



Jordan University of Science and Technology

Faculty of Engineering

Department of Chemical Engineering

*Undergraduate Curriculum for the B.Sc. Degree in
Chemical Engineering*

Vision

To stay ahead in chemical engineering education quality and research

Mission

To Provide students with a high caliber education in the chemical engineering field through a well coordinated, dynamic and practical program with an up-to-date content, professional skills, knowledge, and quality research. The acquired knowledge covers chemical engineering fundamentals and exposure to emerging technologies that prepare graduates for a challenging career in chemical engineering and to be pioneers contributing to the comprehensive sustainable national development plans.

Department Objectives

The educational objectives of the Chemical Engineering Program at JUST are to produce graduates who:

1. Have a strong foundation of scientific and technical knowledge and are equipped with problem solving, critical-thinking, teamwork, and communication skills that will serve them throughout their future careers.
2. Are prepared for entry into careers in chemical engineering in the various areas including, but not limited to, petrochemical, petroleum refining, biochemical, pharmaceutical, water treatment, desalination, environmental pollution control, mineral processing, advanced materials, and food technologies.
3. Are committed to integrate ethical and social codes, environmental regulations, and safety issues into their professional careers.
4. Have the capability to effectively exercise leadership within a multifaceted scope of technological and economical issues.
5. Have the ability to pursue research and advanced studies in areas such as biochemical engineering, environmental engineering, advanced materials, renewable energy, computer-aided design, process synthesis, process control, and petrochemical engineering.
6. Participate in identifying contemporary challenges and propose a plan of action to tackle them.

B. Sc. Program Learning Outcomes

Upon completion of the degree program, students will have:

- A. An ability to apply knowledge of mathematics, science, and engineering.
- B. An ability to design and conduct experiments as well as analyze and interpret data.
- C. An ability to design a system, component, or process to meet desired needs.
- D. An ability to function on multi-disciplinary teams.
- E. An ability to identify, formulate, and solve engineering problems.
- F. An understanding of professional and ethical responsibility.
- G. An ability to communicate effectively.

- H. The broad education to understand the impact of engineering solutions in a global and societal context.
- I. Recognition of the need for and an ability to engage in life-long learning.
- J. Knowledge of contemporary issues.
- K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- L. Recognition of the safety needs, and an ability to adhere to the safety rules and regulations.

Table 1: Mapping of ChE Program Objectives and ABET Program Outcomes

PROGRAM EDUCATIONAL OBJECTIVES	Program/ABET Outcomes											
	A	B	C	D	E	F	G	H	I	J	K	L
1. Have a strong foundation of scientific and technical knowledge and are equipped with problem solving, critical-thinking, teamwork, and communication skills that will serve them throughout their future careers	x	x	x	x	x	x	x	x	x	x	x	x
2. Are prepared for entry into careers in chemical engineering in the various areas including, but not limited to, petrochemical and petroleum refining, biochemical, pharmaceutical, water treatment, desalination, environmental pollution control, mineral processing, advanced materials, and food technologies	x	x	x	x	x	x	x	x	x	x	x	x
3. Are committed to integrate ethical and social codes, environmental regulations, and safety issues into their professional careers						x		x				x
4. Have the capability to effectively exercise leadership within a multifaceted scope of technological and economical issues				x		x	x					
5. Have the ability to pursue research and advanced studies in areas such as Biochemical Engineering, Environmental Engineering, Advanced Materials, Renewable Energy, Computer-Aided Design, Process Synthesis, Process Control, and Petrochemical Engineering	x	x	x		x		x	x	x	x	x	x
6. Participate in identifying contemporary challenges and propose a plan of action to tackle them	x	x	x	x	x			x		x	x	x

Undergraduate Curriculum

Undergraduate Degree Plan

Before introducing courses and degree requirements it is important to describe the numbering / coding system of courses at JUST.

Course Coding

The following codes are used to designate courses:

Department			Level/Year	Field	Sequence
A	B	C	#	#	#

The Department codes (A, B, C) are as follows:

Code	Department
AE	Architectural Engineering
CE	Civil Engineering
ME	Mechanical Engineering
EE	Electrical Engineering

Code	Department
IE	Industrial Engineering
ChE	Chemical Engineering
BME	Biomedical Engineering
NE	Nuclear Engineering

Course Numbering

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

First Digit	Level of Course
1	First year
2	Second year
3	Third year
4	Fourth year
5	Fifth year.

The second digit denotes the course field subject as follows:

Second Number	Specialization
0	Basics of Chemical Engineering
1	Engineering Materials
2	Technology and Applied Chemical Engineering
3	Chemical Reaction Engineering
4	Thermal and Fluid Sciences
5	System Analysis, Modeling and Control
6	Mass Transfer Operations
7	Design and Safety
8	Biochemical and Environmental Engineering
9	Special Topics, Graduation Projects and Engineering Training

Example: ChE 311 means

ChE	3	1	1
Department	Level (Third year)	Field (Engineering materials)	Sequence (1 st semester)

The following presents the courses (and their pre/co-requisite) within each of the requirements needed to obtain a B.Sc. in Chemical Engineering.

