Chemical Engineering Program

Introduction

Chemical engineering is a branch of engineering that deals with the basic sciences such as chemistry, physics, biology, microbiology, and biochemistry, along with mathematics and economics. The design, development and operation of plant, equipment, and chemical processes aim to transform the raw material or feedstock into a product with an economic value, taking into account the preservation of the environment and safety of workers and equipment.

The large number of industries which depend on the synthesis and processing of chemicals and materials place chemical engineers in great demand. In addition to traditional examples such as chemicals, fertilizers, energy, petrochemicals and oil industries, opportunities in biotechnology, pharmaceuticals, electronic device fabrication, and environmental engineering are increasing. The unique training of the chemical engineer becomes essential in these areas whenever processes involve the chemical or physical transformation of matter. For example, chemical engineers working in the chemical industry investigate the creation of new polymeric materials with important electrical, optical or mechanical properties. This requires attention, not only to the synthesis of the polymer, but also to the flow and forming processes necessary to create a final product. In biotechnology, chemical engineers have responsibilities in the design of production facilities that use microorganisms and enzymes to synthesize new drugs. Problems in environmental engineering that engage chemical engineers include the development of processes (catalytic converters, effluent treatment facilities) to minimize the release of or deactivate products harmful to the environment. To carry out these activities, a chemical engineer requires a qualitative and quantitative understanding of both the engineering and scientific principles underlying these technological processes. This is reflected in the curriculum of the chemical engineering department which includes the study of applied mathematics, material and energy balances, thermodynamics, fluid mechanics, energy and mass transfer, separation technologies, chemical reaction kinetics and reactor design, and process design. These courses are built on a foundation in the sciences of chemistry and physics.

Vision

To be well known for chemical engineering education and research integrated with Islamic values.

Mission

The mission of chemical engineering department is to produce competent chemical engineers, to advance scientific knowledge through research, and to provide valuable services to chemical engineering profession and society.

Goals

1. Provide high quality education that prepares our graduates for chemical engineering practice.
2. Develop necessary skills in our graduates that allows them to be professional leaders and vibrant contributors to the society.
3. Maintain a program of study that is consistent with the current and future needs of chemical engineering profession.
4. Perform valuable innovative research to serve the industrial and societal needs.

Program Objectives

Graduates of the chemical engineering program at Al Imam Mohammad Ibn Saud Islamic University are expected to:

1. Successfully commence their career as practicing chemical engineers and/or pursue graduate studies in related fields,
2. Analyze, design and implement sustainable engineering solutions to real world problems considering realistic constraints and societal needs,
3. Demonstrate commitment to lifelong learning and professional development to stay current in modern engineering practice and contemporary issues, and
4. Advance to increasing levels of responsibility and leadership in their professional roles.

Program Outcomes

1. An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Overview of the Curriculum

Course Coding

The chemical engineering courses are tabled and numbered in such a manner to recognize each course regarding its subject area, year level, and semester offered. The symbol ChE denotes "Chemical Engineering" and each number is made of 3 digits. Each digit represents specific information about the course as follows:

The first digit denotes the year level of the course according to student's study plan as follows:

First Digit	Year Level of Course
1	First year
2	Second year
3	Third year
4	Fourth year

The second digit as per the following Table represents the field/specialization within a Department:

Second Digit	Field/Specialization
0	General Engineering Courses
1	Conservation and Conversion of Mass, and Energy Courses
2	Heat and Mass Transfer, Fluid Mechanics, Unit Operations, and Chemical Engineering Thermodynamics Courses
3	Modeling, Simulation, Control, and Applied Mathematics Courses
4	Material Science, and Polymer Engineering Courses
5	Technological Applications, Desalination, Petroleum Refining, and PetroChemical Processes Courses
6	Design, Specification, Safety and Environment Courses
7	Research, Seminars, and Special Topics Courses
8	Biosystems, Food Processes, and Pharmaceutical industries Courses
9	Design Projects Courses

The third digit denotes the sequence number of the course in a certain field/specialization in a given year. The **number 9** as the third digit is reserved for Engineering Training.

