



Jordan University of Science and Technology

Faculty of Engineering

Department of Chemical Engineering

Curriculum for the Bachelor of Science Degree in Chemical Engineering

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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.

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 experienced 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.

Student 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.

Curriculum for the Bachelor of Science Degree in Chemical Engineering

Numbering and coding system of the curriculum courses.

Course Coding

The following codes are used to designate courses:

Department			Level/year	Course Topic	Academic Semester
A	B	C	x	y	z

The Faculty of Engineering Departments codes (A, B, C) are as follows:

Code	Department	Code	Department
AE	Aeronautical Engineering	EE	Electrical Engineering
BME	Biomedical Engineering	IE	Industrial Engineering
ChE	Chemical Engineering	ME	Mechanical Engineering
CE	Civil 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 or level, and semester offered.
- The symbol (ChE xyz) denotes Chemical Engineering and (xyz) is a 3-digits number.
 - A. The first digit (x) denotes the year level of the course according to student's study plan as follows:

Code	Level/year
1	First year
2	Second year
3	Third year
4	Fourth year
5	Fifth year

- B. The second digit (y) denotes the field of the course 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

- C. The third digit (z) denotes sequence of the semester

Example: ChE 345 (Heat Transfer) means

ChE	3	4	5
Chemical Engineering	Level (Third year)	Field (Thermal and Fluid Sciences)	Sequence (1 st semester)

Curriculum

A Bachelor of Science (B.Sc.) degree in Chemical Engineering at JUST is awarded in accordance with the statute stated by JUST regulations (adjusted) 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 160 credit hours, distributed as indicated in the following table.

Distribution of Credit hours

Classification		Credit hours		
		Compulsory	Elective	Total
University Requirements		16	9	25
Faculty Requirements	Offered by other Faculties	29	0	29
	Offered by Faculty of Engineering	2	0	2
Department Requirements		89	15	104
Total		136	24	160

A. University Requirements (25 Credit Hours)**1. Compulsory University Requirements: (16 Credit Hours)**

Course No.	Course title	Credit hours	Theoretical	Practical
ARB 101	Arabic language	3	3	-
HSS 100	Culture and University Behavior	1	1	-
Eng 111 ⁽¹⁾	English Language 1	3	3	-
Eng 112 ⁽²⁾	English Language 2	3	3	-
CIS 100 ⁽³⁾	Computer Skills	3	2	1
MS 100 ⁽⁴⁾	Military Sciences	3	3	-
Total		16	16	-

- (1) Pre-requisite: Passing ENG 099 or passing English Language Placement Test with a grade > 50%.
- (2) Pre-requisite: Eng 111 or passing the English Language Placement Test with a grade > 80%. Students who have a TOEFL score of > 500 are exempted from both ENG 099 and Eng. 111.
- (3) A student who passes the Computer Skills Placement Test with a grade > 50% is exempted from CIS 100.
- (4) This course is required from Jordanian students only; graded on Pass/Fail basis. Students graduating from Royal Military faculty and military candidate's 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).

Note: All non-Arabic speaking international students in the University are required to study one course in Arabic language as shown below:

Course No.	Course title	Credit hours	Theoretical	Practical
ARB 101A ⁽¹⁾	Fundamentals of Arabic Language (for non-Arabic speaking students as a substitute for the course ARB 101 Arabic Language)	3	3	-

(1) The director of the Admission and Registration Department is permitted to determine the students from non-Jordanian/non-Arabic speaking who are eligible to take ARB 101A.