B.Sc. Degree (159 Semester Credits)

A Bachelor of Science (B.Sc.) degree in Chemical Engineering at JUST is awarded in accordance with the statute stated by JUST regulations for B.Sc. awarding issued by the Deans' Council based on the 1987 law for awarding scientific degrees and certifications at JUST, and after the successful completion of 159 credit hours, distributed as indicated in Tables 1 and 2.

Table 1. Distribution of Credit hours

Classification	Credit Hours		
	Compulsory	Elective	Total
University Requirements	16	09	25
Faculty Requirements	32	-	32
Department Requirements	87	15	102
Total	135	24	159

Table 2. Classification of Courses

Source of Courses		Credit Hours	Percentage
Humanities	Lecture	24	15.1%
	Lab	1	0.6%
Basic Sciences	Lecture	36	22.6%
	Lab	3	1.9%
General Engineering	Lecture	18	11.3%
	Lab	2	1.3%
Chemical Engineering	Lecture	68	42.8%
	Lab	7	4.4%
Total	Lecture	146	91.8%
	Lab	13	8.2%

University Requirements (25 Credit Hours)

Compulsory: (16 Credit Hours)

Table 3. University Compulsory Courses

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite or Co-requisite
Arb 101	Arabic Language	3	3		
Arb 103	Applied Arabic Language Studies	1		3	
Eng 111 ⁽¹⁾	English Language	3	3		Pass Eng 99
Eng 112	Communication Skills II	3	3		Eng 111
CIS 100 ⁽²⁾	Computer Skills	3	3		
MS100 ⁽³⁾	Military Sciences	3	3		
	Total	16			

- 1) A student who passes the English Language Placement Test with a grade > 80% is exempted from both Eng 099 and Eng. 111, while a student who passes the English Placement Test with a grade between 50% and 80% is exempted from Eng 099 only.
- 2) A student who passes the Computer Skills Placement Test with a grade > 50% is exempted from CIS 100.
- 3) This course is required from Jordanian students only; graded on Pass/Fail basis. Students graduating from Royal Military faculty and military candidates school and equivalent institutes are exempted from taking this course: Non-Jordanian Arabic Speaking students are required to take a substitute for this course from the elective courses and in this case the grade of this course is included in their grade point average (GPA).

Notice: All non Arabic Speaking foreign students in the University are required to study two courses in Arabic language as shown below:

Table 4. Courses for non Arabic Speaking Students

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite or Co-requisite
Arb101A	Fundamentals of Arabic Language (for non Arabic speaking students as a substitute for the course Arb101 Arabic Language)	3	3		
Arb103A	Fundamentals of Arabic Language Lab for non Arabic speaking students as a substitute for the course Arb103 Applied Arabic Language Studies)	1		3	

Elective: (9 Credit Hours)

The university elective courses are three courses with a total of 9 Cr. Table 5 lists these courses.

Table 5. University Elective Courses for Engineering Students

Course No.	Course title	Cr. Hr.	Lecture	Lab.	Prerequisite or Co-requisite
ES 103	Environment Protection (for non Environment Sciences students)	3	3	0	
PH 200	First Aid and Emergency Procedure (for non Medicine, non Nursing, and non Midwifery students)	3	3	0	
PH 104	Community Health and Nutrition (for non Medicine, non Nursing, and non Midwifery students)	3	3	0	
PHAR 104	Drugs and Medical Plants (for non Medicine, and non Pharmacy students))	3	3	0	
NUR 100	Health Promotion (for non Medicine, non Nursing, and non Midwifery students)	3	3	0	
ADS 100	Oral and Dental Health (for non Dentistry and non Dentistry Sciences students)	3	3	0	
PP 200	Home Gardens (for non Agriculture students)	3	3	0	
PP 201	Bee Keeping (for non Agriculture students)	3	3	0	
VM 211	Animal Health (for non Veterinary Medicine and non Agriculture students)	3	3	0	
VM 212	Pet Animal Care (for non VM and Agriculture students)	3	3	0	
HSS 112	Hadith Shareef	3	3	0	
HSS 113	Aqideh	3	3	0	
HS 114	Fekeh	3	3	0	
HSS 115	Islam and Recent Problems	3	3	0	
HSS 116	Islamic Economy System	3	3	0	
HSS 121	Principles of Sociology	3	3	0	
HSS 126	Principles of Psychology	3	3	0	
HSS 127	Educational Technology	3	3	0	
HSS 128	National Education	3	3	0	
HSS 131	Islamic Civilization	3	3	0	
HSS 132	The History of the City of Jerusalem	3	3	0	
HSS 133	Civilization and Recent Cultures	3	3	0	
HSS 141	Introduction to Economics (for non CIS students)	3	3	0	
HSS 142	Library and Information Research	3	3	0	
HSS 151	Introduction to Management Sciences (for non CIS students)	3	3	0	
HSS 161	Contemporary Problems	3	3	0	
HSS 166	Man and Science	3	3	0	
HSS 182	Studies on Women	3	3	0	
HSS 250	Music History (in English)	3	3	0	
HSS 211	Introduction to Sociology (in English)	3	3	0	
HSS 212	Arab Society	3	3	0	
HSS 213	Individual and Society	3	3	0	
HSS 216	International Global Issues	3	3	0	
HSS 221	Introduction to Psychology (in English)	3	3	0	
HSS 222	Creativity and Problems Solving	3	3	0	

