course covers the fundamentals of catalytic science, catalyst properties, preparation and characterization, catalytic reactor design and catalyst deactivation. This part is followed by an overview of the most important industrial catalytic processes:

Hydrogen production and synthesis gas reactions, hydrogenation and dehydrogenation of organic compounds, and oxidation of organic and inorganic compounds.

CHEN 412 INDUSTRIAL CATALYTIC PROCESSES 3.0: 3 cr. E
This course covers the fundamentals of catalytic science; catalyst properties, preparation and characterization, catalytic reactor design and catalyst deactivation. This part is followed by an overview of the most important industrial catalytic processes: Hydrogen Production and Synthesis Gas Reactions (Fischer-Tropsch Synthesis), Hydrogenation and dehydrogenation of organic compounds, Oxidation of organic and inorganic compounds.

CHEN 413 ADVANCED TRANSPORT PHENOMENA 3.0: 3 cr. E
This course covers the fundamental theory of momentum, energy and mass transport. Shell momentum, heat and mass balances and equations of change are developed and used to determine velocity, temperature, and concentration distributions for laminar flow. Viscosity, thermal conductivity and mass diffusivity are also covered, as well as friction factors and macroscopic balances.

CHEN 416 CHEMICAL ENGINEERING OPTIMIZATION 3.0: 3 cr. E
This course introduces the application of optimization methods to important chemical engineering problems in thermodynamics, unit operations, separation processes, energy design, and optimization in industrial practice. This course includes continuous, linear and nonlinear, and mixed integer linear programing problems. The course emphasizes problem definition, model formulation and solution analysis, with sufficient details on existing algorithms and software to solve problems**.**

CHEN 418 POLYMERS AND POLYMER ENGINEERING 3.0: 3 cr. E
This course provides a good understanding of the synthesis of polymers and their commercial applications. Important properties that these materials possess, including their molecular, physical, chemical, thermal, mechanical, and electrical properties are reviewed. The forming techniques for plastics (compression molding, injection molding…) and the different parameters leading to the degradation of polymers will also be covered.

CHEN 420 FOOD PROCESS ENGINEERING 3.0: 3 cr. E
This course provides concepts of advanced knowledge and understanding of process and engineering principles of various methods of heating, cooling, freezing, drying, and crystallization of foods; it covers water relations in foods and kinetics of physico-chemical changes during processing.

CHEN 421 ADVANCED PETROLEUM PROCESSING 3.0: 3 cr. E
This course presents the following topics: atmospheric and vacuum crude oil distillation units, light end units, catalytic reforming process, fluid catalytic cracking process, and distillate hydro- cracking process. The course also includes concepts of hydro-treating processes, refinery gas treating processes, upgrading residues, and handling of hazardous materials and safety.

CHEN 422 SURFACE AND COLLOID CHEMISTRY 3.0: 3 cr. E
This course examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Some applications are studied in the areas of emulsification, detergency, foaming, fluidization, sedimentation, nucleation, wetting, adhesion, flotation, and electrophoresis.

CHEN 424 CEMENT MANUFACTURING 3.0: 3 cr. E
This course covers the fundamentals of cement manufacturing steps, raw materials management, cement quality control concept, quarrying and its environmental aspect, grinding technology, clinker

manufacture (chemical and thermodynamics aspect), firing systems, classic and alternative fuels, clinker properties, manufacturing performance evaluation, cement applications.

CHEN 426 RESERVOIR ENGINEERING 3.0: 3 cr. E

This course covers both fundamental and applied reservoir engineering concepts. It provides students a detailed understanding of the rock and fluid properties, the PVT analysis and the Darcy's law and applications. It also focuses on the natural water influx models and reservoir drive mechanisms as well as the practical application of the material balance equations in oil and gas reservoirs.

CHEN 427 THERMAL PROCESSES IN THE HEAVY INDUSTRY 3.0: 3 cr. E

The focus of this course is to transmit the Competence of materials and energy use and transformation in the heavy industry as well as the product formulation. Combustion engineering, heat and materials balances, materials transformation, emissions controlling, gas properties and de-dusting systems are as well covered in this course. Automatic process control (PID, LINKman, online gamma analyzers….) and manual process control (gas and materials measures) are also covered in this course.

CHEN 430 ENVIRONMENTAL DESIGN AND LIFE CYCLE ASSESSMENT 3.0: 3 cr. E

This course covers the life cycle thinking approach and details the four phases of life cycle assessment: Goal and scope definition, life cycle inventory, life cycle impact assessment, and life cycle interpretation. Tutorial sessions and a practical case study using a life cycle assessment software are also covered.