2. Elective courses: (9) credit hours selected from the following courses:

Course No.	Course title	Credit hours	Theoretical	Lab
ADS 100	Oral and Dental Health (for non-Dentistry and non Dentistry Sciences students)	3	3	0
AP 200	Farm Animal Products And Production (For Non Agriculture And Veterinary Students)	3	3	0
ARB 200	Appreciation of Literary Texts	3	3	0
ChE 191	Introduction to the Nanotechnology	3	3	0
ES 103	Enviroment Protection (for non Environnent Sciences surdents)	3	3	0
HSS 105	Basic French Language	3	3	0
HSS 106	Basic German Language	3	3	0
HSS 115	Islam and Recent Problems	3	3	0
HSS 116	Economic System in Islam	3	3	0

Course No.	Course title	Credit hours	Theoretical	Lab
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 135	Islamic culture	3	3	0
HSS 137	Human rights	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 211	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

Course No.	Course title	Credit hours	Theoretical	Lab
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 250	The History of Music (in English)	3	3	0
HSS 429	The Science of Children Behavior	3	3	0
ME 102	Introduction to renewable energy	3	3	0
ME 211	Fundamentals of Automobile Engineering (for non ME students)	3	3	0
NF 177	Food Preservation (in English)	3	3	0
NR 200	Natural Resources	3	3	0
NUR 100	Health Promotion (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
PH 200	First Aid (for non Medicine, non Nursing, and non Midwifery and paramedic students)	3	3	0
PHAR 104	Drugs and Medicinal Plants in Jordan	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
PP 202	Natural plants of Jordan (For Non agriculture Students)	3	3	0
PT 100	Wellness and Life Styles (for non physical therapy students)	3	3	0
VM 211	Animal Health (for non Veterinary Medicine and non Agriculture students)	3	3	0

Course No.	Course title	Credit hours	Theoretical	Lab
VM 212	Pet Animal Care (for non VM and Agriculture students)	3	3	0
VM 213	Animal Behaviour and Welfare	3	3	0

B. Faculty Requirements: (31 credit hours) distributed as follows:

I. Courses from the Faculty of Engineering (2 C.H): students are required to take the following courses from the Department of Mechanical Engineering:

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
ME 100	Engineering Workshops	1	0	1	—
ME 200	Engineering Drawing A	1	0	1	CIS 100
Total		2	0	2	

II. Courses from the Faculty of Science and Arts (26 C.H)

a) Mathematics Courses (12 C.H):

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
MATH 101	Calculus 1	3	3	0	—
MATH 102	Calculus 2	3	3	0	MATH 101
MATH 201	Intermediate Analysis	3	3	0	MATH 102
MATH 203	Ordinary Differential Equations	3	3	0	MATH 102
Total		12	12	0	

b) Physics Courses (7 C.H):

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
PHYS 101	General Physics 1	3	3	0	—
PHYS 102	General Physics 2	3	3	0	PHYS 101
PHYS 107	General Physics Lab	1	0	1	PHYS 102 (or Co.)
Total		7	6	1	

c) Chemistry Courses (7 C.H):

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
CHEM 101	General Chemistry 1	3	3	0	—
CHEM102	General Chemistry 2	3	3	0	CHEM 101
CHEM107	General Chemistry Lab	1	0	1	CHEM 102 (or Co.)
Total		7	6	1	

III. Courses from the Faculty of Computer and Information Technology (3 C.H)

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite/Co-request
CS114	Programming For Engineers	3	2	1	CIS 100
Total		3	2	1	

C. Department requirements: (104 Credit Hours) distributed as follows:

1. Department Compulsory Courses (89 credit hours) distributed as follows:

I. Chemical Engineering Compulsory Courses (79 credit hours)

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
ChE 102	Introduction to Chemical Engineering	2	2	0	Chem 102 (or Co), CS 114 (Co)
ChE 202	Numerical Methods for Chemical Engineers	3	3	0	Math 201, Math 203(Passing), CS 114
ChE 203	Fundamentals of Chemical Engineering	4	3	1	CHEM 102 (Passing), ChE 102,
ChE 242	Engineering Thermodynamics	3	3	0	ChE 203
ChE 244	Fluid Mechanics for Chemical Engineers	3	3	0	ChE 203 (Passing)
ChE 303	Communication Skills for Engineers	2	2	0	ChE 347 (Co) ¹
ChE 312	Materials Science and Engineering	3	3	0	Chem 347
ChE 332	Chemical Reaction Engineering I	3	3	0	ChE 202, ChE 341, Chem 347
ChE 341	Chemical Engineering Thermodynamics	3	3	0	ChE 242 (Passing)
ChE 345	Heat Transfer	3	3	0	ChE 244(Passing), ChE 202 (or Co)
ChE 347	Fluid Mechanics Lab.	1	0	1	ChE 244, ME 100
ChE 362	Unit Operations	3	3	0	ChE 345
ChE 364	Mass Transfer	3	3	0	ChE 341, ChE 345
ChE 401	Engineering Economy	2	2	0	ChE 362
ChE 422	Chemical Industries	3	3	0	ChE 463
ChE 433	Chemical Reaction Engineering II	3	3	0	ChE 332 (Passing)