HSS 224	Leadership and Communication Skills	3	3	0	
HSS 231	History of Science in Islam	3	3	0	
HSS 241	Economy in the Third World	3	3	0	
HSS 242	Information and Research	3	3	0	
HSS 429	Behavioral Science and Dealing with Children	3	3	0	
PT 100	Health and Life Styles (for non physical therapy students)	3	3	0	
ME 211	Fundamentals of Automobile Engineering (for non ME students)	3	3	0	
NR 200	Natural Resources and Human Being	3	3	0	
NF 177	Food Preservation (in English)	3	3	0	

Faculty Requirements: (32 Credit Hours)

The Faculty of Engineering requirements consist of 32 Credit Hours distributed as follows:

Table 6. Faculty of Engineering Compulsory Courses

Course No.	Course Title	Cr. hr.	Lecture	Lab.	Prerequisite or Co-requisite
Math101	Calculus I	3	3		----
Math 102	Calculus II	3	3		Math 101
Math 201	Intermediate Analysis	3	3		Math 102
Math 203	Ordinary Differential Equations	3	3		Math 102
Phys 101	General Physics I	3	3		----
Phys 102	General Physics II	3	3		Phys 101
Phys 107	General Physics Lab	1		3	Phys 102 Pre or Co
Chem 101	General Chemistry I	3	3		----
Chem 102	General Chemistry II	3	3		Chem 101
Chem 107	General Chemistry Lab	1		3	Chem 102 Pre or Co
CS 115	Programming in C++ Language	3	3		CIS 100
EE 202	Communication Skills for Engineers	2	2		2 nd Year Standing
ChE 400	Professional Ethics for Engineers	1	1		Completion of 90 Cr. Hr.
	Total	32			

Department Requirements: (102 Credit Hours)

I) Department Compulsory Courses: (87 Credit Hours)

Department compulsory courses are 87 credit hours distributed in Tables 7 and 8.

Table 7: Chemical Engineering compulsory courses (66 credit hours)

Course No.	Course Title	Cr. hr.	Lecture	Lab.	Prerequisite or Co-requisite
ChE 201	Introduction to Chemical Engineering	1	1		Chem 102
ChE 204	Fundamentals of Chemical Engineering	3	3		CS 115, ME 200 or Co & ChE 201
ChE 311	Materials Science and Engineering	3	3		ChE 204 & Chem 212
ChE 340	Thermodynamics	3	3		Math 203
ChE 342	Chemical Engineering Thermodynamics	3	3		ChE 340
ChE 343	Fluid Mechanics for Chemical Engineers	3	3		Math 203 & ChE 340 or Co
ChE 344	Fluid Mechanics Lab.	1		3	ChE 343
ChE 346	Heat Transfer	3	3		ChE 343 & EE 305 or Co
ChE 362	Unit Operations	3	3		ChE 343
ChE 431	Chemical Reaction Engineering I	3	3		Chem 347 & ChE 342
ChE 432	Chemical Reaction Engineering II	3	3		ChE 431
ChE 441	Chemical Measurements & Testing Lab	1		3	ChE 342 & ChE 346
ChE 442	Heat & Mass Transfer Lab.	1		3	ChE 461 or Co
ChE 452	Applied Mathematics and Modeling for Chemical Engineers	3	3		EE 305 & ChE 432 or Co
ChE 461	Mass Transfer	3	3		ChE 342 & ChE 346
ChE 464	Separation Processes	3	3		ChE 461
ChE 472	Equipment Design	3	3		ChE 311 & ChE 464 or Co
ChE 483	Introduction to Biochemical Engineering	3	3		ChE 431 or Co
ChE 490	Engineering Training	3	3		Completion of 117 Cr. Hr. & ChE 400
ChE 535	Chemical Processing Lab.	1		3	ChE 432
ChE 551	Process Dynamics and Control	3	3		ChE 452
ChE 552	Process Control Lab.	1		3	ChE 551
ChE 555	Computer Applications Lab. For Chemical Engineers	1		3	ChE 472 or Co
ChE 557	Instrumental Analysis	3	3		ChE 464 or Co
ChE 565	Unit Operations Lab.	1		3	ChE 362 & ChE 464
ChE 575	Plant Design	3	3		IE 341 & ChE 472 or Co
ChE 591	Graduation Project I	1			Completion of 114 Cr. Hr. & ChE 575 or Co
ChE 592	Graduation Project II	3			ChE 591
	Total	66			

Table 8. Compulsory courses from other departments (21 credit hours)

Course No.	Course Title	Cr. hr.	Lecture	Lab.	Prerequisite or Co-requisite
ME 101	Engineering Workshop	2	1	3	---
ME 101	Engineering Workshop Lab	0	0	0	---
ME 200	Engineering Drawing A	1		3	CIS 100
EE 303	Fundamentals of Electrical Engineering	3	3		Phys 102 & Math 102
EE 305	Numerical Methods for Engineers	3	3		Math 203 & CS 115
IE 341	Engineering Economy	2	2		Math 201
Chem 211	Organic Chemistry I	3	3		Chem 102
Chem 212	Organic Chemistry II	3	3		Chem 211
Chem 213	Organic Chemistry Lab. I	1		3	Chem 212 or CO
Chem 347	Physical Chemistry II	3	3		ChE 340
	Total	21			

II) Department Technical Electives: (15 Credit Hours)

The student is advised to select courses (15 Credit Hours) from Tables 9 and 10.

