



School of Applied Medical Sciences

Department of Pharmaceutical & Chemical Engineering

B.Sc. in Pharmaceutical & Chemical Engineering

2014 Study Plan

School of Applied Medical Sciences
Undergraduate Plan of Study for the Bachelor Degree in:
Pharmaceutical and Chemical Engineering

1. General:

The student is required to complete successfully 180 credit hours as detailed below;

Requirements	Credit Hours		
	Compulsory	Elective	Total
University Requirements	24	6	30
School Requirements	27	-	27
Program Requirements	111	12	123
Total	162	18	180

2. Subject Numbering System:

Each course is identified by three letters (or four when necessary), followed by three part numbers as shown below;

Department Code:

Code	Department
PCE	Pharmaceutical and Chemical Engineering

Subject Areas Codes:

Course Number	Subject
0	Miscellaneous
1	Chemical engineering principles and analysis.
2	Fluid, thermodynamics and chemical reaction engineering.
3	Industrial and waste management, risk and safety topics.
4	Pharmaceutical sciences and engineering.
5	Applied sciences.
6	Chemical engineering laboratories.
7	Pharmaceutical engineering laboratories.
8	Applied sciences laboratories.
9	Project and selected topics.

Level Code:

Number	Level of course
1	First year
2	Second year
3	Third year
4	Fourth year
5	Fifth year

Course Numbering System Example:

Course PCE 212

Course Name: Principles of Chemical Engineering

Department: Pharmaceutical and Chemical Engineering.

Level: Second year.

Subject area: Chemical engineering principles and analysis.

Sequence: Second semester.

PCE	2	1	2
Department	Level	Subject area	Semester sequence: Odd number: First semester. Even number: Second semester.

3. University Requirements: (30 cr.hr))

A. Compulsory Courses: (24) cr. hr

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite	Co-requisite
ENGL098	English I	0	3	0		
ENGL099	English II	0	3	0	ENGL098	
ENGL101	English III	1	3	0	ENGL099	
ENGL102	English IV	1	3	0	ENGL101	
ENGL201	English V	2	3	0	ENGL102	
ENGL202	English VI	2	3	0	ENGL201	
NE101	National Education	3	3	0		
MILS100	Military Science	3	3	0		
ARB099	Arabic 99	0	3	0		
ARB100	Arabic	3	3	0	ARB099	
GERL101	German I	3	9	0		
GERL102	German II	3	9	0	GERL101	
GERL201	German III	3	6	0	GERL102	
Total =		24	57	3		

B. University Electives: (6)credit hour

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite	Co-requisite
DES 101	Arts' Appreciation	3	3	0	–	
IC 101	Intercultural Communications	3	3	0	–	
SFTS 101	Soft Skills	3	3	0	–	
SE 301	Social Entrepreneurship and Enterprises	3	3	0	–	
EI 101	Leadership and Emotional Intelligence	3	3	0	–	

4. School Requirements: (27 cr.hr)

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite	Co-requisite
MATH 101	Calculus I	3	3	0	–	
MATH 102	Calculus II	3	3	0	MATH 101	
CS 116	Computing Fundamentals - Technical	3	3	0		
CS 1160	Computing Fundamentals Lab - Technical	1	0	3		CS116
PHYS 103	Physics I	3	3	0	–	
PHYS 104	Physics II	3	3	-		PHYS 103
PHYS 106	Physics Lab	1		3	PHYS 103	PHYS104
CHEM 103	General chemistry	3	3	-	–	CHEM106
CHEM 106	General Chemistry Lab	1	-	3		CHEM 103
GERL202	German IV	3	6	0	GERL201	
GERL 301	German V	3	9	0	GERL 202	
	Total	27				

5. Program Requirements

A minimum of **123** program credit hours are required for graduation divided into 101 credit hours as compulsory, 10 credit hours as ancillary and 12 credit hours as technical electives.

A. Compulsory Courses

A total of 101 credit hours of core chemical-pharmaceutical engineering coursework are required for graduation, as follows.

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite	Co-requisite
BIO 101	Human Biology	3	3	0	–	
PCE 211	Introduction to Pharmaceutical and Chemical Engineering	1	1	0	CHEM 103	
PCE 212	Principles of Chemical Engineering	3	3	0	PCE 211 + PCE221	PCE 242
PCE 221	Thermodynamics for Pharmaceutical and Chemical Engineering	3	3	0	CHEM103 + MATH102	
PCE 222	Fluid Mechanics for Chemical and Medical Engineers	3	3	0	MATH 203	
PCE 242	Pharmaceutical Physical Chemistry	2	2	-	PCE 221	PCE272
PCE 272	Pharmaceutical Physical Chemistry Lab	1	-	3	-	PCE242
PCE 251	Analytical Chemistry	3	3	-	CHEM103	PCE281
PCE 281	Analytical Chemistry Lab	1	-	3	CHEM106	PCE251
PCE 252	Microbiology	2	3	-	BIO 101	PCE 282
PCE 282	Microbiology Lab	1	-	3	-	PCE 252
PCE 254	Organic Chemistry	2	2	-	CHEM 103	-

GERL 302	German VI	3	6	0	GERL 301	
PCE 311	Transport Phenomena	3	3	0	PCE 212 + PCE 222	
PCE 312	Separation Processes	3	3	-	PCE 311	
PCE 321	Chemical Reaction Engineering	3	3	-	PCE 212	
PCE332	Chemical Engineering Economics	3	-	-	PCE212	
PCE 341	Pharmaceutical Organic Chemistry	2	2	1	PCE 254	PCE 371
PCE 371	Pharmaceutical Organic Chemistry Lab	1	-	3		PCE341
PCE 342	Instrumental Analysis	3	3	-	PCE 251	PCE372
PCE 372	Instrumental Analysis Lab	1	-	3	PCE281	PCE342
PCE 343	Pharmaceutical Technology – Liquid Forms	3	3	-	PCE242 + PCE222	PCE 373
PCE 373	Pharmaceutical Technology – Liquid Forms Lab	1	-	3		PCE343
PCE 344	Pharmaceutical Technology – Solid Forms	3	3	-	PCE242	PCE 374
PCE 374	Pharmaceutical Technology – Solid Forms LAB	1	-	3		PCE 344
PCE 351	Biochemistry	2	2	0	BIO 101+ PCE 254	PCE 381
PCE 381	Biochemistry Lab	1	-	3		PCE 351
PCE 362	Fluid, Heat and Reaction Engineering Lab	1	0	3	PCE 222 + PCE 311+ PCE 321	
PCE 391	Field Training ^Ψ	0	0	160 h		
PCE 499	International Internship	12	0	6 months	DA*	
PCE 511	Unit Operation and Industrial Safety	3	3	0	PCE 312	
PCE513	Chemical Process Dynamics and Control	4	3	1	MATH205 + PCE311	
PCE 531	Industrial Processes Management	3	3	0	PCE332	
PCE 532	Quality Assurance and Process Validation	3	3	0	PCE344	
PCE 533	Hazardous Waste Management	3	3	0	PCE 252 + PCE 311	
PCE 534	Risk Assessment and management	3	2	0	PCE 332	
PCE 541	Medicinal Chemistry	3	3	0	PCE 351	
PCE 542	Pharmaceutical Packaging Technology	1	1	0	PCE 343 + PCE 344	
PCE 543	Pharmaceutical Plant Design	3	3	0	PCE 312 + PCE332	
PCE 562	Separation Processes Lab	1	0	3	PCE 312 + PCE 511	
PCE 591	Graduation Project I	1	-	-	DA*	
PCE 592	Graduation Project II	2	-	-	PCE 591	

^Ψ Students must complete 160 hours of field training in approved industries in Jordan by the end of their third academic year.