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
ChE 436	Chemical Processing Lab.	1	0	1	ChE 433
ChE 445	Heat & Mass Transfer Lab.	1	0	1	ChE 347, ChE 364
ChE 452	Applied Mathematics and Modeling for Chemical Engineers	3	3	0	ChE 202, ChE 433 (or Co)
ChE 454	Computer Applications Lab. For Chemical Engineers	1	0	1	ChE 471 (or Co), ME 200
ChE 456	Instrumental Analysis	3	3	0	ChE 463
ChE 462	Extractive Metallurgy	3	3	0	ChE 312, ChE 362
ChE 463	Separation Processes	3	3	0	ChE 364
ChE 471	Equipment Design	3	3	0	ChE 312, ChE 463 (or Co)
ChE 490 ²	Engineering Training	3	0	0	Completion of 117 Cr. Hr.
ChE 551	Process Dynamics and Control	3	3	0	ChE 452
ChE 552	Process Control Lab.	1	0	1	ChE 551
ChE 565	Unit Operations Lab.	1	0	1	ChE 362, ChE 445, ChE 463
ChE 575	Plant Design	3	3	0	ChE 401, ChE 471
ChE 578	Chemical Process Safety	2	2	0	ChE 575 (or Co)
ChE 591	Graduation Project I	1	1	0	Completion of 120 Cr. Hr., ChE 575 (or Co)
ChE 592	Graduation Project II	3	3	0	ChE 591
TOTAL		79	72	7	

¹ It is compulsory that the student enrolls this course with ChE 347

² 8 weeks of practical training in a by-Faculty accredited institution pertaining to chemical engineering

II. Compulsory Courses from Other Departments (10 credit hours):

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
EE 303	Fundamentals of Electrical Engineering	3	3	0	Phys 102, Math 102
Chem 217	Organic Chemistry	3	3	0	Chem 102
Chem 218	Organic Chemistry Practical	1	0	1	Chem 217 (or Co)
Chem 347	Physical Chemistry II	3	3	0	ChE 242
TOTAL		10	9	1	

2. Department Technical Electives (15 credit hours):

The student is advised to select courses (15 Credit Hours) from the following tables:

I. Chemical Engineering Technical Elective Courses

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
ChE 411	Corrosion Engineering	3	3	0	ChE 312
ChE 412	Polymer Science and Technology	3	3	0	Chem 217, ChE 332
ChE 415	Ceramics Engineering	3	3	0	ChE 312
ChE 424	Petroleum Refining Engineering	3	3	0	Chem 217, ChE 463
ChE 426	Food Engineering	3	3	0	ChE 362, ChE 364

ChE 450	Experimental Design and Data Analysis	3	3	0	ChE 202
ChE 457	Introduction to Optimization	3	3	0	ChE 202
ChE 484	Air Pollution	3	3	0	ChE 362, ChE 364
ChE 518	Electrochemical Engineering	3	3	0	ChE 332, ChE 364
ChE 528	Pharmaceutical Process Engineering	3	3	0	ChE 463
ChE 543	Renewable Energy	3	3	0	ChE 341, ChE 345
ChE 545	Energy and Analysis of Fossil Fuels	3	3	0	ChE 364, ChE 433
ChE 546	Oil shale Technology	3	3	0	ChE 362
ChE 562	Hydrometallurgy	3	3	0	ChE 462
ChE 566	Desalination	3	3	0	ChE 364
ChE 568	Gas Processing and Treatment	3	3	0	ChE 463 (or Co)
ChE 581	Membrane Separation Processes	3	3	0	ChE 364
ChE 583	Physical and Chemical Water Treatment	3	3	0	ChE 463 (or Co)
ChE 585	Biochemical Engineering	3	3	0	ChE 332, ChE 364
ChE 587	Biological Wastewater Treatment	3	3	0	ChE 362
ChE 590 A	Special Topics A	3	3	0	Department approval
ChE 590 B	Special Topics B	2	2	0	Department approval
ChE 590 C	Special Topics C	1	1	0	Department approval

