Undergraduate Catalogue 2017

Faculty of

ENGINEERING

Faculty Administration

Dean	Dr. Adel El-Kordi
Assistant Dean	Dr. Yehya Temsah
Director, Tripoli Branch	Dr. Ahmed El-Lakany
Excutive Administrator	Sereen El Hariri

History

The Faculty of Engineering (FE) at Beirut Arab University was established in recognition of the national & regional need for engineering education in 1975. The Faculty initially offered two degree programs providing opportunities for formal course of study in Electrical & Civil Engineering. The Electrical Engineering Department granted its first Bachelor of Engineering degree to its pioneer-graduates in June 1980, followed by the Civil Engineering Department in June 1981. Two additional departments were established: The Mechanical Engineering Department in 1996 & the Industrial Engineering &Engineering Management Department, established in 2001. The petroleum engineering program was launched in September 2013. Starting fall 2016/2017, Chemical Engineering & Biomedical Engineering programs are offered.

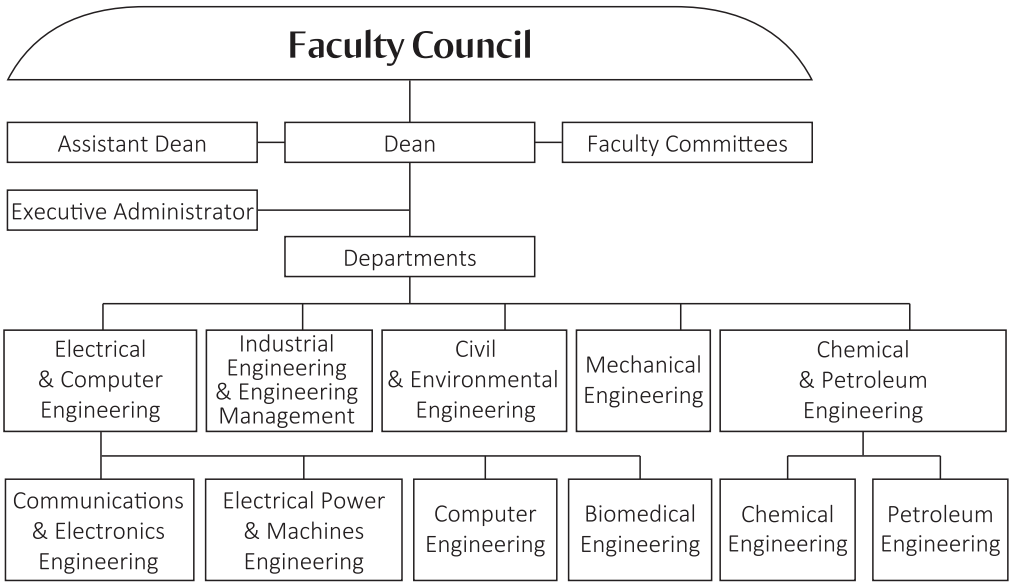
As of 1999, departments of the Faculty of Engineering have updated their curriculum to include a number of courses in humanities, with special emphasis on environmental, economic, managerial, & marketing aspects of engineering. In keeping up with the growing demands for advanced & specialized engineering services, the faculty expanded its programs further by adding both Diploma & Master degree programs. The first Electrical & Civil Engineering Diplomas were awarded in 1986 & the Master degrees in Electrical, Civil & Mechanical Engineering were awarded as of 1994.

In a collaborating effort to provide students with the opportunity to participate in practical projects that exhibit & demonstrate their skills & knowledge, the faculty established mutual incorporation & contacts with various industrial stakeholders. One aspect of this mutual interaction was the instigation of the Engineering Day in 1997. This event involved all faculty, staff & students to display the students respective work projects. The Engineering Day became an annual event to celebrate the faculty's mission of teamwork & creativity. In 2002, the faculty expanded its postgraduate programs further by incorporating a PhD program in all of its four major fields of specialization.

Today, the faculty of Engineering at Beirut Arab University is consistently ranked among the top leading engineering schools in Lebanon & the region. About 250 BE degrees & 20 ME & Ph.D. degrees are awarded annually. The opportunities for study have expanded so that students may choose from more than 200 engineering courses. There are 30 full-time faculty members graduated from top ranked universities in USA & Europe, with diverse research background & experience. The FE also makes use of more than 15 part-time lecturers from abroad on a part-time basis. The faculty has an up-to-date electronic library that includes over 5800 book titles & 230 scientific journal titles, as well as over 15 research laboratories.

Organizational Structure

The Faculty of Engineering constitutes the following five departments: Civil & Environmental Engineering, Electrical & Computer Engineering, Industrial Engineering & Engineering Management, Mechanical Engineering, & Chemical & Petroleum Engineering. The Electrical & Computer Engineering Department offers three programs: Communications & Electronics Engineering, Computer Engineering, Electrical Power & Machines, & Biomedical Engineering. The Department of Chemical & Petroleum Engineering offers two programs: Chemical Engineering & Petroleum Engineering. The organizational chart of the College is shown below:



Vision

The vision of the Faculty of Engineering is to be recognized globally as a beacon for quality engineering education in the Middle East & the world.

Mission

The faculty seeks to serve the engineering educational & professional needs of Lebanon, the region & the international communities. Its mission is to:

- Improve the standard of our graduates through having high caliber faculty members together with quality educational programs & facilities in-line with the rapid technological advancements.
- Provide a balanced regime of quality education that incorporates theoretical & practical education, innovation & creativity as well as freedom of thought & research with emphasis on professionalism & ethical behavior.
- Promote & support research activities over a broad range of academic interests among students & staff.

- Encourage research & technical seminars that contribute to the growth of individual knowledge & prepares for continuous learning.
- Provide an excellent environment for our students, that encourages interaction & enriches the educational experience in the faculty.

Academic Programs

The Faculty of Engineering admits students to the following undergraduate degree programs:

- Bachelor of Engineering in Civil Engineering
- Bachelor of Engineering in Communications & Electronics Engineering
- Bachelor of Engineering in Computer Engineering
- Bachelor of Engineering in Electrical Power & Machines Engineering
- Bachelor of Engineering in Biomedical Engineering
- Bachelor of Engineering in Industrial Engineering
- Bachelor of Engineering in Mechanical Engineering
- Bachelor of Engineering in Petroleum Engineering
- Bachelor of Engineering in Chemical Engineering

Admission Requirements

The most promising eligible applicants are admitted to first year of engineering. Special attention is given to the following factors:

- Lebanese Secondary Certificate (Baccalaureate)
- Entrance exam to measure the level of proficiency in: English, mathematics, physics,Chemistry & logical thinking.