Example: ChE 221 means

Code	First Digit	Second Digit	Third Digit
ChE	**2**	**2**	**1**
Department (Chemical Engineering)	**Year Level (Second year)**	**Field (Thermodynamics)**	**First Thermodynamics course in the second year**

Undergraduate Curriculum of the Chemical Engineering Program

The curriculum leading to the degree of Bachelor's Degree of Chemical Engineering requires 137 credits and is organized as follows:

University requirement	**14** Credit Hours
College of Engineering requirement	**54** Credit Hours
Department requirement	**69** Credit Hours
Total Credit Hours:	**137** Credit Hours

- University requirement (Quran, Tawheed,..etc)
- College of Engineering requirements include:
  1- Mathematics and Basic Sciences. (37 credit hours)
  2- General Engineering. (14 credit hours)
  3- Technical writing in English. (3 credit hours)
- Department requirement includes core courses and Technical Electives. (69 credit hours)

1- General Engineering

The following courses are required as *General Engineering* courses in the undergraduate curriculum of chemical engineering program.

Code	Course Title	Credits	Pre-requisite	Corequisite
CS 108	Computer Programming	3	MATH 115	
GE 100	Introduction to Engineering	0		
GE 103	Engineering Graphics and Design	3		
GE 201	Statics	3	MATH 116 PHYS 117	
GE 303	Engineering Economy	3	MATH 236	
GE 399	Engineering Training	0	Completion of 90 Credits	
GE 302	Professional Ethics for Engineers	2	GE 399	
Total Credit Hours:		**14**		

2- Chemical Engineering Program Requirements

A total of 69 credit hours of Chemical engineering courses, both core courses (60 Credit Hours) and technical electives (9 Credit Hours), must be taken by all students in the undergraduate program. These courses are listed in the following table:

A. Chemical Engineering Core Courses

Code	Course Name	Credit	Prerequisite	Corequisite
ChE 211	Principles of Chemical Engineering I	3	CHEM 104 MATH 115	
ChE 213	Principles of Chemical Engineering II	2	ChE 211 MATH 116	
ChE 221	Chemical Engineering Thermodynamics I	3	ChE 211	
ChE 223	Fluid Mechanics	3	ChE 211 MATH 207	
ChE 224	Heat Transfer I	2	ChE 211 MATH 207	

Code	Course Name	Credit	Prerequisite	Corequisite
ChE 241	Material Science and Engineering	3	CHEM 104	
ChE 311	Chemical Reactions Engineering	3	ChE 329 MATH 346	
ChE 322	Heat Transfer II	2	ChE 223 ChE 224 GE103	
ChE 325	Unit Operations	3	ChE 223 GE 201	
ChE 326	Mass Transfer	3	ChE 223 ChE 224	
ChE 327	Fluid Mechanics and Heat Transfer Lab	1	ChE 322	
ChE 328	Separation Process	3	ChE 326	
ChE 329	Chemical Engineering Thermodynamics II	3	ChE 221 MATH236	
ChE 351	Petrochemicals	3	ChE 241 CHEM 202	
ChE 381	Biochemical Engineering	3		ChE 311
ChE 423	Unit Operations & Separation Process Lab	1	ChE 328 ChE 325	
ChE 431	Process Control	3	ChE 325 MATH 236	
ChE 434	Reaction Engineering & Process Control Lab	1	ChE 431 ChE 311	
ChE 454	Petroleum Refining	3	CHEM 202 ChE 328	
ChE 461	Chemical Processes and Plant Design	3	ChE 325 ChE 326 ChE 241	
ChE 462	Process Synthesis and Modeling	3	ChE 325 GE 303	
ChE 463	Environmental and Safety Management	2		ChE493
ChE 493	Graduation Project-I	2		ChE 461
ChE 494	Graduation Project-II	2	ChE 493	
ChE 4**	Elective I	3	ChE 325 ChE 326	
ChE 4**	Elective II	3	ChE 325 ChE 326	
ChE 4**	Elective III	3	ChE 325 ChE 326	
Total		**69**		

B. Chemical Engineering Technical Elective Courses

Students must take nine credits of elective courses which are listed below.