*DA is Departmental Approval.

B. Ancillary Courses

A total of 10 credit hours of ancillary coursework are required for graduation, as follows.

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite	Co-requisite
IE 121	Workshop	1	0	3	-	
MATH 231	Probability & Statistics for Engineering	3	3	0	MATH 102	
MATH 203	Applied mathematics for Engineers	3	3	0	MATH 102	
MATH 205	Differential equations	3	3	0	MATH 102	

C. Technical Electives

A minimum of 12 credit hours of specialized chemical-pharmaceutical engineering coursework are required for graduation. The offered courses are:

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite	Co-requisite
PCE 401	Biotechnology	3	3	-	PCE321 + PCE 252	
PCE 402	Gene Technology	3	3	-	PCE 351	
PCE 403	Nutrition	3	3	-	BIO 101	
PCE 404	Introduction to Polymer Science	3	3		PCE 254	
PCE 405	Colloids and Surface Chemistry	3	3	-	PCE 242	
PCE 406	Corrosion Engineering	3	3	-	PCE 242	
PCE 407	Chemical & Physical Sensors	3	3		PCE 342	
PCE 408	Shale Oil Production Processes	3	3	-	-	-
PCE 409	Introduction to Oil and Gas Production	3	3	-	-	-
PCE 411	Numerical Methods for Engineers	3	3	-	MATH 231	
PCE 412	Nanotechnology	3	3	-	PCE 344	
PCE 413	Membrane separation processes	3	3		PCE 312	
PCE 421	Fluid Mixing Technology	3	3	-	PCE 222	
PCE 422	Chemical Reaction Engineering II	3	3		PCE 321	
PCE 431	Chemical Process Safety	3	3	-	PCE312	
PCE 444	Antibiotics	3	3	-	PCE 252 + BIO 101	
PCE 445	Particle Technology	3	3	-	PCE 344	
PCE 446	Pharmacokinetics	3	3	-	PCE 321	
PCE 447	Toxicology	3	3	-	BIO 101	
PCE 448	Modern Drug Forms & Delivery Systems	3	3	-	BIO 101	
PCE 491	Environmental Engineering	3	3		PCE 251	

PCE 492	Special Topics in Chemical /Pharmaceutical Engineering I	3	3	-	DA	
PCE 493	Special Topics in Chemical /Pharmaceutical Engineering II	3	3	-	DA	
PCE 494	Special Topics in Chemical /Pharmaceutical Engineering III	3	3	-	DA	
PCE 495	Special Topics in Chemical /Pharmaceutical Engineering IV	3	3	-	DA	
PCE 593	Special Topics in Chemical /Pharmaceutical Engineering V	2	2	-	DA	
PCE 594	Special Topics in Chemical /Pharmaceutical Engineering VI	1	1	-	DA	
PCE 595	Special Field Projects	3	-	9	DA	
WEEM 528	Air Pollution Control	4	3	1	WEEM 352 or DA	
WEEM545	Water and Waste Water Treatment	3	3	-	WEEM222 or DA	
IE 531	Project Management	3	3	-	IE 353 or DA	

*DA is Departmental Approval

Guide Plan for Chemical/Pharmaceutical Engineering Program

Year 1 – Semester 1

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
GERL 101	German I	3	9	0	–	
ENGL 101	English III	1	3	0	ENGL 099	
CHEM 103	General Chemistry	3	3	3	–	
CHEM 106	General Chemistry Lab	1	3	3	–	
MATH 101	Calculus I	3	3	0	–	
PHYS 103	Physics I	3	3	3	–	
ARB 100	Arabic	3	3	0	ARB099	
IE 121	Workshop	1	0	3	–	
Total		18	24	6		

Year 1 – Semester 2

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
GERL 102	German II	3	9	0	GERL 101	
ENGL 102	English IV	1	3	0	ENGL 101	
MATH 102	Calculus II	3	3	0	MATH 101	
PHYS 104	Physics II	3	3	3	PHYS 103	
PHYS 106	Physics Lab	1	3	3	PHYS 103	PHYS 104
BIO 101	Biology	3	3	0	–	
CS 116	Computing Fundamentals	3	3	0		CS 1160
CS 1160	Computing Fundamentals Lab	1	0	3		CS 116
Total		18	24	6		

Year 2 – Semester 1

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
GERL 201	German III	3	6	0	GERL 102	
MATH 203	Applied Mathematics for Engineers	3	3	0	MATH 102	
PCE 221	Thermodynamics for Pharmaceutical and Chemical Engineering	3	3	0	CHEM 103 + MATH 102	
PCE 251	Analytical Chemistry	3	3	-	CHEM103	PCE281
PCE 281	Analytical Chemistry Lab	1	-	3	CHEM106	PCE251
PCE 211	Introduction to Pharmaceutical and Chemical Engineering	1	1	0	CHEM 103	
Math 205	Differential equations	3	3	0	MATH102	
Univ. ???	University Elective I	3	3	0	–	
Total		20	22	6		

Year 2 – Semester 2

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
GERL 202	German IV	3	6	0	GERL201	
PCE 254	Organic Chemistry	2	3	0	CHEM 103	
PCE 252	Microbiology	2	3	3	BIO 101	PCE 282
PCE 282	Microbiology Lab	1	-	3		PCE 252
PCE 242	Pharmaceutical Physical Chemistry	2	3	3	PCE 221	PCE272
PCE 272	Pharmaceutical Physical Chemistry Lab	1	-	3		PCE 242
PCE 212	Principles of Chemical Engineering	3	3	0	PCE 211+ PCE221	PCE 242
PCE 222	Fluid Mechanics for Chemical and Medical Engineers	3	3	0	MATH 203	
Total		17	21	6		

Year 3 – Semester 1

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
GERL 301	German V	3	9	0	GERL 202	
ENGL 201	English V	2	3	0	ENGL 102	
PCE 311	Transport Phenomena	3	3	0	PCE 212 + PCE 222	
PCE341	Pharmaceutical Organic Chemistry	2	2	1	PCE 254	PCE 371
PCE 371	Pharmaceutical Organic Chemistry lab	1	-	3		PCE 341
PCE 351	Biochemistry	2	2		BIO 101 + PCE 254	PCE 381
PCE 381	Biochemistry Laboratory	1	0	3		PCE 351
PCE321	Chemical Reaction Engineering	3	3	0	PCE 212	
PCE 391	Field Training ^ψ	0	0	-	-	
PCE 343	Pharmaceutical Technology – Liquid Forms	3	3	-	PCE242 + PCE222	PCE 373
PCE 373	Pharmaceutical Technology – Liquid Forms Lab	1	-	3		PCE 343
Total		21	24	6		

^ψStudents must complete 160 hours of field training in approved industries in Jordan by the end of third academic year.