Table 9. Department technical elective courses

Course No.	Course Title	Cr. hr.	Lecture	Lab.	Prerequisite or Co-requisite
ChE 411	Corrosion Engineering	3	3		ChE 311
ChE 412	Polymer Science and Technology	3	3		Chem 212 & ChE 431
ChE 415	Ceramics Engineering	3	3		ChE 311
ChE 424	Petroleum Refining Engineering	3	3		Chem 212 & ChE 464
ChE 443	Energy and Analysis of Fossil Fuels	3	3		ChE 432 & ChE 461
ChE 450	Experimental Design and Data Analysis	3	3		EE 305
ChE 457	Introduction to Optimization	3	3		EE 305
ChE 484	Air Pollution	3	3		ChE 362 & ChE 461
ChE 518	Electrochemical Engineering	3	3		ChE 431 & ChE 461
ChE 521	Chemical Industries	3	3		ChE 464 or Co
ChE 524	Food Engineering	3	3		ChE 362 & ChE 461
ChE 543	Renewable Energy	3	3		ChE 342 & ChE 346
ChE 563	Mineral Processing	3	3		ChE 362 & ChE 461
ChE 566	Desalination	3	3		ChE 461
ChE 568	Gas Processing and Treatment	3	3		ChE 464 or Co
ChE 577	Chemical Process Safety	3	3		ChE 575 or Co
ChE 581	Membrane Separation Processes	3	3		ChE 461
ChE 583	Physical and Chemical Water Treatment	3	3		ChE 464 or Co
ChE 585	Biochemical Engineering	3	3		ChE 461 & ChE 483

ChE 587	Biological Water Treatment	3	3		ChE 483
ChE 588	Pharmaceutical Process Engineering	3	3		ChE 362 & ChE 464
ChE 590 A	Special Topics A	3	3		Department approval
ChE 590 B	Special Topics B	2	2		Department approval
ChE 590 C	Special Topics C	1	1		Department approval

Table 10. Technical elective courses from other Engineering Departments (Students are allowed to take one course from this list)

Course No.	Course Title	Cr. hr.	Lecture	Lab.	Prerequisite or Co-requisite
ME 528	Thermal Power Plants	3	3		ChE 340
ME 581A	Heating Ventilation and Air Conditioning	3	3		5 th year standing
ME 582A	Refrigeration	3	3		5 th year standing
IE 548	Facilities Planning	3	3		5 th year standing
IE 556	Total Quality Management	3	3		Completion of 100 Cr. Hr.
IE 557	Introduction to Project Management	3	3		5 th year standing
IE 574	Reliability and Maintenance Management	3	3		5 th year standing

Study Plan for the B.Sc. Degree in Chemical Engineering

First Year

First Semester				Second Semester			
Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite	Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite
CIS 100	Computer Skills	3	-	Chem 102	General Chemistry II	3	Chem 101
Eng 111	English Language	3	Pass Eng 99	Chem 107	General Chemistry Lab.	1	Chem 102 or Co
Phys 101	General Physics I	3	-	Phys 102	General Physics II	3	Phys 101
Chem 101	General Chemistry I	3	-	Phys 107	General Physics Lab	1	Phys 102 or Co
Math 101	Calculus I	3	-	Math 102	Calculus II	3	Math 101
				CS 115	Programming in C++	3	CIS 100
				Eng 112	Communication Skills II	3	Eng 111
Total		15		Total		17	

Second Year

First Semester				Second Semester			
Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite	Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite
ChE 201	Introduction to Chemical Engineering	1	Chem 102	ME 101	Engineering Workshops	2	--
Math 201	Intermediate Analysis	3	Math 102	ME 200	Engineering Drawing A	1	CIS 100
Math 203	Ordinary Differential Equations	3	Math 102	ChE 204	Fundamentals of Chemical Engineering	3	CS115, ChE 201 & ME 200 or Co
Chem 211	Organic Chemistry I	3	Chem 102	Chem 212	Organic Chemistry II	3	Chem 211
EE 202	Communication Skills for Engineers	2	2 nd year standing	Chem 213	Organic Chemistry Lab. I	1	Chem 212 or Co
Arb 101	Arabic Language	3	-	MS 100	Military Science	3	
Arb 103	Applied Arabic Language Studies	1	-	U ---	University Elective	3	
Total		16		Total		16	