1. Energy and Air Pollution Control

Code	Course Name	Credit	Prerequisite
ChE 412	Energy Conversion and Management	3	ChE 325, ChE 326
ChE 413	Renewable Energy	3	ChE 325, ChE 326
ChE 414	Solar Energy	3	ChE 325, ChE 326
ChE 415	Fuel Cells	3	ChE 325, ChE 326
ChE 416	Air Pollution Control	3	ChE 325, ChE 326
ChE 471	Special Topics	3	ChE 325, ChE 326

2. Materials Engineering

Code	Course Name	Credit	Prerequisite
ChE 441	Electro Chemical Engineering and	3	ChE 325, ChE 326
ChE 442	Nanomaterials Technology	3	ChE 325, ChE 326
ChE 443	Polymer Chemistry and Engineering	3	ChE 325, ChE 326
ChE 471	Special Topics	3	ChE 325, ChE 326

3. Petroleum and Petrochemical Industries

Code	Course Name	Credit	Prerequisite
ChE 471	Special Topics	3	ChE 325, ChE 326

4. Desalination

Code	Course Name	Credit	Prerequisite
ChE 451	Desalination	3	ChE 325, ChE 326
ChE 452	Membrane Technology	3	ChE 325, ChE 326
ChE 453	Water and Wastewater Treatment	3	ChE 325, ChE 326
ChE 471	Special Topics	3	ChE 325, ChE 326

5. Bioengineering

Course Code	Course Name	Credit	Prerequisite
ChE 482	Bioprocess Engineering	3	ChE 325, ChE 326
ChE 483	Bioseparations Engineering	3	ChE 325, ChE 326
ChE 484	Applications in Biological	3	ChE 325, ChE 326
ChE 471	Special Topics	3	ChE 325, ChE 326

Department of Chemical Engineering
College of Engineering
Al Imam Mohammad Ibn Saud Islamic University
Riyadh, Kingdom of Saudi Arabia

Chemical Engineering Program [Required Credits = 137]

University Courses	Math. & Basic Sciences	Engineering Fundamentals	Engineering Depths
17 Credits	37 Credits	14 Credits	69 Credits

FIRST YEAR (FRESHMAN)

FALL

- **CUL 101 [2]** Islamic Culture
- **MATH 115 [3]** Calculus I
- **PHYS 117 [3]** Physics I
- **PHYS 119 [1]** Physics I Lab — CO: PHYS117
- **CHEM 104 [3]** General Chemistry
- **CHEM 105 [1]** General Chemistry Lab — CO: CHEM104
- **ENGL 200 [3]** Technical Writing in English

SPRING

- **IDE 133 [2]** Tawheed
- **MATH 116 [3]** Calculus II — PRE: MATH115
- **PHYS 118 [3]** Physics II — PRE: PHYS117, PHYS119
- **PHYS 120 [1]** Physics II Lab — PRE: PHYS117, PHYS119; CO: PHYS118
- **STAT 215 [3]** Probability and Statistics for Engineers — PRE: MATH115
- **CS 108 [3]** Computer Programming — PRE: MATH115
- **GE 103 [3]** Engineering Graphics and Design
- **GE 100 [0]** Introduction to Engineering

SECOND YEAR (SOPHOMORE)

FALL

- **QUR 100 [2]** Quran Kareem
- **MATH 228 [3]** Linear Algebra & Ordinary Differential Equations — PRE: MATH116
- **MATH 207 [3]** Calculus III — PRE: MATH116
- **CHEM 202 [3]** Organic Chemistry — PRE: CHEM104
- **CHEM 203 [1]** Organic Chemistry Lab — CO: CHEM202
- **GE 201 [3]** Statics — PRE: MATH116, PHYS117
- **ChE 211 [3]** Principles of ChEm. Eng. I — PRE: CHEM104, MATH115

SPRING

- **QUR 150 [2]** Quran Kareem
- **MATH 236 [3]** Mathematical Methods for Engineers — PRE: MATH207, MATH228
- **ChE 213 [2]** Principles of ChEm. Eng. II — PRE: ChE211, MATH116
- **ChE 221 [3]** ChEm. Eng. Thermodynamics I — PRE: ChE211
- **ChE 223 [3]** Fluid Mechanics — PRE: ChE211, MATH207
- **ChE 224 [2]** Heat Transfer I — PRE: ChE211, MATH207
- **ChE 241 [3]** Material Sci. and Eng. — PRE: CHEM104

THIRD YEAR (JUNIOR)