Year 3 – Semester 2

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
PCE 342	Instrumental Analysis	3	3	-	PCE 251	PCE372
GERL 302	German VI	3	6	0	GERL 301	
PCE 372	Instrumental Analysis Lab	1	-	3	PCE 281	PCE342
MATH 231	Probability & Statistics for Engineers	3	3	0	MATH 102	
PCE 362	Fluid, Heat and Reaction Engineering Lab	1	0	3	PCE311 + PCE 321 + PCE222	
PCE 312	Separation Processes	3	3	0	PCE 311	
PCE 344	Pharmaceutical Technology – Solid Forms	3	3	-	PCE242	PCE 374
PCE 374	Pharmaceutical Technology – Solid Forms LAB	1	-	3		PCE344
PCE332	Chemical Engineering Economics	3	3	0	MATH 201	
Total		21	15	12		

Year 4 – Semester 1 & 2

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
	Technical Elective I	3	3	–		
	Technical Elective II	3	3	–		
	Technical Elective III	3	3	–		
	Technical Elective IV	3	3	–		
PCE 499	International Internship	12	–	6 months		
	Total	24	12	6 months		

Year 5 – Semester 1

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
PCE 511	Unit Operation and Industrial Safety	3	3	0	PCE 312	
PCE 543	Pharmaceutical Plant Design	3	3	0	PCE312 + PCE332	
PCE513	Chemical Process Dynamics and Control	4	3	1	MATH 205 + PCE311	
PCE 591	Graduation Project I	1	-	-	-	
PCE 541	Medicinal Chemistry	3	3	0	PCE 351	
PCE 531	Industrial Processes Management	3	3	0	PCE332	
PCE 533	Hazardous Waste Management	3	3	0	PCE 252 + PCE 311	
	Total	20	15	12		

Year 5 – Semester 2

Course I.D.	Course Title	Credit Hours	Contact Hours		Prerequisite	Co-requisite
			Lecture	Practical		
PCE 592	Graduation Project II	2	-	-	PCE 591	
PCE 542	Pharmaceutical Packaging Technology	1	1	0	PCE 343 + PCE 344	
Univ. ???	University Elective II	3	3	0	–	
NE 101	National Education	3	3	0	–	
MILS 100	Military Science	3	3	0	–	
PCE 532	Quality Assurance and Process Validation	3	3	0	PCE344	
PCE 534	Risk Assessment and management	3	2	0	PCE332	
PCE 562	Separation Processes Lab	1	0	3	PCE 312 + PCE 511	
	Total	20	12	12		

Course Description for the Chemical-Pharmaceutical Engineering Program

CHEM103 - General Chemistry. (3 Cr. Hrs.)

Co-requisite: CHEM106

Chemical problem solving, measurement in scientific study, uncertainty in measurement. Components of matter. Stoichiometry of formulas and equations. Major classes of chemical reactions (precipitation, acid-base, oxidation-reduction and reversible reactions). Gases and the kinetic theory. Thermochemistry: Energy flow and chemical change. Kinetics: Rates and mechanisms of chemical reactions. Equilibrium: The extent of chemical reactions. Acid-base equilibria. Ionic equilibria in aqueous systems.

CHEM106 - General Chemistry Laboratory. (1 Cr. Hrs.)

Co-requisite: CHEM103

Laboratory safety, first aid. Measurement and proper use of laboratory glassware. Density measurement. Classification of matter: Basic separation techniques. Precipitation reaction. Limiting reactant. Determination of acetic acid in vinegar. Quantitative titration of an antacid tablet. Determination of ions in hard water using EDTA. Molecular weight of a volatile liquid. Kinetic study of reaction of peroxy disulfate and iodide ions. Calorimetry.

BIO101 – Human Biology. (3 Cr. Hrs.)

Human Biology course examines how the human body functions, and looks in detail at cellular events, from the developing embryo to the adult. Topics covered will include cell biology, human reproduction and embryology, physiology and biochemistry, the origins of human variation and inheritance in humans. In addition, students will be introduced to human dysfunction, treatments and preventions

PCE 211 - Introduction to Pharmaceutical and Chemical Engineering. (1 Cr. Hrs.)

Prerequisites: CHEM 103

Chemical Engineering in the Pharmaceutical Industry: an Introduction. Current Challenges and Opportunities in the Pharmaceutical Industry. Engineering calculations: units, dimensional homogeneity and dimensionless quantities. Process data presentation and analysis. Processes and process variables.

PCE 212 - Principles of Chemical Engineering. (3 Cr. Hrs.)

Prerequisites: PCE211 + PCE211

Corequisite: PCE242

Fundamentals of material and energy balances. Single and multiphase systems. Balances on nonreactive and reactive processes.

PCE221 - Thermodynamics for Pharmaceutical and Chemical Engineering. (3 Cr. Hrs.)

Prerequisites:CHEM103 + MATH102.

Development of fundamental thermodynamic property relations and complete energy and entropy balances. Analysis of heat pumps and engines, and use of combined energy-entropy balance in flow devices. Calculation and application of total and partial properties in physical and chemical equilibria. Prediction and correlation of physical/chemical properties of various states and aggregate.

PCE 222 - Fluid Mechanics for Chemical and Medical Engineers. (3 Cr. Hrs.)

Prerequisites:MATH 203

Fluid mechanics in chemical engineering. Density, viscosity and surface tension. Fluid Statics. Mass, energy and momentum balances. Bernoulli's equation. Fluid friction in pipes. Flow in engineering equipment: pumps and compressors. Non-Newtonian fluid flow in circular pipe

PCE242 - Pharmaceutical Physical Chemistry. (2 Cr. Hrs.)

*Prerequisites: PCE 221
Corequisite:PCE272*

This module introduces student to physical pharmacy. They will study the underpinning physicochemical sciences which pertain to the formulation of pharmaceutical products. Main themes: Pharmaceutical solutions: Colligative properties of solutions, Solutions equilibria: Solubility, Partitioning and distribution phenomena. The solid state: Solid state properties: The crystalline structure, Polymorphism and The amorphous state. Physicochemical properties which control complex formation including drug stability and factors affecting its shelf-life. Discussion of diffusion and interfacial phenomenon of adsorption will be included.

PCE 272 - Pharmaceutical Physical Chemistry Laboratory. (1 Cr.Hrs)

Corequisite: PCE 242

Determination of molar mass using the ideal gas law. Partial molar volumes. Boiling point elevation. Boiling point diagram of a binary mixture. Miscibility gap in a ternary system. Kinetics of saccharose inversion. Reaction rate and activation energy of the acid hydrolysis of ethyl acetate. Single electrode potential. Effect of ionic strength on solubility of benzoic acid in water. Adsorption isotherm. Reaction rate of acetic acid and magnesium Determining surface tension using the ring method. Viscosity measurement

PCE251 - Analytical Chemistry. (3 Cr. Hrs.)*Prerequisites:CHEM103**Corequisites:PCE281*

Chemical Measurements, Chemical Equilibrium, Activity and the Systematic Treatment of Equilibrium, Monoprotic Acid-Base Equilibria, Polyprotic Acid-Base Equilibria, Acid-Base Titrations, EDTA Titrations, Fundamentals of Electrochemistry, Reduction-Oxidation titrations, Gravimetric Analysis, Precipitation Titrations, and Combustion Analysis.