Third Year

First Semester				Second Semester			
Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite	Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite
EE 305	Numerical Methods for Engineers	3	Math 203 & CS 115	Chem 347	Physical Chemistry II	3	ChE 340
ChE 311	Materials Science and Engineering	3	ChE 204 & Chem 212	ChE 342	Chemical Engineering Thermodynamics	3	ChE 340
ChE 340	Thermodynamics	3	Math 203	ChE 344	Fluid Mechanics Lab.	1	ChE 343
ChE 343	Fluid Mechanics for Chemical Engineers	3	Math 203 & ChE 340 or Co	ChE 346	Heat Transfer	3	ChE 343 & EE 305 or Co
IE 341	Engineering Economy	2	Math 201	ChE 362	Unit Operations	3	ChE 343
U ---	University Elective	3		EE 303	Fundamentals of Electrical Engineering	3	Phys 102 & Math 102
Total		17		Total		16	

Fourth Year

First Semester				Second Semester			
Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite	Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite
ChE 400	Professional Ethics for Engineers	1	Completion of 90 Cr Hrs	ChE 432	Chemical Reaction Engineering II	3	ChE 431
ChE 431	Chemical Reaction Engineering I	3	ChE 342 & Chem 347	ChE 442	Heat & Mass Transfer Lab.	1	ChE 461 or Co
ChE 441	Chemical Measurements & Testing Lab.	1	ChE 342 & ChE 346	ChE 452	Applied Mathematics & Modeling For Chemical Engineering	3	EE 305 & ChE 432 or Co
ChE 461	Mass Transfer	3	ChE 342 & ChE 346	ChE 464	Separation Processes	3	ChE 461
ChE 483	Introduction to Biochemical Engineering	3	ChE 431 or Co	ChE 472	Equipment Design	3	ChE 311 & ChE 464 or Co
--- ---	Technical Elective	3		--- ---	Technical Elective	3	
Total		14		Total		16	

Summer Session

Course Number	Course Name	Credit Hours	Pre-Requisite
ChE 490	Engineering Training	3	Completion of 117 credit hours + ChE 400
Total		3	

Fifth Year

First Semester				Second Semester			
Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite	Course Number	Course Name	Credit Hours	Pre-Requisite or Co-requisite
ChE 535	Chemical Processing Lab.	1	ChE 432	ChE 552	Process Control Lab.	1	ChE 551
ChE 551	Process Dynamics & Control	3	ChE 452	ChE 592	Graduation Project II	3	ChE 591
ChE 555	Computer Applications Lab. for Chemical Engineering	1	ChE 472 or Co	--- ----	Technical Elective	3	
ChE 557	Instrumental Analysis	3	ChE 464 or Co	--- ----	Technical Elective	3	
ChE 565	Unit Operation Lab.	1	ChE 362 & ChE 464	U ----	University Elective	3	
ChE 575	Plant Design	3	IE 341 & ChE 472 or Co				
ChE 591	Graduation Project I	1	ChE 575 or Co & Completion of 114 Cr. Hr.				
--- ---	Technical Elective	3					
Total		16		Total		13	

Distribution of credit hours over academic year and semester standing

Year standing	First semester	Second semester	Summer semester	Total
First	15	17		32
Second	16	16		32
Third	17	16		33
Forth	14	16	3	33
Fifth	16	13		29

Course Description

ChE 201: Introduction to Chemical Engineering (1 Cr. Hr.)

Careers in Chemical Engineering, units and dimensions, numerical calculations and estimation, process data; representation and analysis, processes and process variables.

Pre: Chem 102

ChE 204: Fundamentals of Chemical Engineering (3 Cr. Hr.)

Material Balances: fundamentals of material balances, single and multi phase systems. Energy balances for processes; steady and transient, reactive and nonreactive.

Pre: ChE 201, CS 115, ME 200 or Co

ChE 311 Materials Science and Engineering (3 Cr. Hr.)

Atomic structure and bonding. Crystal structures. Solidification, crystalline imperfections and diffusion in solids. Mechanical properties of metals. Thermal processing of metals. Phase diagrams and engineering alloys. Polymeric ceramic and composite materials. Corrosion and degradation of materials.

Pre: Chem 212 and ChE 204

ChE 340: Thermodynamics (3 Cr. Hr.)

Forms of energy. Open and closed systems. Work and heat. PVT properties of pure fluids and steam tables. First law of thermodynamics. Second law of thermodynamics. entropy concept and third law of thermodynamics (open and closed systems). Analysis of power cycles (power plants and refrigeration)

Pre: Math 203

ChE 342: Chemical Engineering Thermodynamics (3 Cr. Hr.)

Heat Effects. Phase Rule. Thermodynamic Properties of Gas Mixtures & Liquid Solutions. Vapor-Liquid Equilibria. Liquid-Liquid Equilibria. Chemical Reaction Equilibria.

Pre: ChE 340

ChE 343 Fluid Mechanics for Chemical Engineers (3 Cr. Hr.)