**I. Technical Elective Courses from other Engineering Departments
(Students are allowed to take one course from this list)**

Course No.	Course title	Credit hours	Theoretical	Lab	Prerequisite
ME 528	Thermal Power Plants	3	3	0	ChE 242
ME 581A	Heating, Ventilation and Air Conditioning	3	3	0	Completion of 100 Cr. Hr.
ME 582A	Refrigeration	3	3	0	Completion of 100 Cr. Hr.
IE 545	Project Management	3	3	0	Completion of 100 Cr. Hr.
IE 548	Facilities Planning	3	3	0	Completion of 100 Cr. Hr.
IE 560	Reliability and Maintenance Management	3	3	0	Completion of 100 Cr. Hr.
IE 556	Total Quality Management	3	3	0	Completion of 100 Cr. Hr.

Study Plan

FIRST YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Prerequisite	Course No.	Course name	Total credits	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
Eng 111	English Language 1	3	3	-	Passing Eng 099	Eng 112	English Language 2	3	3	-	Eng 111
PHYS 101	General physics 1	3	3	-	—	CHEM 102	General Chemistry 2	3	3	-	CHEM 101
CHEM 101	General Chemistry 1	3	3	-	—	CHEM 107	General Chemistry Lab.	1	-	3	CHEM 102 (or Co.)
MATH 101	Calculus 1	3	3	-	—	PHYS 102	General Physics 2	3	3	-	PHYS 101
CIS 100	Computer Skills	3	2	3	—	MATH 102	Calculus 2	3	3	-	MATH 101
HSS 100	Culture and University Behavior	1	1	-	—	ChE 102	Introduction to Chemical Engineering	2	2	-	CHEM 102 (or Co.) CS 114 (Co.)
						CS 114	Programming for Engineers	3	2	2	CIS 100
Total		16	15	3		Total		18	16	2	

SECOND YEAR											
First semester						Second semester					
Course No.	Course name	Total Credits	Weekly hours		Prerequisite	Course No.	Course name	Total Credits	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
ChE 203	Fundamentals of Chemical Engineering	4	3	2	CHEM 102 (Passing), ChE 102,	ChE 202	Numerical Methods for Chemical Engineers	3	3	—	Math 201, Math 203 (Passing), CS 114
MATH 201	Intermediate Analysis	3	3	—	MATH 102	ChE 242	Engineering Thermodynamics	3	3	—	ChE 203
MATH 203	Ordinary Differential Equations	3	3	—	MATH 102	ChE 244	Fluid Mechanics for Chemical Engineers	3	3	—	ChE 203 (Passing)
CHEM 217	Organic Chemistry	3	3	—	CHEM 102	Chem 218	Organic Chemistry Lab.	1	—	3	Chem 217 (or Co)
PHYS 107	General Physics Lab.	1	—	3	PHYS 102 (or Co.)	ME 100	Engineering Workshops	1	—	3	—
ME 200	Engineering Drawing A	1	—	3	CIS 100	MS 100	Military Sciences	3	3	—	—
—	University Elective	3	3	—	—	Arb 101	Arabic Language	3	3	—	—
Total		18	15	8		Total		17	15	6	