Graduation Requirements

To receive a Bachelor of Engineering Degree in the engineering programs, a student must satisfactorily complete 150 credit hours with an overall minimum grade point average (GPA) of 2.0 + ICDL (International Computer Driving License). Additionally s/he must attain at least a "C" average in specific courses set by each program. The following table summarizes the number of credits required for each Bachelor granting program in the FE.

Program	Common Requirements			Program Requirements			Total Credit Hours
	General Education	Basic Sciences Mathematics	General Engineering	Major Core	Free Engineering & Major Electives	Internship & FYP*	
CVLE	20	26	15	68	16	5	150
COME	20	26	15	72	12	5	150
COMP	20	26	15	69	15	5	150
POWE	20	26	15	72	12	5	150
BIME	20	26	15	78	6	5	150

INME	20	26	15	69	15	5	150
MCHE	20	26	15	75	9	5	150
PTRE	20	27	12	80	6	5	150
CHME	20	36	15	59	15	5	150

CVLE: Civil Engineering
COME: Communications & Electronics Engineering
COMP: Computer Engineering
POWE: Electric Power & Machines Engineering
BIME: Biomedical Engineering
INME: Industrial Engineering
MCHE: Mechanical Engineering
PTRE: Petroleum Engineering
CHME: Chemical Engineering

*FYP: Final Year Project

Common Requirements

The following are the descriptions of the curricular components that are common to all programs offered in the Faculty of Engineering.

I. General Education

Student working for a BE degree in an engineering program must complete a total of 20 credit hours of general education (university & faculty) requirements distributed as follows:

I.A. General Education Core (12 credits)

This curricular component includes 7 courses comprising 12 credits; 3 courses (total of 5 credits) are University Requirements (UR) & 3 courses (total of 6 credits) are Faculty requirements (FR) as listed in the following table:

Course	Title	Credits	Prerequisite
University Requirement			
ARAB 001	Arabic Language	2	
BLAW 001	Human Rights	1	
ENGL 001	English Language	2	
Faculty Requirement			
ENGL 211	Advanced Writing	2	ENGL 001
ENGL 300	Speech Communications	2	ENGL 211
MGMT 002	Entrepreneurship I	2	
ENGR 001	Engineering Ethics	1	

Descriptions of the University Requirement Courses & the MGMT Course are shown in the introduction section of this catalogue.

Descriptions of the Faculty Requirement core courses are given below:

ENGL 211 ADVANCED WRITING (2Crs.: 2Lec,0Lab)

Students write essays on different topics related to argumentation or presentation of concepts & ideas in an organized manner. This is in addition to descriptive, narrative, reflective, & creative writing. Topics chosen are related to the students' culture diagram as well as current affairs. The ability of students to write academically & classify & organize ideas is stressed. Pre-req.: ENGL 001.

ENGL 300 SPEECH COMMUNICATIONS (2Crs.: 2Lec,0Lab)

Basic oral communication principles & theories; body, intonation, & stress language considerations; speaker-listener relationship; speech topic, context & audience; planning, preparing & delivering of platform speeches; showcase & spotlight ideas; group interactions; projects & formal presentations. Pre-req.: ENGL ٢١١.

ENGR 001 Engineering Ethics, 1 Credit (1 Lecture, 0 Lab)

Ethical issues in the practice of engineering, corporate responsibility; personal rights; honesty, ethical aspects of safety, risk & liability & conflicts of interest; environmental issues & sustainability; codes of ethics; emphasis on developing the capacity for independent ethical analysis of real cases. Pre-req.: earned 90 crs.

I.B. General Education Electives (8 credits)

This component encompasses 8 Credits of General Elective courses selected from the University Elective Courses listed in the introduction section of this catalog.

II. Basic Sciences & Mathematics Courses

The Basic Sciences & Mathematics component for all engineering majors except the PTRE program consists of 26 credits (27 for PTRE program) distributed as follows:

Course	Title	Credits	Prerequisite
CHEM 207/CHEM 405	Environmental Chemistry/Solid State Chemistry	2	CHEM110
CHEM 241/CVLE254	Principles of Chemistry/ Environmental Science in Civil Engineering	3	
MATH 281	Linear Algebra	3	MATH112
MATH 282	Calculus	3	MATH111
MATH 283	Differential Equations	3	MATH 281, 282
MATH 284	Numerical Analysis	3	MATH 283
MATH 381	Probability & Statistics	3	MATH 282
PHYS 281	Electricity & Magnetism	3	PHYS120
PHYS 282	Materials Properties & Heat	3	

Instead of the CHEM 207/CHEM405 & the CHEM241 courses, the PTRE & CHME programs require the following two 6-credits chemistry courses instead:

- CHEM 281: Principles of Chemistry I (3 Credits) Pre-req:CHEM110
- CHEM 282: Principles of Chemistry II (3 Credits)

The CHME programs require the following two 9-credits chemistry courses:

- CHEM 246: Physical Chemistry I (3 Credits) Pre-req: CHEM282
- CHEM 331: Organic Chemistry (3 Credits) Pre-req: CHEM281
- CHEM 345: Inorganic Chemistry (3 Credits) Pre-req: CHEM282

Descriptions of the required mathematics & basic sciences courses are given below

CHEM 281 PRINCIPLES OF CHEMISTRY I (3Crs.: 3Lec,0Lab)

Introduction to the basic concepts & principles of chemistry including: Atoms, molecules, mole concept, chemical reactions & calculations, stoichiometry. Periodic table & properties of the elements, nomenclature. Theories of atomic structure, atomic spectra. Theories of chemical bonding. Covalent bonding & molecular structure: molecular geometry, VSEPR theory, valence bond theory, hybrid orbital & molecular orbital theory. Pre-req:CHEM110

CHEM 282 PRINCIPLES OF CHEMISTRY II (3Crs.: 3Lec,0Lab)

Topics discussed are the three physical states of matter (gases, liquids & solids). Properties of solutions. Chemical equilibrium. Ionic equilibria. Rates of chemical reactions. Introduction to the basic chemical thermodynamics & thermo-chemistry. Pre-req.:CHEM281.

CHEM 207 ENVIRONMENTAL CHEMISTRY (2Crs.: 2Lec,0Lab)

Chemistry of ozone layer in the atmosphere; particulate matter & control of air pollution; global warming; waste management, treatment & disposal; mass-energy transfer; risk, dose response & human exposure assessment; hazard identification; risk characterization; water resources & pollutants; BOD & waste water. Pre-req:CHEM110.