Fluid Static. Continuity Equation. Energy Equation (Bernoulli's Equation). Flow measuring Devices. Fluid Friction of Flowing Systems. Momentum Balance. Dimensional Analysis. Pumps Types and their Performance Curves.

Pre: Math 203 & ChE 340 or Co

ChE 344 Fluid Mechanics Laboratory (1 Cr. Hr., 3 Hrs. Lab.)

The following experiments are expected to be performed: Density, viscosity and surface tension measurements, pressure and flow measurements, friction and Reynolds tests, impact of a water jet, center of pressure, pumps' testing.

Pre: ChE 343

ChE 346 Heat Transfer (3 Cr. Hr.)

Nature and Modes of Heat Transfer. Steady-State Heat Conduction. Unsteady-State Heat Conduction (Lumped Analysis). Principles of Convection. Empirical Relations for Natural and Forced Convection. Introduction to Boiling & Condensation. Heat Exchangers.

Pre: ChE 343 & EE-305 or Co

ChE 362 Unit Operation (3 Cr. Hr.)

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. Evaporation.

Pre: ChE 343

ChE: 400 Professional Ethics for Engineers (1 Cr. Hr)

Awareness on the role of engineers and engineering profession and the ethical issues in the practice of engineering: codes of ethics, safety and liability, professional responsibility to clients and employers, corporate responsibility, legal obligations, conflicts of interest, risk assessment, sustainable development, social and environmental issues, contemporary issues, multidisciplinary teams, and life long learning.

Pre: Completion of 90 Cr. Hr.

ChE 411 Corrosion Engineering (3 Cr. Hr.)

Electrochemical and metallurgical aspects of corrosion. Forms of corrosion. Modern theory of corrosion and its application. Iron and steel corrosion. Corrosion prevention. Case studies.

Pre: ChE 311

ChE 412 Polymer Science and Technology (3 Cr. Hr.)

Chemistry and Physics of polymers. Fundamentals of polymer synthesis; addition and condensation polymers. Mechanisms and kinetics of polymerization reactions. Polymerization techniques; suspension and emulsion. Properties of polymeric materials and polymers reinforced by fibers. Polymers manufacturing techniques. Polymer rheology. Methods of polymer fabrication; casting, blow molding, injection molding, extrusion. Polymeric solutions. Degradation.

Pre: Chem 212 and ChE 431

ChE 415 Ceramics Engineering (3 Cr. Hr.)

Crystalline structure. Phase diagrams. Ceramic materials and properties. Cement, glass, porcelain, bricks and pottery. Ceramic processing: extrusion, pressing, glazing, and finishing processes.

Pre: ChE 311

ChE 424 Petroleum Refining Engineering (3 Cr. Hr.)

Origin and composition of petroleum. Crude oil analysis and evaluation. Petroleum products and their uses. Refinery structure. Refinery operations and processes: Atmospheric & Vacuum Distillation, Fluid Catalytic Cracking, Platforming, Hydro-desulfurization and Hydrotreating, Chemical treatment, Asphalt production, Lube oils production. Refinery Utilities. Waste Treatment. Standards and Specifications.

Pre: Chem 212 and ChE 464

ChE 431 Chemical Reaction Engineering I (3 Cr. Hr.)

Mole balances. Kinetics of homogeneous reactions. Analysis of reaction rate data. Design of isothermal reactors (batch, CSTR, and plug flow). Single and multiple ideal reactors. Multiple reactions.

Pre: Chem 347 and ChE 342

ChE 432 Chemical Reaction Engineering II (3 Cr. Hr.)

Energy balance for ideal reactors. Non-isothermal reactor design. Multiple steady state and stability of CSTR's. Non-ideal reactors and residence time distribution (RTD). Design of heterogeneous reacting systems. Introduction to fluid-fluid reactions.

Pre: ChE 431

ChE 441 Chemical Measurements and Testing Lab. (1 Cr. Hr., 3 Hr. Lab.)

The following experiments and universal tests in chemical engineering are expected to be performed: Temperature measurement, corrosion testing, petroleum fractions testing, vapor pressure measurement, instrumental analysis techniques: gas chromatography (GC), differential thermal Analysis (DTA), atomic absorption spectrophotometry (AAS), high performance liquid chromatography (HPLC) and fluorescence spectrophotometry

Pre: ChE 342 & ChE 346

ChE 442 Heat & Mass Transfer Lab. (1 Cr. Hr., 3 Hr. Lab.)

The following experiments are expected to be performed: Heat conduction in solids, free and forced convection, thermal conductivity of liquids and gases, coil, plate, and shell-and-tube heat exchangers, saturation pressure and throttling, vapor-liquid equilibria, mass transfer and diffusion coefficients of liquids and gases, wetted-wall gas absorption.

Pre: ChE 461 or Co

ChE 443 Energy and Analysis of Fossil Fuels (3 Cr. Hr.)

Importance of energy in our life. Impact of energy generation and use on the environment. Fossil fuels and their analysis. Principles of combustion, gasification, and pyrolysis. Steam and gas generation. Power cycles.

Pre: ChE 432 and ChE 461

ChE 450 Experimental Design and Data Analysis (3 Cr. Hr.)