THIRD YEAR											
First semester						Second semester					
Course No.	Course name	Total credit	Weekly hours		Prerequisite	Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
Chem 347	Physical Chemistry II	3	3	—	ChE 242	ChE 312	Materials Science and Engineering	3	3	—	Chem 347
ChE 303	Communication Skills for Engineers	2	2	—	ChE 347 (Co)	ChE 332	Chemical Reaction Engineering I	3	3	—	ChE 202, ChE 341, Chem 347
ChE 341	Chemical Engineering Thermodynamics	3	3	—	ChE 242 (Passing)	ChE 362	Unit Operations	3	3	—	ChE 345
ChE 345	Heat Transfer	3	3	—	ChE 244 (Passing), ChE 202 (or Co)	ChE 364	Mass Transfer	3	3	—	ChE 341 & ChE 345
ChE 347	Fluid Mechanics Lab.	1	—	3	ChE 244, ME 100	—	University Elective	3	3	—	—
EE 303	Fundamentals of Electrical Engineering	3	3	—	Phys 102, Math 102						
Total		15	14	3		Total		15	15	-	

FOURTH YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Prerequisite	Course No.	Course name	Total credits	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
ChE 401	Engineering Economy	2	2	—	ChE 362	ChE 422	Chemical Industries	3	3	—	ChE 463
ChE 433	Chemical Reaction Engineering II	3	3	—	ChE 332 (Passing)	ChE 436	Chemical Processing Lab.	1	—	3	ChE 433
ChE 445	Heat & Mass Transfer Lab.	1	—	3	ChE 347, ChE 364	ChE 452	Applied Mathematics & Modeling For Chemical Engineering	3	3	—	ChE 202, ChE 433(or Co)
ChE 463	Separation Processes	3	3	—	ChE 364	ChE 454	Computer Applications Lab. for Chemical Engineering	1	—	3	ChE 471 (or Co), ME 200
ChE 471	Equipment Design	3	3	—	ChE 312, ChE 463 (or Co)	ChE 456	Instrumental Analysis	3	3	—	ChE 463
—	Technical Elective	3	3	—	—	ChE 462	Extractive Metallurgy	3	3	—	ChE 312, ChE 362
—	University Elective	3	3	—	—	—	Technical Elective	3	3	—	—
Total		18	17	3		Total		17	15	6	

SUMMER SEMESTER					
Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab	
ChE 490	Engineering training	3	—	—	Completion of 117 Credit hours
Total		3		—	

FIFTH YEAR											
First semester						Second semester					
Course No.	Course name	Total credit	Weekly hours		Prerequisite	Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
ChE 551	Process Dynamics & Control	3	3	—	ChE 452	ChE 552	Process Control Lab.	1	—	3	ChE 551
ChE 565	Unit Operation Lab.	1	—	3	ChE 362, ChE 445, ChE 463	ChE 578	Chemical Process Safety	2	2	—	ChE 575 (or Co)
ChE 575	Plant Design	3	3		ChE 401, ChE 471	ChE 592	Graduation Project II	3	—	—	ChE 591
ChE 591	Graduation Project I	1	—		Completion of 120 Cr. Hr., ChE 575 (or Co)	—	Technical Elective	3	3	—	—
—	Technical Elective	3	3	—	—	—	Technical Elective	3	3	—	—
Total		11	9	3		Total		12	8	3	

Course Catalogue

ChE 102: Introduction to Chemical Engineering (2 Cr. Hr.) (Prerequisite: Chem 102 (or Co.), CS 114 (Co))

The scope of Chemical Engineering, chemical processes, problem solving and team work, ethical considerations (academic integrity and professional ethics), units and dimensions, data analysis, manipulation and representation, applications of spreadsheets, introduction to material balance; introduction to energy balance; introduction to engineering economics.

ChE 202: Numerical Methods for Chemical Engineers (3 Cr. Hr.) (Prerequisite: Math 201, Math 203 (Passing), CS 114)

Introduction to numerical solution, approximations, rounding, and errors, solving non-linear equations, solving system of linear and nonlinear equations, least-squares curve fitting, polynomial interpolation, splines interpolation, numerical differentiation, numerical integration, solving differential equations (ODE's and PDE's), computer applications (MATLAB and spreadsheets).

ChE 203: Fundamentals of Chemical Engineering (4 Cr. Hr.) (Prerequisite: CHEM 102 (Passing), ChE 102)

The role of chemical processing, material balances (non-reactive and reactive processes), physical properties estimation, multiphase systems, energy balances (non-reactive and reactive processes), balances on transient processes.