CHEM 246 PHYSICAL CHEMISTRY I (3Crs.: 3Lec)

The course covers laws of thermodynamics, entropy & free energy changes in chemical reactions, thermodynamic of solutions. Phase equilibria & phase diagrams. Chemical kinetics including rate of chemical reactions, mechanisms of elementary & complex reactions, chain reactions & explosion, fast reactions, catalysis & their applications. Pre-req.: CHEM 282.

CHEM 331 ORGANIC CHEMISTRY (3Crs.: 2Lec, 2Lab)

Introduction to organic chemistry. A new mechanistic approach to the study of the chemical reactions & a survey of hydrocarbons, alcohols & ethers. Detailed study of aromatic compounds, aldehydes, ketones, carboxylic acids & their derivatives, & amines. The course also introduces students to spectroscopic identification of organic compounds. Applied experiments related to the above topics. Pre-req.: CHEM281.

CHEM 345 INORGANIC CHEMISTRY I (3Crs.:3Lec)
Brönsted & Lewis acid & base. Chemistry of main group elements. Basic concepts of coordination compounds: nomenclature, bonding, structure, stability, magnetic properties, stereochemistry. Crystal & ligand field theories. Pre-req.: CHEM 282.

CHEM 405 SOLID STATE CHEMISTRY (2Crs.: 2Lec,0Lab)
Bonding in solids; crystal structures; x-ray diffraction; electron models; band theory; crystal defects; electrical, thermal, optical & magnetic properties of solid state materials from a chemical perspective; fabrication techniques & modern applications. Pre-req:CHEM110

CHEM 241 PRINCIPLES OF CHEMISTRY (3Crs.:3Lec)
A study of the fundamental concepts of chemistry including matter & measurement, atoms, molecules, ions, moles, nomenclature, atomic & molecular weights. Stoichiometry. Chemical reactions, quantitative calculations. Periodic table, atomic structure, periodic properties of the elements, chemical bonding, molecular structure. The gaseous, liquid, & solid states of matter. Properties of solutions, aqueous reactions & solution stoichiometry. Thermochemistry, chemical thermodynamics, chemical kinetics, chemical equilibrium, acids, bases & ionic equilibria, electrochemistry, nuclear chemistry & coordination chemistry.

MATH 281 LINEAR ALGEBRA (3Crs.: 3Lec,0Lab)
Partial fractions; binomial theorem; roots of polynomial equations; convergence of series; Matrices: Determinants, rank, eigen values, eigenvectors, block decomposition, axes transformation solution of linear system of equations; introduction to complex analysis; conic sections; engineering applications. Pre-req:MATH112

MATH 282 CALCULUS (3Crs.: 3Lec,0Lab)
Hyperbolic functions; implicit & logarithmic differentiation; derivatives of higher order functions; Leibniz theorem; mean value theorem; partial differentiation & applications; Taylor expansion; methods of integration; improper integrals; multiple Integrals; engineering applications. Pre-req:MATH111

MATH 283 DIFFERENTIAL EQUATIONS (3Crs.: 3Lec,0Lab)
First- & second-order differential equations with constant & variable coefficients; simultaneous system of differential equations; series solution; Introduction to partial differential equations; Fourier series; Laplace transforms; shifting theorems; convolution theorem; engineering applications. Pre-req.: MATH 281, MATH 282.

MATH 284 NUMERICAL ANALYSIS (3Crs.: 3Lec, 0Lab)
Curve fitting; function approximation; iterative method for finding roots; solution of systems of linear equations; numerical differentiation & integrations; numerical solution for ordinary differential equations (first order, simultaneous system, second order); special functions; numerical analysis software; engineering applications. Pre-req.: MATH 283.

MATH 381 PROBABILITY & STATISTICS (3Crs.: 3Lec, 0Lab)
Probability space, conditional probability & independence, & probability theorems; Random variables, & density functions, joint probability; expectation, variance & covariance, moments & moment generating functions: Discrete & continuous distributions; statistical measures: mean, mode, variance, standard deviation; statistical distribution: t- distribution, chi- distribution; sampling theory; Theory of estimation, confidence intervals; probability & statistical software. Pre-req.: MATH 282.

PHYS 281 ELECTRICITY & MAGNETISM (3Crs.: 3Lec, 0Lab)
Electrostatics: Coulomb's Law, electric dipole, electric field of a continuous charge distribution, Gauss law, electric potential from point & distributed charges, relation between electric field & electric potential, capacitors & dielectrics, series & parallel connections of capacitors, energy stored in capacitors; Electric current: model for electrical conduction & material resistivity, Kirchhoff's laws; Magnetism: magnetic forces, magnetic dipole, magnetic flux & Gauss law in magnetism, sources of magnetic fields, Ampere's Law, Biot & Savart law, magnetism of matter; Geometric optics: Images formed by reflection, refraction from spherical surfaces, thin lenses, lens aberrations & defects of images. Pre-req:PHYS120.

PHYS 282 MATERIAL PROPERTIES & HEAT (3Crs.: 2Lec,2Lab)
Properties of materials: units, dimensions, experimental errors, circular motion of rigid bodies, moment of inertia, compound pendulum, elasticity of materials, Hook's law, relations between stresses & strains, elastic energy, torsion, gravitation & gravity, satellite motion, pressure measurements, flow of ideal fluids, streamlines & equation of continuity, Bernoulli's equation & its applications, viscosity of fluids, flow in capillary tubes; Heat: heat & temperature, temperature measurements, specific heat & latent heat, heat transfer by conduction, heat convection, heat transfer by radiation & black body radiation.

III. General Engineering
The general engineering component includes 15 credits (12 credits for the PTRE program) distributed as follows:

Course	Title	Credits	Prerequisite
COMP 208	Programming I	3	
CVLE 210	Statics	3	
INME 221	Engineering Economy	3	
MCHE 201	Engineering Drawings & Graphics	3	
MCHE 213	Dynamics	3	

Descriptions of these courses are given below.

COMP 208 PROGRAMMING I (3Crs.: 2Lec,2Lab)

Computer fundamentals. Computer system components: hardware & software. Problem solving & flowcharts/pseudocode. High level programming: data types, structured programming constructs, input & output, expressions & assignments, selection, repetition, arrays.

CVLE 210 STATICS (3Crs.: 3Lec,0Lab)

Force vectors (analytical & graphical methods), free-body diagrams; equilibrium of particles & rigid bodies in two & three dimensions; structural elements & supports; plane & space trusses; axial, shear, & moment diagrams of beams; Cable-supported structures. Friction; center of gravity & centroid; moment of inertia. Applications.