PCE281 - Analytical Chemistry laboratory. (1 Cr. Hrs)*Prerequisites:CHEM103**Corequisites:PCE251*

Statistical Treatment of Data, Titration of Strong Dibasic Base with Strong Acids (monoprotic and diprotic), Titrations of Strong Acids/Bases with Weak Bases/Acids (Monoprotic and Polyprotic), Determination of Carbonate and Bicarbonate in Mixtures, Buffer solutions and Buffer Capacity, EDTA Determination of Calcium in Milk, Redox Titration of Dichromate with Iron(II), Redox Titration of Permanganate with Oxalate, Determination of Calcium as Calcium Oxalate, Determination of Chloride by Mohr's Method, Separation of Permanganate and Chromate by Adsorption Chromatography, Separation of Zinc and Magnesium ions by Ion Exchange Chromatography, Gravimetric Determination of Iron as Iron Oxide.

PCE252 - Microbiology. (2 Cr. Hrs.)*Prerequisites:BIO 101**Corequisites:PCE282*

The study of the nature of microorganisms; their structure, function, growth, interaction with the environment, metabolism and genetics. The study of viruses, fungi, cyanobacteria and different types of bacteria. Also it studies the relationship between different microorganisms, the ability of some of them to fix atmospheric nitrogen, the diseases caused by bacteria and the economic importance of microorganisms.

PCE282 - Microbiology laboratory. (1 Cr. Hrs.)*Corequisites: PCE252*

Main Experiments performed in the lab; General orientation & safety in microbiology lab. Microscopical techniques & microscopical research methods; sterility & microorganisms microscopy. Cultural research methods: including media preparation; bacterial culturing, isolation & purification. Cultural, biological & biochemical research methods. Bacterial counting & bacterial growth curve Coliform testing in water. Chemo-resistance testing: agar diffusion test; MIC & E-Test. Urinary tract & genital infection testing. Gastrointestinal tract infection testing; bacteria, fungal & parasites. Respiratory tract infections testing

CPE 254 - Organic Chemistry. (2 Cr. Hrs.)

Prerequisites: CHEM103

Bonding models for CH, simple CC and multiple CC bonds. The possibilities for isomery of open-chained cyclic hydrocarbons including their dynamics (conformation). Electron structure of conjugated double bonds and aromatic π -systems. Stereoisomerism, chirality and enantiomers. Polar single and multiple bonds and the resulting electronic substituent effects. The most important classes of organic compounds including organic halogens, alcohols, aldehydes, ketones, and carboxylic acids. Overview of various reaction types and initial mechanistic reaction observations.

PCE311 - Transport Phenomena. (3 Cr. Hrs.)

Prerequisites: PCE212 + PCE222

A fundamental course in heat transfer processes and an introduction to mass transfer. It introduces the student to precise formulation of transport using the conservation principles and flux expressions. Topics include: Introduction to conductive, convective and radiative mechanisms of heat transfer. Conduction heat transfer. Steady heat conduction. Boundary and initial conditions. Convective heat transfer. Analysis of convective heat transfer in external and internal flow. Empirical correlations for convective heat transfer in laminar and turbulent flow. Simultaneous heat and mass transfer. Heat exchangers. Introduction to diffusive and convective mass transfer. One dimensional steady-state mass transfer in common geometries.

PCE312 - Separation Processes. (3 Cr. Hrs.)

Prerequisites: PCE311

Equilibrium between phases; the equilibrium stage concept. Study of mass transfer operation. Vapor-liquid separation processes; absorption, stripping, distillation and drying of materials.

PCE321 - Chemical Reaction Engineering. (3 Cr. Hrs.)

Prerequisites: PCE 212

Overview of chemical reaction engineering. Kinetics of homogeneous reaction. Interpretation of batch reactors data. Introduction to reactor design. Ideal reactors for single reaction. Design of single reactions. Introduction to heterogeneous reactions. Solid catalyzed reactions

PCE362 - Fluid Mechanics, Chemical Reaction Engineering and Heat Transfer Laboratory. (1 Cr. Hr)

*Prerequisites: PCE321,
PCE 311,PCE 222*

There are different experimental setup available in the laboratory to cover chemical engineering concepts heat transfer. Experiments are: Jacketed vessel with coil and stirrer, shell and tube heat exchanger, concentric tube heat exchanger, extended plate heat exchanger, Linear and radial heat conduction, combined convection radiation heat transfer, continuous stirred tank reactor, batch reactor, tubular reactor, diffusion coefficient, parallel and series pumps, losses in pipes, Reynolds number.

PCE332 – Chemical Engineering Economics. (3 Cr. Hrs)

Prerequisite: PCE212

Accuracy and purpose of capital cost estimates. Fixed and working capital estimate (total capital investment cost). Inflation. Rapid cost estimating methods. The factorial method of cost estimation: Lang factors, detailed factorial method. Estimation of the purchased equipment cost. Operating costs. Economics evaluation of projects: cash flow, tax and depreciation, discount cash flow, rate of return, discount cash flow rate of return, sensitivity analysis. Computer methods for costing and project evaluation.

CPE341 - Pharmaceutical Organic Chemistry. (3 Cr. Hrs.)

*Prerequisites: PCE254
Corequisite: PCE371*

Spectroscopy and structure determination with IR, NMR, mass spectroscopy. Amines and the most important organic nitrogen compounds including their reactions. Organic phosphorus compounds. Organic sulphur compounds. Heterocyclic and polycyclic aromatic compounds of pharmaceutical interest with examples related biologically active compounds.

PCE371 - Pharmaceutical Organic Chemistry Laboratory. (1 Cr. Hr)

Corequisite: PCE341

The course involves separation, purification of and identification organic compounds through their physical properties: melting point, distillation, crystallization, extraction, and chromatography; preparation of simple organic compounds; qualitative tests for selected classes of organic compounds.

PCE342 - Instrumental Analysis. (3 Cr. Hrs.)

*Prerequisites: PCE251
Corequisite: PCE372*

Introduction to Instrumental Analysis, Signals and Noise, Components of Optical Instruments, An Introduction to Ultraviolet- Visible Molecular Spectrometry, Applications of Ultraviolet- Visible Molecular Spectrometry, Atomic Absorption Spectrometry, Atomic X-ray Spectrometry, Molecular Luminescence Spectrometry, An Introduction to Electroanalytical Chemistry, Potentiometry, An

Introduction to Chromatographic Separations, Gas Chromatography, Liquid Chromatography, Thermal Methods.

PCE 372 - Instrumental Analysis Laboratory. (1 Cr. Hr)

*Prerequisites: PCE281
Corequisites: PCE342*

Ultraviolet-Visible Spectroscopy, Infrared Spectroscopy, Atomic Spectroscopy, Potentiometry, Thermal Analysis, Chromatography.

PCE 343 - Pharmaceutical Technology – Liquid Forms. (3 Cr. Hrs.)

*Prerequisites: PCE242 +
PCE222
Corequisite: PCE373*

This course includes the major liquid dosage forms (solutions, injectables and dispersed systems including emulsions, suspensions and aerosols) and types of semisolid dosage forms like ointments, pastes and gels. The principles of biopharmaceutics including formulation and drug delivery design will be approached for each form. On the basis of physicochemistry knowledge the students will be trained to formulate and how to control pharmaceutical dosage forms. Preparation evaluation, storage and packaging will be also discussed.

PCE373 - Pharmaceutical Technology – Liquid Forms Laboratory. (1Cr.Hrs.)