ChE 242: Engineering Thermodynamics (3 Cr. Hr.) (Prerequisite: ChE 203)

Forms of energy and their conversion, open and closed systems, work and heat, PVT properties of pure fluids, steam tables, first law of thermodynamics, second law of thermodynamics, entropy concept and zeroth law of thermodynamics, third law of thermodynamics (open and closed systems), analysis of power cycles (steam power plants and refrigeration).

ChE 244 Fluid Mechanics for Chemical Engineers (3 Cr. Hr.) (ChE 203 (Passing))

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.

ChE 303 Communication Skills for Engineers (2 Cr. Hr.) (Prerequisite: ChE 347 (Co))

Managing technical data and writing for the workplace, memorandums, letters, applications, and research projects, building presentation skills through several individual and team presentations, focusing on style of delivery, and interaction with audience, job interview skills.

ChE 312 Materials Science and Engineering (3 Cr. Hr.) (Prerequisite: Chem 347)

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.

ChE 332 Chemical Reaction Engineering I (3 Cr. Hr.) (Prerequisite: ChE 202, ChE 341, Chem 347)

Kinetics of homogeneous reactions, mole balance, design of isothermal reactors (batch, CSTR, PBR, and plug flow), single and multiple ideal reactors, non-elementary homogeneous reactions, multiple reactions, collection and analysis of reaction rate data.

ChE 341: Chemical Engineering Thermodynamics (3 Cr. Hr.) (Prerequisite: ChE 242 (Passing))

Heat Effects, phase rule, thermodynamic properties of pure compounds, gas mixtures & Liquid Solutions, Kay's rule, vapor-Liquid equilibria. liquid-Liquid equilibria, chemical reaction equilibria.

ChE 345 Heat Transfer (3 Cr. Hr.) (Prerequisite: ChE 244 (Passing), ChE 202 (or Co))

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.

ChE 347 Fluid Mechanics Lab. (1 Cr. Hr., 3 Hrs. Lab.) (Prerequisite: ChE 244, ME 100)

Density, viscosity and surface tension measurements, pressure and flow measurements, friction and Reynolds tests, impact of a water jet, center of pressure, pumps' testing.

ChE 362 Unit Operations (3 Cr. Hr.) (Prerequisite: ChE 345)

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.

ChE 364 Mass Transfer (3 Cr. Hr.) (Prerequisite: ChE 341, ChE 345)

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.

ChE 401 Engineering Economy (2 Cr. Hr.) (Prerequisite: ChE 362)

Economic concepts, supply and demand relations, interest and investment costs, taxes, insurance, depreciation, inflation, cash flow, profitability measures, estimation of unit operation and production cost, feasibility studies, etc.

ChE 411 Corrosion Engineering (3 Cr. Hr.) (Prerequisite: ChE 312)

Electrochemical and metallurgical aspects of corrosion, Forms of corrosion, modern theory of corrosion and its application, iron and steel corrosion, corrosion prevention, case studies.

ChE 412 Polymer Science and Technology (3 Cr. Hr.) (Prerequisite: Chem 217, ChE 332)

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.

ChE 415 Ceramics Engineering (3 Cr. Hr.) (Prerequisite: ChE 312)

Crystalline structure, phase diagrams, ceramic materials and properties, cement, glass, porcelain, bricks and pottery, ceramic processing, extrusion, pressing, glazing, and finishing processes.

ChE 422 Chemical Industries (3 Cr. Hr.) (Prerequisite: ChE 463)

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.

ChE 424 Petroleum Refining Engineering (3 Cr. Hr.) (Prerequisite: Chem 217, ChE 463)

Origin and composition of petroleum, crude oil analysis and evaluation, petroleum products and their uses, refinery structure, refinery operations and processes, atmospheric and vacuum distillation, fluid catalytic cracking, platforming, hydro-desulfurization and hydrotreating, chemical treatment, asphalt production, lube oils production, refinery utilities, waste treatment, standards and specifications.

ChE 426 Food Engineering (3 Cr. Hr.) (Prerequisite: ChE 362, ChE 364)

Rheological properties of food, phase transitions and transformations in food systems, food freezing, food dehydration, transport phenomena in food systems, food packaging.