INME 221 ENGINEERING ECONOMY (3Crs.: 3Lec,0Lab)

Basics principles & techniques of economic analysis of engineering project, time value of money, cost allocation & estimation, evaluation of engineering projects & investments, depreciation, inflation, bond & loan financing, after tax cash flow analysis, sensitivity analysis, selection among mutually exclusive alternatives using present worth, annual worth, internal rate of return, benefit-cost.

MCHE 201 ENGINEERING DRAWING & GRAPHICS (3Crs.: 2Lec,2Lab)

Constructional Geometry-constructing tangents. Plane curves & polygons. Orthographic drawing & theory of sketching shapes & surface identification. Orthographic projection of views. Sectional views & conventions. Pictorial drawing. Applications of Auto-CAD software for 2D drawings & solid modeling; project.

MCHE213 DYNAMICS (3Crs.: 3Lec,0Lab)

Dynamics of a particle, system of particles, & planar rigid bodies using Newton's law of motion. Work & energy principle, impulse & momentum principle. Free-body diagram & concept of equilibrium. Inertia properties of rigid bodies .

Program Requirements

Requirements for the Bachelor of Engineering degree are program-specific. They encompass three categories: Major specific core courses, major specific elective courses, & engineering courses chosen from outside the major. The program requirements for the bachelor degrees in the different engineering majors are given hereafter. Details & titles of relevant courses are included in the Student's Study Plan (SSP) that is distributed to all engineering students.

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

Academic staff

Chairperson	Adnan Masri,
Professors	Adel El Kordi, Yehia Temsah, Hamdi Seif, Issam Gouda Oussama Baalbaki, Jamal Khatib
Associate Professors	Youssef Atallah, Raafat Ismail
Assistant Professors	Zaher Abou Saleh, M.Kahil, Hassan Ghanem, Ayman Trad
Part-time Lecturers	R. Sammoura
Full-time Instructors	Lina Jaber
Part-time Instructors	W. Hajj, M. Mashaaka, Hanadi El Khansa, Y. Al-Rawi, S. Chahaal

Mission

The mission of the Civil & Environmental Engineering Department is dedicated to educate & graduate commendable civil engineers by providing a high-standard education delivered in a stimulating & supportive environment that expose students to a broad balanced program of theoretical & practical learning; to prepare graduates to build skills, competencies, leadership qualities, professionalism & ethics, in addition to cultivate a sense of creativity as well as team-work innovations to impart professional services of the highest quality to the community & the environment; & to instill in them a passion to continuous & lifelong learning (LLL) to surmount problems encountered in a rapidly changing & challenging world, for a better lifelong productive career.

Objectives

The Civil & Environmental Engineering Department offers a program that aims to achieve a set of educational, professional, & community service objectives, listed below:

1. Graduates who acquire & impart a sound understanding of the fundamental principles & concepts of civil engineering, & continuously develop their intellectual skills by endorsing independent & creative thinking leading to novel technologies & advanced innovative research & solutions meeting prevailing technical challenges.
2. Engineers who continuously cultivate their career advancement & professional skills, & are prepared to assume leading roles in the profession & the community while emphasizing the issues of professional & ethical conduct.
3. Engineers who exhibit commitment to the wellbeing of their community & the environment in pursuant of relevant solutions & better service to their community & society.

Learning Outcomes

The graduates of the CE program will acquire each of the following characteristics & abilities, which constitute the program outcomes in conformity with the objectives:

a. An ability to apply knowledge of mathematics, science, & engineering.
b. An ability to identify, to formulate, & solve engineering problems.
c. An ability to conduct experiments, as well as to analyze & interpret data.
d. An ability to design a system, component, or process to meet desired needs.
e. An ability to use the techniques, skills, & modern tools necessary for engineering practice.

f. An ability to appreciate the impact of engineering solutions in a local & global context.
g. An ability to function in a team environment.
h. An ability to communicate effectively.
i. An understanding of professional & ethical responsibility.
j. An ability to engage in life-long learning.
k. Exposed to site and/or office practical experience in civil engineering projects or undergraduate research.

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Civil Engineering (CE) consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 10 semesters.

Career Opportunities

The demand for civil engineers has been consistently high, in the Middle East & the Gulf region, during the last decade. Engineers have been involved primarily in large public & private development projects. The emerging reconstruction activity in Lebanon & the Gulf offers ever increasing & expanding opportunities for civil engineers for even decades to come. Graduating civil engineers are benefiting from very stimulating work experiences in the region, many of which are related to mega projects in the building & infrastructure sectors; this has resulted in a booming job market & in highly competitive salaries for civil engineers. Potential senior students are on high demand for recruitment by leading engineering companies for practical training, prior to their graduation, & eventually hired as practicing engineers.

The civil engineering graduate can generally work either in the private sector or in government agencies. Civil engineers attain a broad spectrum of skills sought by almost every profession. The fields of work applied to civil engineering are in form of design & consultation, contracting & supervision, or management & quality control. Being interrelated, it is not unusual that these fields are combined during the performance of a project. The civil engineer can work as an employee, partner, or owner in consulting design offices (local or regional) in the departments of structures, transportation & planning, geotechnical engineering, environmental engineering, water resources, & computer software, & in contracting firms & construction management consultant offices.

Program Overview

The Student's Study Plan is provided to every CE student upon his/her enrollment. The CE curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences & Mathematics	26
General Engineering topics	15
II. CE Program-Specific Requirements	**Credits**
A. Engineering topics from outside the major	3
B. Civil Engineering Core Courses	65
C. Civil Engineering Technical Electives	9
D. Free Engineering Electives	7
E. Internship (Approved Experience / Independent Study)	1
F. Final Year Project (FYP)	4

I. Common Requirements

The list of Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II. CE Program-Specific Requirements

A. Engineering topics from outside the major

This part of the CE curriculum includes a 3-credits course offered by Industrial Engineering &Engineering Management department (INME).The course is listed below.

Course	**Title**	**Credits**	**Prerequisite**
INME 423	Project Planning & Management	3	

A description of the INME-designated course is given in the catalogue section of the Industrial Engineering program.

B. Civil Engineering Core

The Civil Engineering core courses are listed in the table below.