Corequisite: PCE343

The laboratory course will serve as a foundation course for applying the knowledge and skills to practice the science and practice of pharmaceutical compounding. Special emphasis is given on preparation of dosage formulations in a laboratory scale while keeping the industrial practice in view. Evaluation tests are also included for every formulation; this includes practical implementation and use of some solid-state characterization techniques. Introduction to Lab and Safety, First Aid, Waste Disposal, Pharmaceutical Calculations, External Pharmaceutical Drops, Preparation of Syrup, Preparation of Suspensions, Mineral Oil Emulsion, Preparation of Cream, Preparation of Ointment, Preparation of Gel, Preparation of Suppositories, Make-Up Preparation, Shampoos.

PCE344 - Pharmaceutical Technology – Solid Forms. (3 Cr. Hrs.)

*Prerequisite: PCE242
Corequisite: PCE374*

This course includes the major conventional pharmaceutical solid dosage forms intended for oral use and forms for rectal use. It is designed to provide a practical understanding to the solid dose manufacture and the theory behind Processes and technologies for manufacturing the finished solid dosage forms including granulation, blending and milling, powder transfer, compression, coating, powder transfer and contaminant. An introduction to the GMP requirements for the formulation, scale up and optimization of finished Dose Forms, and Validation requirements as it applies to solid dose formulations will be also included.

PCE374 - Pharmaceutical Technology – Solid Forms Laboratory. (1 Cr. Hr)

Corequisite: PCE344

This laboratory course will concentrate on solid dosage forms and will build on the knowledge obtained from various earlier pharmacy relevant courses including fundamentals of PCE 343. It will ensure competency of skills to drug analysis, solid dosage preparation, pharmaceutical and pharmacokinetic calculation. An appreciation of the practical experience of the scope of various analytical and characterisation techniques with the opportunity to design, undertake measurement protocols, description of the concepts associated with the drug performance will be included.

Solubilization of Mefenamic Acid, Size Reduction Of Powders, Quality Control Of Tablets, Misterm Exam (Assay of Ibuprofen), USP Dissolution Method For Paracetamol 500 mg Tablets, Granulation Of Powders, Characterization Of Granules, Effect Of Additives On The Physical Properties Of Granules, Tablets Preparation and Testing, Tablet Coating, Determination of Dissolution Profiles of Solid Dosage Form, Capsules filling and testing,

PCE 351 - Biochemistry. (2 Cr. Hrs.)

*Prerequisites: PCE254,
BIO101*

Corequisite: PCE 381

This course covers the following: The study of the principles of biochemistry by studying the molecular composition of the cell; proteins, enzymes, sugars, lipids, nucleic acids vitamins, coenzymes and enzymes. In addition, the course covers DNA replication and gene expression (transcription and translation).

PCE 381– Biochemistry Laboratory. (1 Cr. Hrs.)

Corequisite: PCE 351

The Biochemistry laboratory course will enable students to apply basic biochemistry lab techniques to solve problems. The students will learn the theoretical background of each experiment and the methods used and will have enough knowledge to decide which tool to be used in real situations. The methods/experiments included in this course are: Extraction/purification and characterization of the macromolecules [proteins (SDS lysis, determination of protein content and SDS-PAGE), carbohydrates, lipids and nucleic acids (DNA extraction, 260/280 nm spectrophotometry and gel electrophoresis)]. At the end of this course the students will be able to work as a team, write scientific reports and interpret results.

PCE 511 - Unit Operations and Industrial Safety. (3 Cr. Hrs.)

Prerequisite: PCE312

This course is a combination of two parts; the first one is an application of fluid mechanics, phase transition, and transport phenomena in chemical engineering. It deepens the students' knowledge of the unit operations with a focus on adsorption, crystallization, evaporation, leaching, liquid - liquid extraction and membrane separation. The second part focuses on chemical process safety, subjects include; toxicology, industrial hygiene, gas dispersion, fires and explosions.

PCE 562 - Separation Processes Laboratory. (1 Cr. Hr.)

*Prerequisites: PCE312.
PCE511*

Conduct experiments applying separation processes concepts. Spray dryer, tray dryer, fixed and fluidized bed, batch distillation, cooling tower, single stage evaporation unit, liquid-liquid extraction, filtration unit with plate and frame, reverse osmosis, solid-liquid extraction.

PCE513 – Chemical Process Dynamics and Control. (4 Cr. Hrs.)

*Prerequisite: MATH205
+PCE311*

Introduction to Chemical Processes and Systems. Mathematical models of simple processes, including feedback control. The Blending Tank, Two Tanks in Series, Operability of Processes, The Heated Tank, The Exothermic Reactor, Higher-order Overdamped Systems, Cascade and Feed Forward Control Schemes

PCE543 - Pharmaceutical Plant Design. (3 Cr. Hrs.)

Prerequisites: PCE212+PCE332

Project definition and organization. Input information and batch versus continuous. Input-output structure of the flowsheet. Recycle structure of the flowsheet. Separation system. Index flowsheet. Process flowsheet. Equipment sizing and design. Safety analysis. Safety and environmental analysis. Economic Evaluation. Considerations in the design of pharmaceutical plants; Site selection, layout, Cleanrooms, utilities, special production systems.

PCE 531 - Industrial Process Management. (3 Cr. Hrs.)

Prerequisites: PCE332

Operations and supply chain management. Quality and quality management. Process capability and statistical control. Designing products. Process design technology. Capacity and facilities planning. Human Resources in Operations Management. Managing projects. Strategic supply chain management and design. Forecasting

PCE 532 - Quality Assurance and Process Validation. (3 Cr.Hrs)

Prerequisites: PCE344

This module provides integrated learning across the pharmaceutical and scientific disciplines by consideration of basic qualification and validation regulations for different themes that relate to pharmaceutical production and quality of medicines. Being informing but influencing practice, this course prepares students for professional career in quality assurance and regulatory affairs department. It covers; The legal principles and regulations of the medicines, active ingredients and medical devices. British Pharmacopeia act. Sterile manufacturing. Industry quality control concepts, auditing and regulatory inspection. Specifications for raw materials and packaging material purchasing. Standards for quality management, contents for registration documents and marketing authorization dossiers.

PCE 533 - Hazardous Waste Management. (3 Cr. Hrs.)

*Prerequisites:PCE252+
PCE 311*

Definition of hazardous waste.Fate and transport of contaminants, Toxicology.Pollution prevention,waste minimization, reuse, and recycling.Facility development and operations. Treatment and disposal methods: physicochemical processes; biological methods; stabilization and solidification; thermal methods; land disposal. Medical/biomedical/infectious waste management. Hazardous waste worker health and safety.

PCE534 - Risk Assessment and Management. (3 Cr. Hrs.)

Prerequisite: PCE332

An introduction to risk assessment. Reasons for risk assessment: legal/economical. Legal requirements. Hazards and Risks. Objectives of risk assessments. Implementing and reviewing risk reduction measures. The principles of protection, elimination and reduction.

PCE 541 - Medicinal Chemistry. (3 Cr. Hrs.)

Prerequisite:PCE351

3D-structure of protein, protein data banks, PDB files and protein visualization. Enzymes, receptors, nucleic acids as drug targets. Drug discovery and design concepts and practical examples of computer aided drug design. Quantitative structure activity relationship models. Case studies and examples on anti-bacterial, antiviral, anticancer and other important drugs.

PCE 542 - Pharmaceutical Packaging Engineering. (3 Cr. Hrs.)