FALL

- **FIQ 150 [2]** Fiqh
- **MATH 346 [3]** Numerical Analysis — PRE: MATH236, CS108
- **ChE 322 [2]** Heat Transfer II — PRE: ChE223, ChE224, GE103
- **ChE 325 [3]** Unit Operations — PRE: ChE223, GE201
- **ChE 326 [3]** Mass Transfer — PRE: ChE223, ChE224
- **ChE 327 [1]** Fluid Mechanics & Heat Transfer Lab — Co: ChE322
- **ChE 329 [3]** Chem. Eng. Thermodynamics II — PRE: ChE221, MATH236

SPRING

- **NAHU 105 [2]** NAHU
- **GE 303 [3]** Engineering Economy — PRE: MATH236
- **ChE 311 [3]** Chemical Reaction Eng. — PRE: ChE329, MATH346
- **ChE 328 [3]** Separation Processes — PRE: ChE326
- **ChE 351 [3]** Petrochemicals — PRE: ChE241, CHEM202
- **CHE 381 [3]** BioChEmical Eng. — CO: ChE311

SUMMER SEMESTER

GE 399 Engineering Training [0] (Pre-requisite: 90 credits)

FOURTH YEAR (SENIOR)

FALL

- **HST 101 [2]** Asserah Annabawia
- **ChE 423 [1]** Unit Operations & Sep. Processes Lab — PRE: ChE328, ChE325
- **ChE 431 [3]** Process Control — PRE: ChE325, MATH236
- **ChE 461 [3]** Chemical Processes and Plant Design — PRE: ChE241, ChE325, ChE326
- **ChE 462 [3]** Process Synthesis & Modeling — PRE: ChE325, GE308
- **ChE 463 [2]** Environmental & Safety Management — Co: ChE491
- **ChE 493 [2]** Graduation Project I — CO: ChE461; Credit > 100h
- **ChE 4** [3]** Elective I — PRE: ChE325, ChE326

SPRING

- **GE 302 [2]** Professional Ethics for Engineers — PRE: GE399
- **ChE 434 [1]** Reaction Eng. & Process Control Lab — PRE: ChE311, ChE431
- **ChE 454 [3]** Petroleum Refining — PRE: ChE328, CHEM202
- **ChE 494 [2]** Graduation Project II — PRE: ChE493
- **ChE 4** [3]** Elective II — PRE: ChE325, ChE326
- **ChE 4** [3]** Elective III — PRE: ChE325, ChE326

No. of Courses / Credits each semester:

FIRST YEAR		SECOND YEAR		THIRD YEAR		FOURTH YEAR	
[7/ 16]	[8 / 18]	[7 / 18]	[7 / 18]	[7 / 17]	[6 / 17]	[8 / 19]	[6/ 14]

Chemical Engineering Undergraduate Curriculum

First Year (Freshman)

First Level

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	CUL 101	Islamic Culture	2	2		
2	ENGL 200	Technical Writing in English	3	3		1
3	CHEM 104	General Chemistry	3	3		1
4	CHEM 105	General Chemistry Lab	1		2	
5	MATH 115	Calculus I	3	3		2
6	PHYS 117	Physics I	3	3		1
7	PHYS 119	Physics Lab I	1		2	
Total Semester Hours			**16**	**14**	**4**	**5**

Second Level

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	IDE 133	Tawheed	2	2		
2	MATH 116	Calculus II	3	3		2
3	PHYS 118	Physics II	3	3		1
4	PHYS 120	Physics II Lab	1		2	
5	STAT 215	Probability and Statistics for Engineers	3	3		1
6	GE 100	Introduction to Engineering	0			2
7	GE 103	Engineering Graphics and Design	3	2	2	
8	CS 108	Computer Programming	3	2	2	
Total Semester Hours			**18**	**15**	**6**	**6**
Cumulative Credit Hours			**34**	**29**	**10**	**11**

Second Year (Sophomore)

Third Level

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	QUR 100	Quran Kareem	2	2		
2	CHEM 202	Organic Chemistry	3	3		1
3	CHEM 203	Organic Chemistry Lab	1		2	
4	MATH 207	Calculus III	3	3		2
5	MATH 228	Linear Algebra & Ordinary Differential Equation	3	3		2
6	GE 201	Statics	3	3		1
7	ChE 211	Principles of Chemical Engineering I	3	3		1
Total Semester Hours			**18**	**17**	**2**	**7**
Cumulative Credit Hours			**52**	**46**	**12**	**18**