Course	**Title**	**Credits**	**Prerequisite**
CVLE 260	Engineering Surveying I	2	
CVLE 211	Mechanics of Materials	3	Pre: CVLE 210
CVLE 212	Elementary Structural Analysis	3	Pre: CVLE 211
CVLE 231	Engineering Geology	2	

CVLE 261	Engineering Surveying II	2	Pre: CVLE 260
CVLE 270	Civil Engineering Drawings & Detailing	2	Pre: MCHE 201
CVLE 311	Structural Analysis I	3	Pre: CVLE 212
CVLE 312	Structural Analysis II	3	Pre: CVLE 311
CVLE 321	Construction Materials & Technology	3	Pre: CVLE 211
CVLE 322	Reinforced Concrete I	3	Pre: CVLE 211
CVLE 432	Foundation Engineering	3	Pre: CVLE 333 CVLE 322
CVLE 333	Soil Mechanics	3	Pre: CVLE 211 CVLE 231
CVLE 341	Hydraulics I	3	
CVLE 342	Hydraulics II	3	Pre: CVLE 341
CVLE 354	Environmental Engineering	2	Pre: CHEM207
CVLE 371	Structural Modeling	2	Pre: CVLE 212
CVLE 421	Reinforced Concrete II	3	Pre: CVLE322, CVLE212
CVLE 422	Reinforced Concrete III	3	Pre: CVLE 421
CVLE 423	Steel Design I	3	Pre: CVLE 212
CVLE 424	Steel Design II	3	Pre: CVLE 423
CVLE 432	Foundation Engineering	3	Pre: CVLE 333 CVLE 322
CVLE 441	Hydrology	2	Pre: CVLE342
CVLE 453	Sanitary Engineering	3	Pre: CVLE354
CVLE 463	Transport Planning & Traffic Engineering	3	
CVLE 464	Highway Engineering	3	Pre: CVLE 333

Description of Core Courses

CVLE 210 STATICS (3Crs.:3Lec,0Lab)

Force vectors (analytical & graphical methods), free-body diagrams; equilibrium of particles & rigid bodies in two & three dimensions; structural elements & supports; plane & space trusses; axial, shear, & moment diagrams of beams; Cable-supported structures. Friction; center of gravity & centroid; moment of inertia. Applications.

CVLE 260 ENGINEERING SURVEYING I(2Crs.:1Lec,2Lab)
Basic principles, linear surveying & scales, maps plotting, compass surveying, theodolite surveying: Vernier, optical & digital, traverses: open, closed, link, & traverse network, adjustment & plotting, engineering & precise leveling, contouring.

CVLE 211 MECHANICS OF MATERIALS (3Crs.:3Lec,0Lab)
Center of Gravity. Moments of Inertia. Stresses, strains, & stress-strain relationships. Temperature effect. Stresses due to axial loads. Axial deformation. Torsion of circular bars. Stresses due to pure bending. Stresses due to axial forces & biaxial bending. Shear stresses. Combined stresses. Stress transformation & Mohr's circle. Buckling of columns. Pre-req: CVLE 210

CVLE 212 ELEMENTARY STRUCTURAL ANALYSIS (3Crs.:3Lec,0Tut)
Types of loads, structural elements & supports. Analysis of simple, cantilever & overhanging ended beams. Axial, shear, & bending moment diagrams. Analysis of compound & inclined Beams, frames & composite structures. Moving loads, influence lines for statically determinate structures, Muller-Breslau's principle, maximum value of internal force function due to moving loads. Applications. Pre-req: CVLE 211.

CVLE 231 ENGINEERING GEOLOGY (2Crs.:2Lec,0Tut)
Earth-structure, composition & properties of rocks; geologic processes; geologic hazards; geologic structure & engineering consequences; terrain analysis & geologic mapping; interpretation & use of geologic maps; application of geology to engineering practice; reservoirs, dam sites, & construction of tunnels.

CVLE 261 ENGINEERING SURVEYING II (2Cr.: 1Lec,2Lab)
Distance measurements, stadia system, tangential system, & double image system, Basics of electromagnetic distance measurements EDM, total Station, introduction to GPS, areas & volumes for earthworks, mass hauk diagrams, curve ranging simple, compound, reversed, transition, & vertical curves. Pre-req: CVLE 260.

CVLE 270 CIVIL ENGINEERING DRAWING & DETAILING(2Cr.:1Lec,2Lab)
Graphical analysis of engineering drawings, computer-aided drafting & work drawing, applications: RC slabs, beams, stairs, retaining walls, footing, RC bridges, weirs, earth slopes, roads, interchanges & sections. AutoCAD Applications. Pre-req: MCHE 201.

CVLE 311 STRUCTURAL ANALYSIS I(3Crs:3Lec,0Lab)
Stability & determinacy of structures. Elastic deformation (slope & deflection) of beams by double-integration method; Moment-area theorems; & Conjugate Beam Method. Strain energy theorems – Slopes & deflection of beams, frames & trusses utilizing principle of virtual work. Introduction to indeterminate structures: Compatibility conditions & analysis of indeterminate structures by consistent deformation method. Pre-req: CVLE 212.

CVLE 312 STRUCTURAL ANALYSIS II (3Crs.:3Lec,0Lab)
Flexibility method for analysis of indeterminate structures (Beams. Trusses & frames) utilizing concept of Virtual Work. Matrix analysis of structures. Effect of temperature change & yielding of supports. Three Moment Equations & applications. Slope-deflection method for analysis of beams & rigid frames. Concept of Moment distribution methods & applications on continuous beams, & frames with & without side-sway. Influence lines of indeterminate structure - Qualitative influence lines. Computer applications. Pre-req: CVLE 311.

CVLE 321 CONSTRUCTION MATERIALS & TECHNOLOGIES (3Crs.:2Lec,2Lab)
Portland cement: Processing, properties, types & testing, aggregate: processing, properties & testing, water & admixtures, concrete mix design (mixture proportioning), properties of fresh concrete (Workability tests), concrete batching, mixing & placing, hard concrete: properties & testing, building construction materials: Blocks, tiles, lime, wood. Pre-req: CVLE 211.

CVLE 322 REINFORCED CONCRETE DESIGN I (3Crs.:3Lec,0Lab)
Introduction, working stress & limit state methods of design. Sections subjected to: normal force, bending moment, & shear, eccentric force, torsion, bond development & anchorage, code requirements, detailing, applications: columns & beams. Pre-req: CVLE 211.