ChE 433 Chemical Reaction Engineering II (3 Cr. Hr.) (Prerequisite: Passing ChE 332)

Energy balance for ideal reactors, non-isothermal reactor design, stability of CSTR's, non-ideal reactors and residence time distribution, catalytic reaction mechanism, design of catalytic reactors, deactivation of catalyst.

ChE 436 Chemical Processing Lab. (1 Cr. Hr., 3 Hr. Lab.) (Prerequisite: ChE 433)

Batch reactor, tubular reactor, CSTR, dynamics of stirred tanks in series, residence time distribution, water treatment, flocculation, oil extraction, and phosphoric acid production.

ChE 445 Heat & Mass Transfer Lab. (1 Cr. Hr., 3 Hr. Lab.) (Prerequisite: ChE 347, ChE 364)

Temperature measurements, heat conduction in solids, free and forced convection, thermal conductivity of liquids and gases, shell-and-tube heat exchangers, saturation pressure and throttling, mass transfer and diffusion coefficients of liquids and gases, wetted-wall gas absorption (convective mass transfer).

ChE 450 Experimental Design and Data Analysis (3 Cr. Hr.) (Prerequisite: ChE 202)

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.

ChE 452 Applied Mathematics and Modeling for Chemical Engineers (3 Cr. Hr.) (Prerequisite: ChE 202, ChE 433 (or Co))

Introduction to mathematical modeling, modeling steady state processes, degree of freedom analysis, heat integration, solution techniques for ODE's, distributed models development, Laplace transformation, modeling dynamic behavior of processes, computer applications for model analysis.

ChE 454 Computer Applications Lab. for Chemical Engineers (1 Cr. Hr., 3 Hr. Lab.) (Prerequisite: ChE 471 (or Co), ME 200)

Introduction to process simulation, the Aspen one packages, Aspen Plus user interface, physical and thermodynamic properties, pressure changer units, heat exchangers, flow sheet analysis, reactions and reactors, equilibrium separation processes.

ChE 456 Instrumental Analysis (3 CR. Hr.) (Prerequisite: ChE 463)

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.

ChE 457 Introduction to Optimization (3 Cr. Hr.) (Prerequisite: ChE 202)

Survey of continuous optimization problems, unconstrained optimization problems, introduction to constrained optimization, solution of constrained optimization problems, software packages in optimization.

ChE 462 Extractive Metallurgy (3 Cr. Hr.) (Prerequisite: ChE 312 and ChE 362)

Scope of extractive metallurgy, chemistry of metals, classification of metals, Classification of ores and ore preparation, extraction of metals from ores, pyrometallurgy (copper and iron) and hydrometallurgy (Cu, Al, Au, and U), unit operations and technology aspects, thermodynamics and kinetics of extractive processes.

ChE 463 Separation Processes (3 Cr. Hr.) (Prerequisite: ChE 364)

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

ChE 471 Equipment Design (3 Cr. Hr.) (Prerequisite: ChE 312, ChE 463 (or Co))

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

ChE 484 Air Pollution (3 Cr. Hr.) (Prerequisite: ChE 362, ChE 364)

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.

ChE 490 Engineering Training (3 Cr. Hr.) (Prerequisite: Completion of 117 Cr. Hr.)

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

ChE 518 Electrochemical Engineering (3 Cr. Hr.) (Prerequisite: ChE 332, ChE 364)

Basics of electrochemistry, mass transfer in electrochemical systems, electrochemical applications, batteries, fuel cells, electroplating, electrolytic industries, metal recovery from electrochemical process wastes.

ChE 528 Pharmaceutical Process Engineering (3 Cr. Hr.) (Prerequisite: ChE 463)

Separation processes and unit operations in the pharmaceutical industry such as particle size reduction, sieving, blending, drying, granulation, tableting, coating, encapsulation, and crystallization.

ChE 543 Renewable Energy (3 Cr. Hr.) (Prerequisite: ChE 341, ChE 345)

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

ChE 545 Energy and Analysis of Fossil Fuels (3 Cr. Hr.) (Prerequisite: ChE 364, ChE 433)

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.