Fourth Level

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	QUR 150	Quran Kareem	2	2		
2	MATH 236	Mathematical Methods for Engineers	3	3		2
3	ChE 213	Principles of Chemical Engineering II	2	2		1
4	ChE 221	Chemical Engineering Thermodynamics I	3	3		1
5	ChE 223	Fluid Mechanics	3	3		1
6	ChE 224	Heat Transfer I	2	2		1
7	ChE 241	Material Science and Engineering	3	3		1
Total Semester Hours			**18**	**18**	**0**	**7**
Cumulative Credit Hours			**70**	**64**	**12**	**25**

Third Year (Junior)

Fifth Level

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	FIQ 150	Fiqh	2	2		
2	MATH 346	Numerical Analysis	3	3		2
3	ChE 322	Heat Transfer II	2	2		1
4	ChE 325	Unit Operations	3	3		1
5	ChE 326	Mass Transfer	3	3		1
6	ChE 327	Fluid Mechanics and Heat Transfer Lab	1		2	
7	ChE 329	Chemical Engineering Thermodynamics II	3	3		1
Total Semester Hours			**17**	**16**	**2**	**6**
Cumulative Credit Hours			**87**	**80**	**14**	**31**

Sixth Level

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	NAHU 105	NAHU	2	2		
2	GE 303	Engineering Economy	3	3		1
3	ChE 311	Chemical Reaction Engineering	3	3		1
4	ChE 328	Separation Process	3	3		1
5	ChE 351	Petrochemicals	3	3		1
6	ChE 381	Biochemical Engineering	3	3		1
Total Semester Hours			**17**	**17**		**5**
Cumulative Credit Hours			**104**	**97**	**14**	**36**

Engineering Training

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	GE 399	Engineering Training	0	0	0	0

Fourth Year (Senior)

Seventh Level

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	HST 101	Asserah Annabawia	2	2		
2	ChE 4**	Elective I	3	3		1
3	ChE 423	Unit Operations & Separation Process Lab	1		2	
4	ChE 431	Process control	3	3		1
5	ChE 461	Chemical Process and Plant Design	3	3		1
6	ChE 462	Process Synthesis and Modeling	3	3		1
7	ChE 463	Environmental and Safety Management	2	2		1
8	ChE 493	Graduation Project I	2		4	
Total Semester Hours			**19**	**16**	**6**	**5**
Cumulative Credit Hours			**123**	**113**	**20**	**41**

Eighth Level

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	GE 302	Professional Ethics for Engineers	2	2		
2	ChE 4**	Elective II	3	3		1
3	ChE 4**	Elective III	3	3		1
4	ChE 434	Reaction Engineering & Process Control Lab	1		2	
5	ChE 454	Petroleum Refining	3	3		1
6	ChE 494	Graduation Project II	2		4	
Total Semester Hours			**14**	**11**	**6**	**3**
Cumulative Credit Hours			**137**	**124**	**26**	**44**

Course Description

1. GENERAL ENGINEERING

GE 100	Introduction to Engineering	0 Credit Hours

Introduction to the engineering profession, roles and responsibilities of engineers, professional and ethical aspects of the profession, major engineering disciplines, academic background and requirements of each discipline, sub-specialties within each discipline, jobs availability and financial benefits, role of professional engineering bodies and societies, teamwork.

GE 103	Engineering Graphics and Design	3 Credit Hours

Use of computer drafting software (AutoCAD) to model parts and assemblies. Use of parametric and non-parametric solids, surface and wire frame models. Part editing, two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi-view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerance techniques. Team or individual design project.

CS 108	Computer Programming	3 Credit Hours

The course introduces students to structured programming techniques. Topics include different control statements (sequence, selection, and repetition), functions, fundamental data types, and data structures (arrays and pointers). Upon successful completion of the course, students will solve computer problems by using structured programming techniques and adequate tools (text editor, compiler, and debugger).

GE 201	Statics	3 Credit Hours

Vector analysis, forces, moments, and couples, resultants of force systems, equilibrium analysis and free-body diagrams, analysis of forces acting on members of trusses and frames. Shear-force and bending-moment distributions, centroids, center of mass, hydrostatic pressure, moment of inertia, parallel axis theorem, polar moment of inertia, and product of inertia.