CHEN432 PETROLEUM ECONOMICS AND MANAGEMENT 3.0: 3 cr. E

This course provides an introduction to financial reporting for oil companies. Capital budgeting: Cash flow analysis. Risk analysis: Probability theory and methods. Reserve estimation. Market theory: Supply and demand, oil price models, product prices, profit maximization, inflation and depreciation. The main geopolitical characteristics of the Energy Industry in the Gulf and Levant regions. Oil field project (Upstream and Downstream) management topics: project planning and scheduling techniques, project monitoring and control techniques. Overview of the factors that affect states' failure and success in management of petroleum resources. General knowledge of the regulation of pollution control.

CHEN 440 FOOD CREATION AND DEVELOPMENT 3.0: 3 cr. E

This course covers the techniques involved in systematic food product creation, development, and process technology of specialty, fabricated, and synthetic foods. The complete process of bringing a new product to the market; it involves the idea generation, product design and detail engineering market research and marketing analysis.

CHEN 441 FOOD SANITATION 3.0: 3 cr. E

This course covers hygienic practices, requirements for sanitation programs, and modern sanitation practices in food processing facilities. Topics include need for food safety training, cause of food borne illness; biological food contamination; chemical and physical contamination; purchasing and receiving; storing foods; preparing, cooking, and serving food; cleaning and sanitizing; hazard analysis critical control points (HACCP) and facilities self-inspection.

CHEN 442 CHEMISTRY OF FOOD AND BIOPROCESSED MATERIALS 3.0: 3 cr. E

The course focuses on the properties of biological molecules (e.g., proteins, enzymes lipids, carbohydrates and pigments) found in foods and pharmaceuticals. The course also presents basic elements of molecules, such as structure and reactive groups, in regard to how they affect the properties of foods and pharmaceuticals; and reactions such as Maillard browning and lipid oxidation in regard to mechanisms, products and controlling processes.

CHEN 443 FOOD MICROBIAL WORLD **3.0: 3 cr. E**
This course covers food relevant microorganisms and their metabolic activities; sources of microbial contamination during food production, processing and storage; microbial spoilage; pathogens; physical and chemical destruction of microorganisms in foods and the kinetics involved; conversions of raw foods by microorganisms into food products.

CHEN 444 FOOD SENSORY SCIENCE **3.0: 3 cr. E**
This course covers the principles and procedures for sensory evaluation of food. Appropriate uses of specific tests will be discussed, along with physiological, psychological, and environmental factors affecting sensory verdicts; it applies principles of experimental design and statistical analysis to the use of human senses for the purposes of evaluating consumer products.

CHEN 450 ECOTOXICOLOGY FOR ENGINEERS **3.0: 3 cr. E**
This course focuses on toxic agents and implication of pollutants in the conception and operation of processes. Transport of contaminants in the environment and exposure modes. Evaluation tools. Dose-response relationship. Chronic/acute effects. Implication of ecotoxicological risk in the protection of the environment and industrial sanitation. Industrial ecology and re-engineering. Importance of impact assessment in the design of plants and processes.

CHEN 468 MECHANISMS IN PETROLEUM ENGINEERING **3.0: 3 cr. E**
This course covers the three main aspects of production mechanisms used in the Petroleum Industry: 1) Primary Production which depends on decreasing reservoir pressure, 2) Secondary Recovery that uses water injection as a displacing fluid and for pressure maintenance, and 3) Tertiary Recovery which covers thermal operations using steam, miscible or immiscible gas injection, and polymer waterflood. Classification and reserve estimates based on material balance; steady-state and transient fluid flow in permeable reservoir rocks as applied to subsurface engineering problems will be reviewed.

CHEN 478 CORROSION IN CHEMICAL PROCESSES **3.0: 3 cr. E**
This course describes the principles of corrosion engineering from the basic principles of electrochemistry and chemical thermodynamics to the prevention of corrosion problems in relation with material cost, reduced performance, reliability, and impact on the environment. The different forms of corrosion are described as well as their prevention control. Case studies from petrochemical industries are also covered.

CHEN 480 FIELD TRAINING **0.0: 3 cr. E**
Eight weeks of training in a field related to chemical engineering.