CVLE 333 SOIL MECHANICS & LABORATORY (3Crs.:2Lec,2Lab)
Origin & nature of soil, clay minerals & soil structure, phase relationships, grain size analysis, consistency & soil classification. Soil Hydraulics: Principle of effective stresses, capillarity, permeability, pumping wells, 1-D & 2-D seepage, flow nets, filter design. Stress distribution, Mohr circles & pole method. Compressibility of soil, theory of consolidation. Failure criteria. Shear strength of soil slope stability, mass procedures & methods of slices. Laboratory testing & reports. Pre-req: CVLE 211 & CVLE 231.

CVLE 341 HYDRAULICS I (3Crs.:2Lec,2Lab)
Properties of liquids. Hydrostatic, measurements of liquid pressures, buoyancy, principles of liquid kinematics & dynamics, continuity, energy, & momentum equations, application: steady flow, flow in pipes, velocity & discharge measurements, laminar & turbulent flow, head losses, pipe networks, emptying of tanks, laboratory experiments.

CVLE 342 HYDRAULICS II (3Crs.:2Lec,2Lab)
Open channel hydraulics: Classification of open channel flow. Flow resistance equations, velocity distribution, boundary shear stress distribution & critical shear, design of channel cross-section, hydraulic jump, gradually varied flow, flow measurement, hydraulic models, pumps: function, types & performance curves. Main specifications of pumps, economical design of pumps & piping system, pumps in parallel & series, selection of pumps, installation, priming, & water hammer. Intake design. Laboratory experiments. Pre-req: CVLE 341.

CVLE 354 ENVIRONMENTAL ENGINEERING (2Crs.:2Lec,0Lab)
Saltwater intrusion: Ghyben-Herzberg interface, limiting conditions, hydrodynamic effects, control methods. Outdoor air pollution: meteorology effects, atmospheric dispersion, point-source Gaussian plume model. Solid waste management: landfill disposal & design, liners & cover systems, use of geosynthetics, vertical barriers, slope stability & settlement analyses. Groundwater pollution: contaminant transport, cone of depression, capture–zone curves, control of groundwater plumes, remediation techniques. Environmental impacts of highways & dams projects. Pre-req: CHEM207.

CVLE 371 STRUCTURAL MODELING (2Crs.:1Lec,2Lab)
Programming: routines of elements stiffness, overall matrix, bandwidth, solution of equations & calculation of elements internal forces, use of available packages (SAP 2000, STAAD, ROBOT, etc.) Pre-req: CVLE 212.

CVLE 421 REINFORCED CONCRETE DESIGN II (3Crs.:3Lec,0Lab)
Serviceability limit state: deflection, cracking & exposure to fire resistance, floor systems: solid slabs, ribbed slabs, flat plate, & slabs, waffle slabs, & paneled beam floor slabs, design methods: Direct design method, & equivalent frame method, loads transmitted from floors to the supported beams, code requirements, detailing, & applications. Pre-req: CVLE 322 & CVLE 212.

CVLE 422 REINFORCED CONCRETE DESIGN III (3Crs.:3Lec,0Lab)
Design of framed structures, hinges, corbels & brackets, beam ledges, & shear friction, slender columns, biaxial bending, reinforced concrete stairs, water tightness, applications: ground, underground & elevated tanks, deep beams, circular beams, code requirements. Detailing. Pre-req: CVLE 421.

CVLE 423 STEEL DESIGN I (3Crs.:3Lec,0Lab)
Introduction - Structural Framing Floor Systems - Stability & Bracing Systems - Tension Members - Compression Members - Bolted Truss Connections - Welded Truss Connections - Laterally Supported Beams - Lateral Torsion Buckling of Beams Specifications & Detailing. Pre-req: CVLE 212.

CVLE 424 STEEL DESIGN II (3Crs.:3Lec,0Lab)
Beam-Column Members. -Built-up Columns - Eccentrically Loaded Connections – High Tensile Bolts - Frame Connections – Column Bases - Simply Supported Slab-Girder Roadway Bridges - Built-up Plate Girders. Specifications & Detailing. Pre-req: CVLE 423.

CVLE 432 FOUNDATION ENGINEERING (3Crs.:3Lec,0Lab)
Soil investigation, sampling & in-situ testing. Shallow foundation: types, bearing capacity & settlement, design of isolated, combined & raft foundations. Groundwater control & dewatering. Deep foundations: bearing capacity & settlement / displacement of axially-and laterally-loaded piles, driving formulas, pile load tests, negative skin friction, pile groups; structural design of pile caps. Code requirements, computer applications. Pre-req: CVLE 333 & CVLE 322.

CVLE 441 HYDROLOGY (2Crs.:2Lec,0Lab)
The hydrologic cycle, precipitation, system flow, evaporation, transpiration, hydrograph analysis, estimating volume runoff, runoff from snow, reservoir engineering, & channel routing, groundwater: occurrence, aquifers, hydraulics of wells, surface & subsurface investigations of groundwater. Water harvesting, surface & ground water case studies. Pre-req: CVLE 342.

CVLE 453 SANITARY ENGINEERING (3Crs.:3Lec,0Lab)
Sources of water supply, quality of water, water & diseases, water consumptions, collection works & water purification, chlorination & distribution systems, quantity of sewage, sewage systems, & appurtenances, & methods of sewage disposal, sewage treatment: necessity & methods. Pre-req: CVLE 354.

CVLE 463 TRANSPORTATION PLANNING & TRAFFIC ENGINEERING (3Crs.:3Lec,0Lab)
Introduction to urban transportation planning, travel behavior, transportation demand models, public transport planning, line capacity, headways, operation principles, traffic engineering principles, traffic control, traffic management, transportation infrastructure & facilities, transport & the environment, air pollution, traffic noise, energy consumption, evaluating alternative transportation plans: Technical, environmental, economic criteria.

CVLE 464 HIGHWAY ENGINEERING (3Crs.:3Lec,0Lab)
Elements of highway transportation planning, traffic engineering, geometric design of highways, highway planning, vertical & horizontal Alignment, transition curves, super-elevation, & intersections, highway materials: mineral aggregates & bituminous materials, structural design of rigid & flexible pavements: bituminous pavements, base courses, concrete pavements. Pre-req: CVLE 333.

C. Civil Engineering Technical Electives
The CE curriculum includes three 3-credit hour courses as technical electives. The courses are chosen from the courses listed in the table below, with their descriptions given thereafter.