GE 202	Dynamics	3 Credit Hours

Kinematics and kinetics of particles including Newton’s second law, energy-work principles, and impulse-momentum methods. Planar kinematics and planar kinetics of rigid bodies: translation, rotation about a fixed axis, and general plane motion. Introduction to three-dimensional dynamics of rigid bodies.

GE 302	Professional Ethics for Engineers	2 Credit Hours

Introduction to engineering ethics; definition of a profession, personal and professional ethics, explore many of the ethical issues, discussion of ethical theories, code of ethics, problem

solving techniques. Introduce engineer's rights and responsibilities. Asses Safety, risk and accidents. Explain the Rights and Responsibilities of Engineers.

GE 303	Engineering Economy	3 Credit Hours

This course investigates methods of economic analysis for decision making among alternative courses of action in engineering, business and government applications. Topics include: Time value of money, Money management, and Equivalence calculations under inflation, Present worth analysis, Annual Equivalence Analysis, Rate of return analysis. Benefit-Cost ratio & profitability index analyses.

GE 399	Engineering Training	0 Credit Hours

8 weeks training in a relevant industry under the supervision of an external supervisor from industry. Each student must submit a technical report about his learning experience during training in addition to fulfilling any other requirements as determined by the department.

2. CHEMICAL ENGINEERING CORE COURSES

ChE 211	Principles of Chemical Engineering I	3 Credit Hours

Introduction to chemical engineering and the role of the chemical engineer. The emphasis on engineering problem analysis, units and dimensions, engineering calculations, processes and process variables, and fundamentals of material balances that involve single-phase and multiphase systems.

ChE 213	Principles of Chemical Engineering II	2 Credit Hours

Energy balance: Energy and energy balances, balances on nonreactive processes, balances on reactive processes.

ChE 221	Chemical Engineering Thermodynamics I	3 Credit Hours

Fundamental concepts of thermodynamic systems, heat and work, properties of pure substances, first and second laws, entropy and exergy analysis.

ChE 223	Fluid Mechanics	3 Credit Hours

This course will provide the student with a basic understanding of fluid properties, fluid statics and dynamics, and fluid flow. The flow of incompressible fluids in pressure systems constitutes the major portion of this course. The course covers also the momentum balance and basic fluid measurements.

ChE 224	Heat Transfer I	2 Credit Hour

Fundamentals of heat transfer. Theory of heat transfer and solution methods for heat transfer problems. Introduction to the concept of heat transfer; introduction to conduction; one-dimensional steady-state conduction; two-dimensional steady-state conduction; transient Conduction.

ChE 241	Materials Science and Engineering	3 Credit Hours

Atomic structure and interatomic bonding. Material microstructures, dislocations and defects in solids. Diffusion in solid materials. Mechanical properties of metals, polymers, and ceramics. Fracture, fracture mechanics, fatigue, and creep. Phase diagrams.

ChE 311	Chemical Reaction Engineering	3 Credit Hours

Reaction kinetics: batch reactor system, CSTR reactor, tubular reactor, CSTR in series, reaction conversion and rate, adiabatic reaction, Isothermal and Non-Isothermal reaction- catalytic reactions.

ChE 322	Heat Transfer II	2 Credit Hours

Introduction to convection: external flow, internal flow; free convection; boiling and condensation; Condensation and boiling heat transfer. Heat exchanger design, applications of heat transfer in engineering Systems.

ChE 325	Unit Operations	3 Credit Hours

Chemical unit operations encompass all the processes that run through the influence of mechanical forces or force fields. The basic operations include: characterization of solid particles; storage of solids; drag and drag coefficients; flow through beds of solids; mechanics of particle motion; settling; fluidization; size reduction; screening; filtration; gravity sedimentation processes; separation by centrifuges; separation by cyclones; crystallization processes; separation by filtration and evaporation.

ChE 326	Mass Transfer	3 Credit Hours

Introduction to mass transfer and diffusion, molecular diffusion in gases and liquids, convective mass transfer coefficients, mass transfer between phases, membrane, absorption with and without Chemical reactions, and principles of unsteady-state mass transfer.

ChE 327	Fluid Mechanics and Heat Transfer Lab	1 Credit Hours

Thermal Conductivity, double pipe heat exchanger, free convection, forced convection, extended surface, Flow Measurements, Laminar and turbulent Flow, Flowing Fluids and Pressure Variation, Flow in Conduits, Cavitation.