CHEN 485 FUEL CELL TECHNOLOGY **3.0: 3 cr. E**
The course provides an overview of the various types of fuel cells followed by a detailed discussion of the proton-exchange membrane (PEM) fuel cell fundamentals: thermodynamics relations including cell equilibrium, standard potentials, and Nernst equation; transport and adsorption in proton-exchange membranes and supported liquid electrolytes; transport in gas-diffusion electrodes; kinetics and catalysis of electrocatalytic reactions including kinetics of elementary reactions, the Butler-Volmer equation, reaction routes and mechanisms; kinetics of overall anode and cathode reactions for hydrogen and direct methanol fuel cells; and overall design and performance characteristics of PEM fuel cells.

CHEN 513 SUBSURFACE PRODUCTION ENGINEERING **3.0: 3 cr. E**
This course covers the advanced theories and techniques of tubing and packer design; hydraulic fracturing and acidizing; oil and gas well performance; vertical lift and choke performance; systems analysis; production operations.

CHEN 514 AIR-POLLUTION PROBLEMS AND CONTROL **3.0: 3 cr. E**
This course presents advanced concepts on air-pollutant identification and control technology; estimation of pollutant transport, dispersion, and conversion; design of control units using computer simulation applications.

CHEN 515 DYNAMICS OF PARTICULATE SYSTEMS **3.0: 3 cr. E**
This course analyzes systems of discrete particles which grow in size or in some other characteristic variable (e.g., age, molecular weight); reaction engineering and population balance analyses are discussed for batch and continuous systems; steady state and transient system dynamics are covered. Application topics may be selected from crystallization, latex synthesis, polymer molecular weight distribution, fermentation/ ecological systems and gas-solid systems.

CHEN 517 CHEMICAL-PROCESS DYNAMICS AND CONTROL **3.0: 3 cr. E**
This course provides the tools for designing a strategy for operating a plant and the hardware (sensors, control valves, computer controllers) to make it work. This course focuses on the applications of dynamic process responses based on the principles of material and energy balances, fluid flow, heat transfer, separation processes, and reaction kinetics. The course also covers the elements of a feedback control system including sensors, control valves, and computer-based controllers (feed forward control, cascade control, dead time compensation, and de-couplers)

CHEN 524 FOOD LAWS AND REGULATIONS **3.0: 3 cr. E**
This course covers the legislation in the form of directives and regulations which are put by government or regulatory agencies to control food safety; Controlled Designation of Origin CDO regulations; official inspections of specific design features, and certification of food handlers.

CHEN 525 POWDER TECHNOLOGY AND OPERATING DESIGN **3.0: 3 cr. E**
This course deals with the fundamentals of powder technology: production, handling, modification, and use of a wide variety of particulate materials, both wet and dry, in sizes ranging from nanometers to centimeters. The first part concerns particulate characterization: granulometric analysis and mechanical properties of powders. It is followed by the design of operating systems using powders: mixing, storage in silos, fluidization, granulation, crystallization, grinding, pneumatic transport and spraying techniques.

CHEN 531 OIL FIELD DEVELOPMENT **3.0: 3 cr. E**
This course covers the fundamentals of petroleum geology, properties of reservoir rocks, petroleum fluids, source rocks, traps, black and volatile oils, petroleum geochemistry, the conditions under which petroleum occurs in nature, the main problems which have to be solved in the exploration and development of oilfields.

CHEN 532 ADVANCED NATURAL GAS ENGINEERING **3.0: 3 cr. E**
This course covers the properties of natural gases and condensate systems; In addition, the course includes the concepts of gas flow in porous media; gas reservoir engineering, gas field development; gas condensate reservoirs and natural gas transportation and storage.

CHEN 541 QUALITY CONTROL IN FOOD AND BIOPROCESSING **3.0: 3 cr. E**
This course covers the principles of quality control in the food and bioprocessing industries; regulations and process control to maintain safety and quality; evaluation of physical, microbiological, chemical, sensory, and stability testing for food and bioprocessed materials; risk assessment, hazard analysis and critical control point, process control, water quality, wastewater analysis and reduction; cleaning and sanitation and compliance inspection.

CHEN 542 FOOD PRESERVATION **3.0: 3 cr. E**
This course covers the methods employed in food preservation; emphasis on thermal, freezing, drying and fermentation processes and corresponding physical, chemical, and organoleptic changes in product; relationship of these preservation techniques to development of an overall processing operation.

CHEN 543 WELL TESTING **3.0: 3 cr. E**
This course teaches well completion from drilling in the pay zone to production start-up. It also covers the main methods for artificial lift, and well servicing. The student will learn the concepts and equipment that are indispensable for completion and servicing operations. Students will be able to understand the operational aspects and the process of completing oil and gas wells in order to perform the designated and various tasks needed in the oil and gas industry.