Prerequisites:PCE343,PCE 344

Introduction. Types of packaging systems. Criteria for the selection of package type and package materials. Packaging evaluation. Dosage forms and package forms. Containers. Adhesives and inks. Closures: *glass, plastic, metal, paper and board, films, foils and laminates, rubber compounds, cotton*. Special type of delivery – Devices: *Aerosols, Transdermals*. Packaging of medical/surgical devices. Economic aspects.

PCE 591 - Graduation Project I. (1 Cr. Hr)

Theoretical and/or experimental investigation of a problem in chemical/pharmaceutical 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 with integration of chemical/pharmaceutical engineering principles.

PCE 592 - Graduation Project II. (2 Cr. Hrs.)

Prerequisites: PCE 591.

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

PCE 499 – International Internship. (12 Cr. Hrs.)

Prerequisites: DA

Practical training for 6 months after the completion of at least 90 credit hours (See Practical Training Regulations of the College of Applied Medical Sciences).

PCE401 - Biotechnology. (3 Cr. Hrs.)

Prerequisites: PCE252 + PCE321

The tasks of biotechnology in the pharmaceutical industry, agriculture, food industry. Biotechnological methods and processes. Fermentation process and reactors. Processing of biotechnological products for applications from intra and extra cellular products to packaging. What are enzymes, their biotechnological production, their applications in medicine, diagnostics, food production, pharmacy, agriculture and research. Biotechnological production of biomass, low molecular weight products and macromolecules and also biotransformations.

PCE402 - Gene Technology. (3 Cr. Hrs.)

Prerequisites: PCE351

Introduction; transfer of genetic information into proteins: transcription/ translation; tools of the genetic engineer; host organisms and properties; cloning; polymerase chain reaction; applications in genetic engineering.

PCE403 - Nutrition. (3 Cr. Hrs.)

Prerequisites: BIO 101

This Course is designed to make the student aware of their food environment in relation to nutrition and disease. The course also deals with the description of balanced diet and the influence of food habits on health and physical performance.

PCE404 - Introduction to Polymer Science. (3 Cr. Hrs.)

Prerequisites: PCE254

Definitions and classification, nomenclature, basic concepts on structure and on thermal and mechanical behavior. Polycondensation and polyaddition, radical, ionic and metal catalyzed polymerization. Copolymerisations. Chemical modification of polymers. Polymer blends and new developments. Equipment and additives, processing of plastics. Disposal and recycling. Natural macromolecular substances and their most important technical and pharmaceutical derivatives. The characterization of polymers.

PCE405 - Colloids and Surface Chemistry. (3 Cr. Hrs.)

Prerequisites: PCE242

Nature of colloidal dispersions. Thermodynamics of surfaces. Transport properties of suspensions. Particle size and shape. Adsorption onto solid surfaces. Electrically charged interfaces. Particle interaction and coagulation. Rheology of colloidal dispersions.

PCE406 - Corrosion Engineering. (3 Cr. Hrs.)

Prerequisites: PCE242

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

PCE407 - Chemical & Physical Sensors.(3 Cr. Hrs.)

Prerequisites: PCE342

Definitions and basic concepts of chemical sensor technology, physico-chemical basics of sensor technology, dividing sensors into classes, properties and design of sensors, general fields of application, types of detection in sensors, sensor systems and applications, sensors as parts of Microsystems. Definition and basic concepts of physical sensor technology, general fields of application.

PCE408 – Shale Oil Production Processes. (3 Cr. Hrs)

Origin and properties of oil shale. Oil shale resources in Jordan. The chemical and physical nature of kerogen, the precursor to oil shale. Mining and reporting oil shale. In situ retorting. Refining shale oil. The environmental aspects of shale.

PCE409 – Introduction to Oil and Gas Production. (3 Cr. Hrs)

Process Overview: facilities, main process sections, utility Systems. Reservoir and Wellheads: crude oil and natural gas, the reservoir, exploration and drilling, the well, wellhead, artificial lift, well workover, intervention and stimulation, unconventional sources of oil and gas. The Oil and Gas Process: manifolds and gathering, separation, gas treatment and compression, oil and gas storage, metering and export. Utility systems: control and safety systems, power generation and distribution, flare and atmospheric ventilation, Instrument air, water systems, chemical treatment

PCE411 - Numerical Methods for Engineers. (3 Cr. Hrs.)

Prerequisites: MATH 231

Introduction to MATLAB, systems of linear algebraic equations, interpolation and curve fitting, roots of equations, numerical differentiation, numerical integration, numerical solutions of ordinary differential equations (ODEs) and partial differential equations (PDEs).

PCE412 - Nanotechnology. (3 Cr. Hrs.)

Prerequisites: PCE344

Basic Concepts; Molecular Structures; MacroMolecular Structures; Surfaces and Interfaces; Properties of Nanostructures; Nanofabrication; Characterization of Nanostructures and Nanomaterials; Nanomaterials and Applications; Thin Films; NanoParticles; NanoPorous Structures; NanoTubes and Fibers; Nanocomposites; Nanosystems

PCE413 - Membrane Separation Processes. (3 Cr. Hrs.)

Prerequisites: PCE312

Introduction; classification; definitions. Membranes: materials, preparation, modules, characterization, transport Mechanisms. Membrane Processes: microfiltration, ultrafiltration, nanofiltration, reverse osmosis, dialysis, electrodialysis, pervaporation, gas separation, liquid membranes, other techniques, membrane reactors.

PCE421 - Fluid Mixing Technology. (3 Cr. Hrs.)

Prerequisites: PCE222

Theory of mixing processes in laminar and turbulent flows. Practical aspects of mixing processes (equipment selection, design, scale-up). Mechanical design of fluid mixers. Heat transfer in agitated vessels.

PCE422 - Chemical Reaction Engineering II. (3 Cr. Hrs.)

Prerequisites: PCE321

Nonideal flow. Mixing of fluids. Fluid-particle reactions. Fluid-fluid reactions. Deactivating catalysts.

PCE431 - Chemical Process Safety. (3 Cr. Hrs.)

Prerequisite: PCE312

This course will cover safety subjects that are considered core for process safety. Subjects include toxicology, industrial hygiene, sources of toxic releases, gas dispersion, fires and explosions, relief valves and their sizing, flaring, hazard identification and risk assessment.

PCE444 - Antibiotics. (3 Cr. Hrs.)

Prerequisites: PCE252+BIO101

Introduction to antibiotics and antibacterial chemotherapy. Classification and structure-activity relationship of antibiotics and antibacterial agents. Epidemiology of resistance to antibacterial agents. Development of an antibiotic. Inhibitors of β -lactamases, DNA-gyrase. Cofactors. Coumarin antibiotics. Development of resistance and the use of multiple antibacterials during an infection. Drug interactions. Antibacterials and bioterrorism. Clinical quality assurance and the international development of new anti-infective agents.

PCE445 - Particle Technology.

Prerequisites: PCE344

Particle size analysis. Single particles in a fluid. Multiple particle systems. Fluid flow through a packed bed of particles. Fluidization. Pneumatic transport and standpipes. Separation of particles from a gas: gas cyclones. Storage and flow of powders. Mixing and segregation. Particle size reduction. Size enlargement. Fire and explosion hazards of fine powders.

PCE446 - Pharmacokinetics. (3 Cr. Hrs.)