Review of Statistical distributions. Simple comparative experiments. Experiments with a single factor. Analysis of variance; randomized blocks, Latin squares, and related designs. Incomplete block designs, Factorial designs, Confounding in factorial designs, Two-level fraction factorial designs, Multi-factor experiment and nested designs.

Pre: EE 305

ChE 452 Applied Mathematics and Modeling for Chemical Engineers (3 Cr. Hr.)

Mathematical modeling of chemical engineering processes. Solution of mathematical models involving ordinary, differential and algebraic equations. Solution of partial differential equations (PDE's), Fourier half-range cosine and sine expansions. Bessel's function. Generalized Bessel's equation, Sturm-Liouville theorem. Laplace transforms.

Pre: EE 305 & ChE 432 or Co

ChE 457 Introduction to Optimization (3 Cr. Hr.)

Survey of continuous optimization problems. Unconstrained optimization problems. Introduction to constrained optimization. Solution of constrained optimization problems. Software packages in optimization.

Pre: EE 305

ChE 461 Mass Transfer (3 Cr. Hr.)

Molecular diffusion. Mass transfer coefficients. Mass transfer across interface. Analogy between momentum, heat and mass transfer. Continuous and stage-wise processes. Equipment for gas-liquid mass transfer operations. Absorption.

Pre: ChE 342 and ChE 346

ChE 464 Separation Processes (3 Cr. Hr.)

Binary and multi-component distillation, humidification and dehumidification, drying, extraction, and leaching.

Pre: ChE 461

ChE 472 Equipment Design (3 Cr. Hr.)

Selection of materials of construction. Design of pipes and pumping systems, compressors, tanks, pressure vessels, storage equipment, heat exchangers, and plate and packed towers.

Pre: ChE 311, ChE 464 or Co

ChE 483 Introduction to Biochemical Engineering

This course provides integration of the principles of chemical engineering, biochemistry, and microbiology with applications to the biochemical processes. Quantitative, problem-solving methods are emphasized. Topics include: cellular biology, polymeric cell compounds, enzyme and microbial kinetics, application of industrial enzymes, and cell growth cycle.

Pre: ChE 431 or Co

ChE 484 Air Pollution (3 Cr. Hr.)

Introduction to air pollution. Clean air act, quality and emission standards. Criteria pollutants. Air pollution and meteorology. Atmospheric dispersion. Emission control. Effect of pollutants on the global atmosphere.

Pre: ChE 362 and ChE 461

ChE 490 Engineering Training (3 Cr. Hr.)

Practical training for 8 weeks after the completion of 117 credit hours (See Engineering Training Regulations of the College of Engineering).

Pre: Completion of 117 Cr. Hr. and ChE 400

ChE 518 Electrochemical Engineering (3 Cr. Hr.)

Basics of electrochemistry. Mass transfer in electrochemical systems. Electrochemical applications: batteries, fuel cells, electroplating, electrolytic industries. Metal recovery from electrochemical process wastes.

Pre: ChE 431 & ChE 461

ChE 521 Chemical Industries (3 Cr. Hr.)

Fundamentals of chemical industries. Study of selected industries such as water treatment; industrial gases; ceramic, cement and glass industries; fertilizers industries; sulfuric acid; phosphoric acid; etc. case studies on industries related to consumer products.

Pre: ChE 464 or Co

ChE 524 Food Engineering (3 Cr. Hr.)

Rheological properties of food. Phase transitions and transformations in food systems. Food freezing. Food dehydration. Transport phenomena in food systems. Food packaging.

Pre: ChE 362 and ChE 461

ChE 535 Chemical Processing Lab. (1 Cr. Hr., 3 Hr. Lab.)

The following experiments are expected to be performed: Batch reactor, tubular reactor, CSTR, dynamics of stirred tanks in series, residence time distribution, water treatment, flocculation, oil extraction, and phosphoric acid production.

Pre: ChE 432

ChE 543 Renewable Energy (3 Cr. Hr.)

Wind, solar, hydraulic, geothermal, tidal power, solid wastes, biofuels, ...etc. Nuclear energy. Fuel cells, hybrid systems.

Pre: ChE 342 and ChE 346

ChE 551 Process Dynamics and Control (3 Cr. Hr.)

Process dynamics in time and Laplace domains. Input/output relationships. Basic components of control systems. Design of single-loop feedback control systems: stability, tuning, and synthesis techniques. Applications to chemical engineering processes.

Pre: ChE 452

ChE 552 Process Control Lab. (1 Cr. Hr., 3 Hr. Lab.)

The following experiments are expected to be performed: Temperature control, level control, pressure control, flow control, and process module.

Pre: ChE 551

ChE 555 Computer Applications Lab. for Chemical Engineers (1 Cr. Hr., 3 Hr. Lab.)

Usage of commercial process simulation packages; Aspen, Chemcad, Hysys, or others,

Pre: ChE 472 or Co

ChE 557 Instrumental Analysis (3 CR. Hr.)