CHEN 544 NANOFABRICATION **3.0: 3 cr. E**
This course provides basic engineering principles of nanofabrication. Topics include: photo-, electron beam and nanoimprint lithography, block copolymers and self-assembled monolayers, colloidal assembly, and biological nanofabrication.

CHEN 545 PROCESSING DAIRY PRODUCTS **3.0: 3 cr. E**
This course covers unit operations in dairy processing. Topics include formulation, processing, packaging and evaluation of fluid milk and manufactured products.

CHEN 546 FOOD SAFETY AND TOXICOLOGY **3.0: 3 cr. E**
This course covers issues and developments related to the relationship between food safety and public health, including emerging food-borne pathogens; virulence and pathogenicity; food-borne toxins; epidemiological techniques used in the investigation of food-borne disease; rapid detection methods; and quantitative microbial risk assessment in food safety.

CHEN 547 LACTATION, MILK, AND NUTRITION **3.0: 3 cr. E**
This course focuses on issues related to the nutritional properties of milk as a high-quality food with nutritional diversity; principles of physiology, biochemistry and cell biology in the mammary gland; procedures of milk production and milk collection for milk quality and nutrition; impacts of biotechnology and food safety on dairy production.

CHEN 550 FOOD MANAGEMENT AND MARKETING **3.0: 3 cr. E**
This course provides the student with realistic managerial experience. Staffing, merchandising, and cost control procedures are integral parts of the course. Marketing principles, theories and strategic concepts such as leadership, business definition, situation assessment, planning and objectives in specialized food sectors.

CHEN 551 DRILLING ENGINEERING **3.0: 3 cr. E**
This course covers the begins with an overview of drilling operations where students are introduced to: drilling equipment and mechanisms of accessories, rotary drilling rig components, drill strings, drill bits and, drilling fluids. Moreover, this course covers basic drilling engineering aspects associated to friction pressure losses, drilling hydraulics, casing and /cementing, well blowout prevention and /control and in addition to (some) of the mostly encountered drilling problems and their respective (practical) solutions.

CHEN 555 EMERGING FOOD TECHNOLOGIES AND BIOTECHNOLOGY **3.0: 3 cr. E**
This course covers new and emerging food technologies and food biotechnology; develops ways to process, preserve, package, or store food, according to industry, specifications, and regulations; studies the physical, microbiological, and chemical makeup of food.

CHEN 566 BIOSEPARATION ENGINEERING **3.0: 3 cr. E**

This course covers principles of bioseparation engineering including specialized unit operations not normally covered in regular chemical engineering courses. Processing operations downstream of the initial manufacture of biotechnology products, including product recovery, separations, purification, and ancillary operations such sterile processing, clean-in place and regulatory aspects. The principles of chromatography will be emphasized.
Ion exchange, and affinity-based separation will be discussed in detail.

CHEN 577 FOOD PACKING **3.0: 3 cr. E**

This course covers the packaging of food; the main objectives of packaging from physical protection, barrier protection, containment, information transmission, marketing, convenience, to portion control; different types of food packages and containers.

CHEN 579 NUMERICAL METHODS IN PETROLEUM INDUSTRY **3.0: 3 cr. E**

This course covers theory and practice of numerical simulation in the Geological (static) and Reservoir Engineering (dynamic) systems. The course describes methods, tools, and uses of numerical methods and computers in petroleum problems. The use of 2 Dimensional and 3 Dimensional models will be covered and examples provided. Mathematical equations governing fluid flow in reservoirs; numerical methods to solve the equations; numerical reservoir simulation; treatment of wells and history matching methods will be reviewed.

CHEN 588 FOOD ANALYSIS TECHNIQUES **3.0: 3 cr. E**

This course studies the theory and practice of the analysis of food components, including their chemical separation, identification and quantification comparing classical to modern instrumental food analysis techniques.

CHEN 589 WASTE TREATMENT ENGINEERING **3.0: 3 cr. E**

This course introduces concepts of physico-chemical, thermal, and biological methods for purification of solid waste and wastewater, and conversion to bioproducts/industrial products, energy and clean water. Industrial pollution sources, treatment methods, and legal requirements are examined.