ChE 546: Oil shale Technology (3 Cr. Hr.) (Prerequisite: ChE 362)

Formation of oil shale–geological background, distribution and reserves of oil shale in the world and in Jordan, oil shale composition and methods of characterization and analysis, oil shale as an energy source, methods of oil shale utilization for energy production (pyrolysis, gasification, combustion and solvent extraction), industrial processes for oil shale utilization, environmental issues of oil shale technology, effluent gases, wastewater and solid residue.

ChE 551 Process Dynamics and Control (3 Cr. Hr.) (Prerequisite: ChE 452)

Introduction to practical and theoretical aspects of process control, process modeling, transfer functions, MATLAB, dynamics of open-loop systems, feedback control system, instruments of control system, control laws (P, PI, PD and PID), block diagrams, dynamics of closed-loop systems, stability analysis, root-locus analysis, tuning of controllers, frequency analysis, Bode stability, cascade control, feed-forward control, other control schemes.

ChE 552 Process Control Lab. (1 Cr. Hr., 3 Hr. Lab.) (Prerequisite: ChE 551)

Temperature control, level control, pressure control, flow control, and process module.

ChE 562: Hydrometallurgy (3 Cr. Hr.) (Prerequisite: ChE 462)

The chemistry and engineering aspects of hydrometallurgical unit processes - leaching, separation, extraction and recovery, extraction techniques will include the oxidative and non-oxidative leaching of minerals, purification and recovery of metals by precipitation, ion exchange and solvent extraction, recovery of metals by reduction and electrowinning, chemistry, design and operation of some common hydrometallurgical processes.

ChE 565 Unit Operations Lab. (1 Cr. Hr., 3 Hr. Lab.) (Prerequisite: ChE 362, ChE 445, ChE 463)

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

ChE 566 Desalination (3 Cr. Hr.) (Prerequisite: ChE 364)

Physical and chemical properties of sea water, scale formation and control, distillation processes, membrane processes, energy consumption in the different desalting systems.

ChE 568 Gas Processing and Treatment (3 Cr. Hr.) (Prerequisite: ChE 463 (or Co))

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.

ChE 575 Plant Design (3 Cr. Hr.) (Prerequisite: ChE 401, ChE 471)

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, codes of ethics, case studies.

ChE 578 Chemical Process Safety (2 Cr. Hr.) (Prerequisite: ChE 575 (or Co))

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, management of change, case Studies.

ChE 581 Membrane Separation Processes (3 CR. Hr.) (Prerequisite: ChE 364)

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

ChE 583 Physical and Chemical Water Treatment (3 Cr. Hr.) (Prerequisite: ChE 463 (or Co))

Water quality, sedimentation, thickening and flotation, filtration and centrifugation, adsorption, membrane separation processes, chemical equilibria in aqueous systems, coagulation, ion exchange, oxidation and disinfection.

ChE 585 Biochemical Engineering: (3 Cr. Hr.) (Prerequisite: ChE 332, ChE 364)

Introduction to microbiology and biochemistry, enzyme engineering, enzyme kinetics, biomass production in cell cultures, preparation of cell culture media, fermentation systems, sterilization, agitation and aeration, design and scale-up of biochemical reactors, industrial bioseparation processes.

ChE 587 Biological Wastewater Treatment (3 Cr. Hr.) (ChE 362)

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, anaerobic digestion, fixed-film biological systems, sludge treatment and disposal.

ChE 590A Special Topics A (3 Cr. Hr.) (Prerequisite: Department Council Approval)

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

ChE 590B Special Topics B (2 Cr. Hr.) (Prerequisite: Department Council Approval)

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

ChE 590C Special Topics C (1 Cr. Hr.) (Prerequisite: Department Council Approval)

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

ChE 591 Graduation Project I (1 Cr. Hr.) (Prerequisite: Completion of 120 Cr. Hr. and ChE 575 (or Co))

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.

ChE 592 Graduation Project II (3 Cr. Hr.) (Prerequisite: ChE 591)

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