Course	Title	Credits	Prerequisite
CVLE 510	Non-Destructive Concrete Testing	3	Pre: CVLE 321
CVLE 511	Photogrammetry & Geodesy	3	Pre: CVLE 261
CVLE 512	Advanced Surveying	3	Pre: CVLE 261
CVLE 513	Computer Application for Surveying	3	
CVLE 514	Advanced Structural Analysis	3	Pre: CVLE 312
CVLE 516	Inelastic Analysis of Structure	3	Pre: CVLE 312
CVLE 517	Earthquake Engineering	3	Pre: CVLE 311
CVLE 518	Materials Technology	3	Pre: CVLE 321
CVLE 519	Concrete Technology	3	Pre: CVLE 321

CVLE 520	Structural Modeling of Buildings	3	Pre: CVLE 371
CVLE 521	Steel Bridges	3	Pre: CVLE 424
CVLE 522	Reinforced Concrete Bridges	3	Pre: CVLE 422
CVLE 523	Advanced Reinforced Concrete	3	Pre: CVLE 422
CVLE 524	Tall Building Structure	3	Pre: CVLE 422
CVLE 525	Pre-Stressed Concrete Structure	3	Pre: CVLE 421
CVLE 526	Design with Geosynthethics	3	Pre: CVLE 432
CVLE 527	Retaining Structures	3	Pre: CVLE 432
CVLE 528	Soil & Site Improvement	3	Pre: CVLE 333
CVLE 529	Feasibility Study & Marketing	3	
CVLE 530	Railway Engineering	3	Pre: CVLE 463
CVLE 531	Harbor Engineering	3	Pre: CVLE 432
CVLE 534	Advanced Highway Engineering	3	Pre: CVLE 464
CVLE 535	Airports Engineering	3	Pre: CVLE 464
CVLE 537	Irrigation & Drainage Engineering	3	Pre: CVLE 441
CVLE 538	Hydraulic Structures	3	Pre: CVLE 342 & CVLE 432
CVLE 539	Hydraulic & Hydrologic Modeling	3	Pre: CVLE 441
CVLE 542	Water & Wastewater Treatment	3	Pre: CVLE 342 & CVLE 432
CVLE 543	Water & Wastewater Network	3	Pre: CVLE 342 & CVLE 453
CVLE 546	Environmental Process Engineering	3	Pre: CVLE 354

Description of Technical Elective Courses

Elective Courses - Structural Sequence

CVLE 510 NON-DESTRUCTIVE CONCRETE TESTING (3Crs.:3Lec,0Lab)

Types, calibration & maintenance. Analysis of fresh concrete. Accelerated testing methods. Analysis of hardened concrete. Core drilling & testing. Partially destructive testing. Non-destructive testing. Load testing. Assessment of reinforcement condition. Standards, Specifications & Code of Practice of existing documents relevant to preceding items & discussion of their relevance. Pre-req: CVLE 321.

CVLE 514 ADVANCED STRUCTURAL ANALYSIS (3Crs.:3Lec,0Lab)
Force & Displacement Methods for analysis of indeterminate structures. Flexibility & Stiffness matrix method for analysis of indeterminate trusses, beams, & frames. Grid beams & structures on elastic supports. Influence lines of indeterminate structure utilizing concepts of virtual work & moment distribution methods – Qualitative & Quantitative approaches. Pre-req: CVLE 312.

CVLE 516 INELASTIC ANALYSIS OF STRUCTURE (3Crs.:3Lec,0Lab)
Plastic analysis: concept of plastic analysis, plastic hinges, incremental load method (step by step), mechanism method, upper bound, lower bound, & uniqueness theorems, combined mechanisms, beams, multistory, multiply & gable frames, computer implementation. Pre-req: CVLE 312.

CVLE 517 EARTHQUAKE ENGINEERING (3Crs.:3Lec,0Lab)
Earthquake causes & measures, earthquake faults & waves, plate tectonics, structural dynamics of single & multi-degree of freedom systems, dynamic response spectra, equivalent static lateral force method, lateral loads resistive systems, mitigation of earthquake forces. Pre-req: CVLE 311.

CVLE 518 MATERIALS TECHNOLOGY (3Crs.:3Lec,0Lab)
Theory of composites: Micro-composite & Macro–composite, Engineering applications of fibers, Design of Composite sections, Nonlinear analysis, Fracture Mechanics: crack initiation & propagation. Pre-req: CVLE 321.

CVLE 519 CONCRETE TECHNOLOGY (3Crs.:3Lec,0Lab)
Evaluation of Existing Structures, field investigation, hot-weather concreting, cold-weather concreting, special types of concrete; (High-strength concrete, Mass concrete, High performance concrete), analysis of fresh concrete, analysis of hard concrete, concrete structures defects, concrete epoxy injection, ready-mixed concrete. Pre-req: CVLE 321.

CVLE 520 STRUCTURAL MODELING OF BUILDINGS (3Crs.:3Lec,0Lab)
The course include the modeling technique for the numerical structural analysis of building with a review of the basic Structural systems in buildings, the loadings (Gravity, Lateral, temperature, settlement…..), the modeling of space truss structures, of building skeletons, of slabs & shear walls of walls & deep beams as pier & spandrel. Pre-req: CVLE 371.

CVLE 521 STEEL BRIDGES (3Crs.:3Lec,0Lab)
Types of Steel Bridges – Loads – Bracing Systems – Multi-Span Roadway & Railway Bridges – Composite Construction of Girder- Slab Bridges. Design of splices & bearings. Design of Truss Bridges & Arched Bridges. Specifications & Detailing. Pre-req: CVLE 424.

CVLE 522 REINFORCED CONCRETE BRIDGES (3Crs.:3Lec,0Lab)
Introduction, types of bridges, & loads, slab type hollow-type bridges, box-type bridges, girder type bridges, bearing pads, code requirements, detailing applications. Pre-req: CVLE ٤٢٢.

CVLE 523 ADVANCED REINFORCED CONCRETE (3Crs.:3Lec,0Lab)
Design of R.C. walls: walls designed as compression members, empirical design method, alternate design of slender walls, shear walls, pre-cast concrete: distribution of forces among members, member design, structural integrity, connection & bearing design, strength evaluation of existing structures, reinforced concrete arches. Pre-req: CVLE 422.

CVLE 524 TALL BUILDING STRUCTURE (3Crs.:3Lec,0Lab)
Introduction, types of structural resisting systems, structural walls, cantilever columns, rigid frames, dual systems, code requirements, detailing. Pre-req: CVLE 422.

CVLE 525 PRE-STRESSED CONCRETE STRUCTURE (3Crs.:3Lec,0Lab)
Definitions, methods of prestressing, materials & their properties, losses of prestress, elastic behavior & stress distribution under different load stages, analysis & design of homogeneous sections, care of simply supported members. Pre-req: CVLE 421.