FACULTY OF ENGINEERING GENERAL COURSES

ENVE 401 WATER RESOURCES ENGINEERING **3.0: 3 cr. E**

This course covers the principles of ground-water development. Techniques for analyzing rainfall, runoff, fluid flow, reservoir siting, aquifer and groundwater flows. Design of reservoirs, conduits, water distribution systems, well fields, transmission lines, sewers, and drains. Well pumps. Stresses in pipes; materials and design of pipes; Metallic corrosion. Storage and distributing reservoirs, construction and maintenance. Water supply system appurtenances and special structures. Population growth and its effects on water supply requirements.

GENG 221 ENGINEERING ETHICS **3.0: 3 cr. E**

This course introduces and reinforces the concepts, theories, and practice of engineering ethics and aims at providing basic knowledge of ethics for engineers in different types of work roles. It prepares the engineering students for identifying, taking responsibility for, and finding solutions to potential ethical problems/cases. It provides students with an interactive study of ethical theory and the development of professionalism and helps them think more clearly and deeply about ethical issues of the natures that engineers often face in professional practice, and explore resources, strategies, and options for dealing with such complications. Students review case studies of ethical conflicts in engineering practice. The course also covers engineering codes of ethics and requires students to resolve theoretical situations through the application of ethical codes.

(A core BS course as of 2023/24 to replace a CSPR XXX course for students who started from year 2022/2023. Previous students can take it as an equivalent of a CSPR XXX course if they have not already taken the required 3 CSPR XXX courses)

Pre-requisite: CHEN/CIVE/ELCP/MECH/290 (according to discipline), ENGL 203

GENG 222 SUSTAINABLE DEVELOPMENT FOR ENGINEERS **3.0: 3 cr. E**

This course introduces the fundamental and advanced concepts of sustainable development. It transitions students' understanding of the UN Sustainable Development Goals (SDGs) to focus specifically on the critical role of engineers in achieving these SDGs. Students should then be able to resolve problems by adopting sustainability principles, which should in turn reflect on the students' multidisciplinary design ability to ensure a proper sustainable design process to improve and preserve the quality of life for future generations.

(A core BS course as of 2023/24 to replace a CSPR XXX course for students who started from year 2022/2023. Previous students can take it as an equivalent of a CSPR XXX course if they have not already taken the required 3 CSPR XXX courses)

Pre-requisite: CHEN/CIVE/ELCP/MECH/290 (according to discipline), ENGL 203

GENG 311 ENGINEERING MANAGEMENT AND ECONOMICS **3.0: 3 cr. E**

Engineers with excellent managerial skills and superior economic acumen are needed as leader of the new century engineering world. This course prepares engineers to fulfill their managerial responsibilities and acquire useful economic perspectives. This course is organized to contain two major parts: (I) Functions of engineering management, and (II) Economic fundamentals for engineering managers. Part (I) introduces the basic functions on engineering management such as planning, organizing, leading and controlling, while part (II) covers the fundamentals of engineering economics.

GENG 400 ENGINEERING SEMINARS **2.0: 1 cr. E**

This module consists of lectures and seminars covering recent research and advances in various fields and applications of engineering disciplines.

GENG 402 PROJECT MANAGEMENT **3.0: 3 cr. E**

To make available the fundamentals of project management with the most workable types of organizations and the necessary capabilities that must be included to reasonably ensure success and minimize the possibility of failure. The course consists of construction contracting for contractors, owners, and engineers: bidding, industry structure, types of contracts, and delivery systems of construction, planning, estimating, quantity take-off and pricing, labor and equipment estimate, proposal preparation, contract documents to prepare detailed estimates, permits, risk management, and taxes. Basic critical path planning and scheduling with activity on nodes and activity on arrows, monitoring, updating, controlling, crashing, resource leveling, resource allocation, and least cost scheduling including time-cost trade-off analysis. Computer applications using the Primavera software.

GENG 490 GRADUATION PROJECT **3.X: 3 cr. E**

An approved final design project.

Refer to General Listing of Course Descriptions for:

CHEM XXX
Refer to Faculty of Arts and Sciences

CIVE XXX
Refer to the Department of Civil Engineering

CSIS XXX
Refer to Faculty of Arts and Sciences

CSPR XXX
Refer to the Faculty of Arts and Sciences

ENGL XXX
Refer to the Faculty of Arts and Sciences

ENMG XXX
Refer to the Department of Engineering Management

GENG XXX
Refer to the Faculty of Engineering Requirements

LISP XXX
Refer to the Faculty of Arts and Sciences

MATH XXX
Refer to the Faculty of Arts and Sciences

MECH XXX
Refer to the Department of Mechanical Engineering

MGMT XXX
Refer to the Faculty of Business and Management

MRKT XXX
Refer to the Faculty of Business and Management