ChE 328	Separation Process	3 Credit Hours

Equilibrium stage approach to absorption/stripping, distillation, solvent extraction. Graphical methods are introduced as well as the concepts of minimum number of stages, minimum solvent or stripping agent rate and minimum reflux ratio. The concept of humidity and the use of psychrometric charts are introduced. Membrane separation processes.

ChE 329	Chemical Engineering Thermodynamics II	3 Credit Hours

Multicomponent systems, phase equilibria, prediction of thermodynamic properties and reaction equilibria.

ChE 351	Petrochemicals	3 Credit Hours

Technologies used in petrochemical industries such as thermal and catalytic cracking processes. Basic, intermediate and final petrochemicals. Synthesis gas and derivatives, ethylene, propylene, butene, BTX, and their derivatives. Competing technologies.

ChE 381	Biochemical Engineering	3 Credit Hours

Introduction to the principles of biochemical technology, application biochemical technology chemical engineering field, biological reactors systems, Flow Measurements, food and medicine applications.

ChE 423	Unit Operations & Separation Process Lab	1 Credit Hours

Packed and tray distillation, packed-column gas absorption, liquid-liquid extraction, humidification/dehumidification in cooling towers, tray drying, evaporation, filtration, fluidization, screen analysis and size reduction

ChE 431	Process Control	3 Credit Hours

Process flow sheet development –Process modeling: closed loop system, load variables and controlled variables ,transient response, first and higher order system, integrated system control, advanced control configurations.

ChE 434	Reaction Engineering & Process Control Lab	1 Credit Hours

Reaction kinetics: batch reactor system, CSTR reactor, tubular reactor, CSTR in series, reaction conversion and rate, adiabatic reaction, Isothermal and Non-Isothermal reaction (practical study), automatic process control, PID control, control gain, unsteady state transition, damping, controlled and manipulated variables, closed loop, cascade control, feedforward control.

ChE 454	Petroleum Refining	2 Credit Hours

The origin and composition of petroleum. Crude oil analysis and evaluation. Petroleum products and their uses. Refinery structure. The main unit operation in the different refinery processes: Atmospheric & vacuum distillation, fluid catalytic cracking, platforming, hydro-desulfurization and hydrotreating processes. Chemical treatment. Asphalt production. Lube oils production. Refinery Utilities. Standards and specifications of fuels.

ChE 461	Chemical Processes and Plant Design	3 Credit Hours

Process flow sheet development – Energy-efficient design – Control Philosophy – materials of constructions – safety – Plant layout – equipment selection and specification – Design of pressure vessels, columns internals and heat exchangers – Transport of fluids.

ChE 462	Process Synthesis and Modeling	3 Credit Hours

Conceptualization of Chemical processes, engineering economic analysis, computer-aided design of Chemical processes with emphasis on process economics, profitability analysis, and optimum operating conditions

ChE 463	Environmental and Safety Management	2 Credit Hours

The course provides a comprehensive guide to process safety and environmental management. It covers the theories and procedures for applying safety and environmental procedures in the process industry.

ChE 493	Graduation Project I	2 Credit Hours

The course enables the students to be able to write a technical report and conduct an effective oral presentation, select most suitable process, and apply of chemical engineering design principles to conduct material and energy balance.

ChE 494	Graduation Project II	2 Credit Hours

The course enables the students to be able to apply chemical engineering design principles to simulate a process, fully design of some equipment (chemical and mechanical design), implement economic calculations for a process, write a technical report, design a poster, and present their results.

3. TECHNICAL ELECTIVES

ChE 412	Energy Conversion and Management	3 Credit Hours

The principles of energy conversion, steam generation and steam turbine performance, gas turbine, dual cycle analysis, types of fuels, combustion of fuels, heating value of fuels (GHV, NHV); production and combustion of biomass fuels. Energy consumption and Environmental pollution.

ChE 413	Renewable Energy	3 Credit Hours

The concept of sustainability, wind energy, solar energy, hydraulic energy, geothermal energy, tidal power, solid wastes energy, and biofuel energy; nuclear energy; fuel cells, hybrid systems.

ChE 414	Solar Energy	3 Credit Hours

Sun nature, sun-earth movement; calculation of extraterrestrial solar radiation; solar angles; measurements and calculations of hourly, daily, and monthly insolation on horizontal and inclined surfaces; solar energy collection systems; solar energy storage systems; industrial utilization of solar energy.