Prerequisites: PCE321

Introduction to Pharmacokinetics and Pharmacodynamics, Passage of Drug through Membranes, Drug Absorption, Drug Distribution, Drug Elimination.

PCE447 - Toxicology. (3 Cr. Hrs.)

Prerequisites: BIO101

Disposition of toxic compounds, metabolism of foreign compounds, types of exposure and response, drugs as toxic substances, industrial toxicology, food additives and contaminants, pesticides, environmental pollutants, natural products, household products, toxicity testing and risk assessment.

PCE448 - Modern Drug Forms & Delivery Systems. (3 Cr. Hrs)

Prerequisites: BIO101

Therapeutic systems, nanoparticles, nanosuspensions, microemulsions, Self-MicroEmulsifying Delivery Systems (SMEDDS), multiple emulsions. Special Adsorbates. Biopharmaceutical in vitro models of drug release investigation of several drug delivery systems and in vitro absorption models, exploitation of drug release and absorption investigations, biopharmaceutical aspects of application sites and drug delivery systems, investigation of plasma concentration curve, bioavailability.

PCE491 - Environmental Engineering (3 Cr. Hrs.)

Prerequisites: PCE251

Legal framework in the fields of water, soil and air. Sampling techniques in the different environmental domains. Online analytical processes. Legal framework in the fields of water, soil and air. Sampling techniques in the different environmental domains. Online analytical processes.

PCE492 - Special Topics in Chemical/Pharmaceutical Engineering I. (3 Cr. Hrs.)

Prerequisites: DA

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

PCE493 - Special Topics in Chemical/Pharmaceutical Engineering II. (3 Cr. Hrs.)

Prerequisites: DA

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

PCE494 - Special Topics in Chemical/Pharmaceutical Engineering III. (3 Cr. Hrs.)

Prerequisites: DA

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

PCE495 - Special Topics in Chemical/Pharmaceutical Engineering IV. (3 Cr. Hrs.)

Prerequisites: DA

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

PCE 593 Special Topics in Chemical/Pharmaceutical Engineering V. (2 Cr. Hrs.)

Prerequisites: DA

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

PCE 594 Special Topics in Chemical/Pharmaceutical Engineering VI. (1 Cr. Hrs.)

Prerequisites: DA

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

PCE 595 Special Field Projects. (3 Cr. Hrs.)

Prerequisites: DA

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

Courses From Other Departments

WEEM528 – Air Pollution Control. (4 Cr. Hrs)

Prerequisite: WEEM352 or DA

Air pollution control law and regulations. Air pollution measurements, emission estimates. Meteorology for air pollution control engineers. Air pollution concentration models. Designing air pollution control systems and equipment. Combustion and control systems. (particulate pollutants, primary particulates, VOCs, Sox and NOx). Air pollutants and global climate

WEEM545 – Water and Wastewater Treatment. (3 Cr. Hrs)

Prerequisite: WEEM222 or DA

The course examines the needs for water quality and how to achieve it by drinking water treatment, wastewater treatment, and other water-quality control strategies. The emphasis of the course is on principles and theory.

IE531 – Project Management. (3 Cr.Hrs)

Prerequisite: IE353 or DA

Examines the organization, planning, and controlling of projects and provides practical knowledge on managing project scope, schedule and resources. Topics include project life cycle, work breakdown structure and Gantt charts, network diagrams, scheduling techniques (CPM and PERT), and resource allocation decisions. Concepts are applied through team projects using project management software.

IE 121 - Engineering Workshop (1 Cr.)

General safety, materials and their classifications, measuring devices and their accuracy, basic household plumbing and electricity, fits and tolerances, theoretical background for the practical exercises including fitting, forging, carpentry, casting, welding, mechanical saws, shearers, drills, lathes, milling machines, shapers and grinders.

MATH 101 - Calculus I. (3 Cr. Hrs.)

Prerequisites: MATH 099

Review of functions, functions, Inverse functions, Inverse trigonometric functions, The concept of limits, Computation of limits, Continuity, Asymptotes, The Derivative, Computation of derivatives, The product and quotient rules, The Chain Rule, Derivatives of Trigonometric, Inverse Trigonometric, Exponential, Logarithmic, and Hyperbolic Functions. Applications of Differentiation: Increasing and Decreasing Functions, Extrema of Functions, Graphs of Functions, Indeterminate Forms and L'Hopital Rule. Antiderivatives, Definite integrals, Fundamental Theorem of Calculus, Integration by Substitutions, Integration by Parts, Applications of integration: Area between curves, Arc length, Volume and Surface Area of Solids of Revolution.

MATH 102 - Calculus II. (3 Cr. Hrs.)

Prerequisite: MATH 101

Review of Integration, Integration by Trigonometric Substitutions, Integration using Partial Fractions, Improper Integrals. Vectors in 2 and 3 Spaces, The Inner and Cross Products of vectors. Polar Coordinates, Graphs and Arc length of Polar curves. Functions of Several Variables; Domain, Limits, and Continuity. Partial Derivatives, The Chain Rule, The Gradient and Directional Derivatives, Extrema of Functions of Several Variables and Lagrange multipliers. Double Integrals, Area of Plane Region and Volumes of Solids using Double integrals, Triple Integrals, Cylindrical and Spherical Coordinates, Triple Integrals using Cylindrical and Spherical Coordinates.

MATH 203 Applied Mathematics for Engineers. (3 Cr. Hrs.)

Prerequisite: MATH 102

Vector analysis in Cartesian coordinates. General Curvilinear Coordinates, Vector calculus in general curvilinear coordinates with emphasis on Spherical and Cylindrical coordinates, transformations between different coordinate systems, vector differentiation. Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors. Complex Numbers and Complex Variables; Representation of complex numbers, Powers and roots of complex numbers, Functions of a complex variable. Review of Infinite Series; Infinite series of constant terms, Convergence tests, Power series and radius of convergence, Taylor, and Maclaurin series and Fourier series.

MATH 205 - Differential Equations (3 Cr. Hrs)

Prerequisite: MATH102

Ordinary differential equations; Sturm-Liouville theory, properties of Special Functions, Solution methods including Laplace transform, and Fourier transform. Eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in Applied Mathematics; Applications to illustrate typical problems and methods of applied mathematics in solid and fluid mechanics, fields of physics, deformation and vibration, wave phenomena, diffusion phenomena, heat conduction, chemical and nuclear reactors, and biological processes.

MATH 231 - Probability and Statistics for Engineers. (3 Cr. Hrs.)

Prerequisite: MATH 101

Co-requisite: MATH 102

This course familiarizes students with descriptive statistics, probability basics, random variables, special discrete random variables, and various distributions: normal, Student's t, Chi-square, and Fisher's F. It includes a discussion of inference about one mean, one proportion, difference between two means and difference between two proportions and the ratio of two variances, large and small samples, paired and independent samples. The MINITAB statistical software package will be used; there will also be an introduction to the use of SPSS.

PHYS 103 - Physics I. (3 Cr. Hrs.)

Physics and measurement. Motion in one dimension. Vectors . Motion in two dimensions. Force and motion. Kinetic energy and work. Potential energy and conservation of energy. Linear momentum and collisions. Rotation. Rolling and angular momentum.

PHYS 104 - Physics II. (3 Cr. Hrs.)

Prerequisite: PHYS103

Electric Fields. Gauss's Law. Electric Potential. Capacitance and Dielectrics. Current and Resistance. Direct Current Circuits. Magnetic Fields. Sources of Magnetic Field. Faraday's Law.