Analytical measurements and measurement systems, separation methods of analysis, spectroscopic methods of analysis, thermal methods of analysis, electrochemical methods of analysis, Mass and NMR spectroscopy, Automated methods of analysis.

Pre: ChE 464 or Co

ChE 563 Mineral Processing (3 Cr. Hr.)

Classification of ores and metals. Ore preparation. Extraction of metals from ores. Pyrometallurgy and hydrometallurgy. Thermodynamics and kinetics of extractive processes. Metallurgical furnaces. Metal refining.

Pre: ChE 362 and ChE 461

ChE 565 Unit Operations Lab. (1 Cr. Hr., 3 Hr. Lab.)

The following experiments are expected to be performed: packed and tray distillation, packed-column gas absorption, liquid-liquid extraction, humidification/dehumidification in cooling towers, spray drying, tray drying, evaporation, filtration, fluidization, screen analysis and size reduction.

Pre: ChE 362 & ChE 464

ChE 566 Desalination (3 Cr. Hr.)

Physical and chemical properties of sea water, scale formation and control. Distillation processes. Membrane processes. Energy consumption in the different desalting systems.

Pre: ChE 461

ChE 568 Gas Processing and Treatment (3 Cr. Hr.)

Natural and refinery gases. Liquefied petroleum gases. Water-hydrocarbon system, hydrate formation and inhibition. Dehydration and sweetening, sulfur dioxide removal. Conversion of gas impurities. Removal of nitrogen compounds from gas streams. Equipment sizing, selection and design.

Pre: ChE 464 or Co

ChE 575 Plant Design (3 Cr. Hr.)

Process design development. General plant design considerations: health and safety, environmental factors, plant location and plant layout. Computer aided design. Economic principles including cost estimation. Design optimization. Report writing. Case studies.

Pre: IE 341, ChE 472 or Co

ChE 577 Chemical Process Safety (3 Cr. Hr.)

Importance of safety in industry. Accident analysis. Hazards of fires, explosions, dust, noise, radiation, electrical current and preventive methods. Hazards of toxic, corrosive, and carcinogenic chemicals and threshold limit values. Risk analysis exceeding the operating conditions. Required safety tools. Case Studies.

Pre: ChE 575 or Co

ChE 581 Membrane Separation Processes (3 CR. Hr.)

Membranes and module preparation: symmetrical, asymmetrical, ceramic and metal, and liquid membranes. Microfiltration, ultrafiltration, reverse osmosis, gas separation, pervaporation, electrodialysis, facilitated transport, membrane distillation.

Pre: ChE 461

ChE 583 Physical and Chemical Water Treatment (3 Cr. Hr.)

Water quality. Sedimentation, thickening and flotation. Filtration and centrifugation. Adsorption. Membrane separation processes. Chemical equilibria in aqueous systems. Coagulation. Ion exchange. Oxidation and disinfection. **Pre: ChE 464 or Co**

ChE 585 Biochemical Engineering: An Integrated approach to the application of engineering principles to biochemical processes. Quantitative, problem-solving methods are emphasized. Topics include: enzyme immobilization, transport phenomena in biological systems, design of bioreactors, sterilization, scale-up of bioreactors, and bioseparation.

Pre: ChE 461& ChE 483

ChE 587 Biological Wastewater Treatment (3 Cr. Hr.)

Wastewater characterization. Aeration and mass transfer. Biological mechanisms and kinetics. Models for biological reactors. Biological design parameters. Biological nutrient removal (BOD, nitrogen and phosphorous). Activated sludge processes. Anerobic digestion. Fixed-film biological systems. Sludge treatment and disposal. **Pre: ChE 483**

ChE 588 Pharmaceutical Process Engineering (3 Cr. Hr.)

Application of transport processes and unit operations in pharmaceutical engineering such as particle size reduction, sieving, blending, drying, granulation, tableting, coating, encapsulation, sterilization. Crystallization processes for concentrated drug solutions and solids.

Pre: ChE 362 & ChE 464

ChE 590A Special Topics A (3 Cr. Hr.)

Title and course contents of the topic must be approved by the Department's Council and pre-announced by the Department of Chemical Engineering. **Pre: Department Council Approval**

ChE 590B Special Topics B (2 Cr. Hr.)

Title and course contents of the topic must be approved by the Department's Council and pre-announced by the Department of Chemical Engineering. **Pre: Department Council Approval**

ChE 590C Special Topics C (1 Cr. Hr.)

Title and course contents of the topic must be approved by the Department's Council and pre-announced by the Department of Chemical Engineering. **Pre: Department Council Approval**

ChE 591 Graduation Project I (1 Cr. Hr.)

Theoretical and/or experimental investigation of a problem in chemical engineering, or design and development of a chemical process. A student or a group of students undertake an independent project under the supervision of a faculty member. The general objectives are to improve the student's skills and creativity, and to give him/her the experience of problem solving through integration of chemical engineering principles.

Pre: Completion of 114 Cr. Hr. & ChE 575 or Co

ChE 592 Graduation Project II (3 Cr. Hr.)

Completion of the same project started in CHE 591 with more details, theoretical and/or experimental work, design and calculations. **Pre: ChE 591**