ChE 415	Fuel Cells	3 Credit Hours

Introduce the student to the theory and applications of fuel cells. Topics to be covered: fuel cell concept, hydrogen generation and storage, electrode reactions, types of fuel cells. Electrodes materials, performance of a fuel cell and factors which affect the performance of a fuel cell.

ChE 416	Air Pollution Engineering	3 Credit Hours

Formalize students with techniques for measuring and controlling pollutants in order to design the pollution control equipment. Topics to be covered: Specific pollutants, sources and effects, particle dynamics and deposition mechanisms. Effects of particulate matter, control of particulate matter, photoChemistry, combustion-related pollutants, role of the automobile and power plant, air pollution meteorology, air pollution transport, building ventilation and pollutant penetration, sources and major indoor air pollutants, radon, global warming and greenhouse gases.

ChE 441	Electrochemical Engineering	3 Credit Hours

Elements of electrochemical processing as they derive from electrochemical fundamentals. Of Electrochemistry application in engineering. Basic thermodynamics and kinetics of electrochemical reactions, with emphasis on electrochemical techniques in order to illustrate how electrochemical parameters of electrode reactions can be determined and used for different applications. The use of electrochemistry in the field of corrosion, electroplating ،extractive metallurgy and fuel cells will be highlighted.

ChE 442	Nanomaterials Technology	3 Credit Hours

Principles and theories relevant at the nanoscale dimension, properties and characterization of nonmaterial, current and future nanotechnology applications in engineering materials, electronics, energy and desalination.

ChE 443	Polymer Chemistry and Engineering	3 Credit Hours

The polymer Chemistry and reactions; polymerization mechanisms; thermodynamics of polymer solutions, morphology, crystallization and mechanical properties; polymer processing equipment and technology; reactive polymeric resins and biological applications of macromolecules.

ChE 451	Desalination	3 Credit Hours

Fundamentals of desalination and other industrial aspects. These fundamentals are necessary to analyze and evaluate the performance for any of the existing and known desalination processes. The content is: Introduction. Single Effect Evaporation, Vapor compression, Multi Effect Evaporation and Multi Stage Flash distillation. Reverse Osmosis, Associated processes. Economic analysis.

ChE 452	Membrane Technology	3 Credit Hours

Introduction of detailed descriptions of the fundamentals and applications of the membrane separation processes. Membrane module designs is presented besides the following: Overview of membrane science and technology. Membrane transport theory, Membrane and modules and Concentration polarization. Reverse osmosis. Ultra-filtration, Micro filtration. Gas separation. Pervaporization, Ion exchange membrane and electrodialysis. Carrier facilitated transport, Medical application and other membrane processes.

ChE 453	Water and Wastewater Treatment	1 Credit Hours

This course covers the technologies that are applied to the treatment and purification of drinking water and wastewater. The methods and technologies discussed are a combination of physical, Chemical and thermal techniques. The following topics are covered: an overview of water and wastewater characterization and treatment, filtration, Chemical additives to enhance filtration, filter media, pressure and cake filtration, cartridge filters, sand filtration, sedimentation, clarification, flotation, and coalescence membrane separation technologies, ion exchange and carbon adsorption, water sterilization technologies, treating the sludge, microbiology of wastewater treatment.

ChE 482	Bioprocess Engineering	3 Credit Hours

Emphasis the engineering principles of biochemical processes and conversion of biological agents to food, pharmaceuticals, biofuels, and chemicals. Microbiology and metabolic pathways, and enzyme reactions. Concept of dissolved oxygen demand (DOD), and Chemical oxygen demand (COD). Gas and liquid system (aeration). Fermentation kinetics. Enzyme immobilization, transport phenomena in biological systems. Design and modeling of single and multi-stage bioreactors. Sterilization. Scale-up of bioreactors.

ChE 483	Bioseparation Engineering	3 Credit Hours

Identify the role of equilibrium and biochemical separation to demonstrate how they are used in the analysis and design of different bioseparators.

ChE 484	Application in Biological Engineering	3 Credit Hours

Overview of the research and applications of Biological Engineering such as bio processing, biotechnology, transport processes, biosensors, bioremediation, biological materials, and biomedicine.