PHYS 106 - Physics Laboratory. (1 Cr. Hrs.)

Prerequisite: PHYS 103

Co-requisite: PHYS 104

Laboratory exercises that apply physical principles introduced in Physics I and Physics II courses. The lab includes the use of data logging techniques, observations, and scientific reasoning in practical situations.

CS116 - Computing Fundamentals – Technical. (3 Cr. Hrs)

Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control

structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation.

CS 1160 – Computing Fundamentals Laboratory – Technical .(1 Cr. Hrs.)

Corequisite: CS116

Session every week to enhance hands-on experience on topics that are theoretically covered in the course using Gnu C compiler on a Solaris/Sun environment.

ARB100 - Arabic (3 Cr. Hrs.)

Grammar and structure. Rectifying weakness in linguistic application; training in sound reading. Dictation; use of language in a manner free from grammatical and linguistic errors; accurate expression of intended meaning. Study and analysis of literary texts through the discussion of linguistic, grammatical and writing skills therein

ENGL 098: English I (Elementary English). (0 Cr. Hrs.)

Students will focus on English at an elementary level concentrating on the receptive skills of reading and listening, and the productive skills of writing and speaking. These will include such things as independent clauses, verb tenses, modal verbs, adverbs, short dialogues, reading simple material and answering short questions, writing short meaningful sentences, listening to short conversations.

ENGL 099: English II (Pre-Intermediate English) (0 Cr. Hrs.)

Students will focus on English at a pre-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include such things as comparatives and superlatives, quantifiers, possessive adjectives and pronouns, vocabulary building, role play activities for speaking, reading comprehension and writing short descriptive paragraphs.

ENGL 101: English III (Intermediate English) (1 Cr. Hr.)

Students will focus on English at an intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include collocations, tense review, affirmative, negative statements, synonyms and antonyms, time clauses, conditionals, active and passive forms, reported speech, phrasal verbs, reading comprehension with detailed questions, vocabulary and writing developed descriptive and opinion essays.

ENGL 102: English IV (Upper-Intermediate English). (1 Cr. Hr.)

Students will focus on English at an upper-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. Model verb review, silent letters and proper pronunciation, jobs and careers, requests and offers, more phrasal verbs with vocabulary building, relative clauses and relative pronouns, narrative tenses for writing exercises, wishes and regrets, reading and comprehending longer passages with direct and inference questions

of medium difficulty, hypothesizing, and writing fully developed descriptive, argumentative and analytical essays of 350 words.

ENGL 201: English V (Advanced English I). (2 Cr. Hrs.)

Students will focus on English at an Advanced level. Students will analyze and produce 2 – 3 page essays with an emphasis on argumentation and persuasion working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Class activities include interactive lectures, small group and class discussions, informal debates, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using basic literary terms and concepts.

ENGL 202: English VI (Advanced English II) (2 Cr. Hrs.)

Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.

GERL 101: German I (3Cr. Hrs.)

Can understand and use familiar, everyday expressions and very simple sentences, which aim at the satisfaction of specific needs. Can introduce oneself, and others, and ask others questions to themselves - e.g. where they live, which people they know or what kind of things they have - and can give answers on questions of this kind. Can communicate on a basic level if those involved with him/ her in a conversation speak slowly and clearly and are willing to help.

GERL 102: German II (3 Cr. Hrs.)

Can understand sentences and frequently used expressions if those are connected with things of immediate meaning (e.g. information to the person and to the family, buying, work, closer environment). Can communicate in simple, routine situations, with the purpose of a simple and direct exchange of information about familiar and common things. Can describe with simple means their own origin and training, direct environment and things that are in connection with direct needs.

GERL 201: German III (3 Cr. Hrs.)

Can understand the main points if no dialect is used and if it concerns familiar things about work, school, spare time etc. Can master most situations which one encounters on journeys in a German speaking area. Can express oneself simply and coherently about familiar topics and areas of personal interest. Can report experiences and events, describe dreams, hopes and goals and give short reasons or explanations about plans and opinions.

GERL 202: German IV (3 Cr. Hrs.)

Can understand the main contents of complex texts, as well as concrete and abstract topics; even discussions between specialists in his/ her own special field. Can communicate spontaneously and fluidly a normal discussion with native speakers, without larger effort on both sides. Can express oneself clearly and in detail in a broad spectrum of topics, describe a point of view to a current question and indicate the pro and cons of different possibilities.

GERL 301: German V (3 Cr. Hrs.)

Can understand and also seize implicit meanings of a broad spectrum of demanding, longer texts. Can express oneself spontaneously and fluidly, recognizing words without having to search for words frequently. Can use the language effectively and flexibly in social and vocational life or in training and study. Can express oneself clearly, structured and detailed, to complex subjects and use appropriate different means for linkage of texts.

GERL 302: German VI (3 Cr. Hrs.)

Can understand and assimilate appropriately written and spoken texts, which are relevant in a university-referred context. Can implement appropriately writings and actions of speech, which are relevant in a university-referred context.

IC 101: Intercultural Communication(3 Cr.Hrs.)

This course is designed to provide prospective students (whose majors have an international flavor) with tools that offer powerful possibilities for improving the communication process. We will examine the process of sending and receiving messages between people whose cultural background could lead them to interpret verbal and nonverbal signs differently. We will learn about the diversity of these cultural differences and at the same time learn how we might overcome them. Our efforts to recognize and surmount cultural differences will hopefully open up business opportunities throughout the world and maximize the contribution of all the employees in a diverse workforce.

MILS 100: Military Sciences (3 Cr. Hrs.)

History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development.

NE 101: National Education (3 Cr. Hrs.)

In a context of striving towards democracy like the one Jordan enjoys today, the meaning and practice of active and responsible citizenship becomes more crucial. It is often argued that democracy requires “democrats” to flourish, and become well established. Democrats are those women and men who recognize pluralism, inclusion, positive engagement, and participation as the main values that govern their interaction with the state as citizens and with each other as diverse people of different interests. In this course you will be able to understand your rights and responsibilities as Jordanian citizen, expand your knowledge about the frameworks, and processes that regulates citizen-state relationships as well as the basic necessary skills for you to practice your citizenship rights in a civic manner.

SE 301: Social Entrepreneurship and Enterprises (3 Cr. Hrs.)

This course will serve as an introduction to the field of social entrepreneurship and social enterprises. Through lectures, field visits, analyses of relevant literature, case studies and exercises, this course will explore social entrepreneurship’s potentials, opportunities and limitations.

The topics will cover: Defining Social Entrepreneurship. Contextualizing Social Entrepreneurship (need, motives, forms, criteria). Role of Leadership, Creativity and Innovation. Locating SE on the

profit/non-profit continuum. SE in the larger fields of development, social change, community activism. Social Enterprises (Missions, Markets, Finances). Ethical business and Corporate social responsibility.

SFTS 101: SOFT SKILLS (3 Cr. Hrs.)

This course is designed to help develop strong oral and written communication skills. The student will be given opportunities to practice writing and editing professional correspondence and technical reports. Additionally, the student will compose and deliver oral presentations. Assignments will include the use of inductive and deductive approaches to conveying a variety of messages. The course emphasis the use of software tools to prepare presentations, stress management, confidence, and sensitivity to others. It also stresses on resume writing and conducting interviews.