Elective Courses - Geotechnical Sequence

CVLE 526DESIGN WITH GEOSYNTHETICS (3Crs.:3Lec,0Lab)
Overview on geosynthetic products: geotextiles, geogrids, geonets, geomembranes & geocomposites; physical, mechanical, hydraulic & environmental properties. Functions: separation, reinforcement, filtration, & drainage. Applications: unpaved & paved roads, reinforced-earth walls, embankments, foundations, slope stabilization, drainage behind retaining walls, erosion control, landfill liners & caps, earth dams, & wick drains. Construction methods, techniques, & specifications. Computer applications. Pre-req: CVLE 432.

CVLE 527 RETAINING STRUCTURES (3Crs.:3Lec,0Lab)
Lateral earth pressures: at rest, active & passive states, limit equilibrium methods & theory of elasticity, seismic conditions, hydrostatic & seepage pressures. Retaining walls: design of gravity, cantilever, & basement walls. Sheet-piles: cantilever & anchored bulkheads, free- & fixed-earth support methods, moment reduction, anchorage design. Braced cuts: pressure envelopes, design of sheeting, wale beams & struts, stability against bottom heave or piping. Shoring systems: types, control of groundwater, construction stages, anchors prestressing & testing, ground settlement around excavations. Code requirements, computer applications. Pre-req: CVLE 432.

CVLE 528 SOIL & SITE IMPROVEMENT (3Crs.:3Lec,0Lab)
Mechanical methods: compaction theory, properties of compacted soils, laboratory tests, field equipment, compaction specifications & control, dynamic compaction, vibroflotation, blasting techniques. Hydraulic methods: theory of wells, dewatering systems, drainage of slopes, preloading & use of vertical sand/wick drains. Physical & chemical methods: granular admixtures, Portland cement, lime, calcium chloride, fly ash, bitumen, grouting materials & techniques. Inclusion methods: reinforced earth with steel strips or geosynthetics, soil nails & rock bolts. Laboratory & computer applications. Pre-req: CVLE 333.

Elective Courses - Environmental & Water Resources Sequence

CVLE 537 IRRIGATION & DRAINAGE ENGINEERING (3Crs.:3Lec,0Lab)
Irrigation: planning & design of canals networks, field irrigations, sprinkler irrigation system, drip irrigation system, drainage: importance of drainage, open drainage design & planning, tile drainage design & planning, canal lining design. Pre-req: CVLE 441.

CVLE 538 HYDRAULIC STRUCTURES (3Crs.:3Lec,0Lab)
Hydraulic & structural design of drainage structures, design of dams, environmental considerations, design of pumping stations, design of control structures, design of drop structures, applications. Pre-req: CVLE 342 & CVLE 432.

CVLE 539 HYDRAULIC & HYDROLOGIC MODELING (3Crs.:3Lec,0Lab)
Hydraulic modeling: Physical modeling, numerical modeling, hydrologic modeling, application of deterministic & probabilistic concept to simulate & analyze hydrologic systems; discussion of the theory & application of linear & non-linear, lumped, & distributed systems techniques in modeling the various phases of the hydrologic cycle. Pre-req: CVLE 441.

CVLE 542 WATER & WASTE WATER TREATEMENT (3Crs. :3Lec,0Lab)
Water networks quality of raw water, intakes, pumping raw water to treatment plant, plain & chemical sedimentation, filtration, disinfection, ground tank, characteristics of wastewater, aerobic & anaerobic processes-preliminary, primary & tertiary treatment-biological filtration, activated sludge-oxidation ditches, stabilization ponds-aerated, lagoons-sludge treatment & Re-use. Pre-req: CVLE 342 & CVLE 453.

CVLE 543 WATER & WASTE WATER NETWORKS (3Crs.:3Lec,0Lab)
Storage of water, ground & elevated storage, equalization between consumption rates & storage, high lift pumps, distribution network (pipe lines, valves, connections, & hydrants), construction & maintenance of collection works.(Domestic, storm, industrial & filtration wastewater), design of collection gravity systems, sewer appurtenances, safety of maintenance of collection works, pumping wastewater to treatment & recycle locations. Pre-req: CVLE 342 & CVLE 453.

CVLE 546 ENVIRONMENTAL PROCESS ENGINEERING (3Crs.:3Lec,0Tut)
An introduction to analysis, characterization, & modeling of environmental, physical, chemical, & biological processes & reactor configurations commonly used for water quality control; applications to the development & design of specific water & wastewater treatment operations; discussion of economic & legislative constraints & requirements. Pre-req: CVLE 354.

Elective Courses - Transportation Sequence

CVLE 511 PHOTOGRAMMETRY & GEODESY (3Crs.:3Lec,0Lab)
Principles of photography, types of photographs, aerial cameras, vertical photographs: scale, ground coordinates, relief displacement, project planning: end & side lap-flying height, ground coverage, & flight map-stereoscopic viewing, figure of the earth, geodetic coordinates system, theory of errors, methods of least squares, triangulation network, trilateration network, types of conditions, adjustment network. Pre-req: CVLE 261.

CVLE 512 ADVANCED SURVEYING (3Crs.:3Lec,0Lab)
Astronomical observations for geodesy, Surveying by total station. Positioning by intersection & resection: with angles & with distances. Trilateration system. Adjustment of trilateration network. Adjustment by variation of coordinates. The use of laser beam in surveying. Global positioning system GPS. Pre-req: CVLE 261.

CVLE 513 COMPUTER APPLICATION FOR SURVEYING (3Crs.:3Lec,0Lab)
Route surveying & geometric design, topographic site surveys & mapping, civil engineering & construction surveys, layout of industrial plants, building, pipelines & manufacturing machinery, horizontal curves ,circular curve layout by different methods, special circular curve problems, compound & reverse curves, vertical curves. General software for surveying: CivilCad, SURFER, SDR, software for GPS surveying.

CVLE 530 RAILWAY ENGINEERING (3Crs.:3Lec,0Lab)
Train dynamics (Tractive Effort, Train Resistances, Ruling Gradient, Acceleration & Deceleration, Braking & Stopping distances), Design of Railway tracks (Subgrade, Ballast Section, Sleepers, Rails, fastenings & rail joints, Stresses in Track Components), Track alignment (Cant - Transition Curves - Longitudinal & Cross sections, Track junctions (turnouts- crossings- crossover- double cross over- slips, planning dimensions of track junctions), Stations (passenger stations- freight stations- planning of marshalling yards- locomotive & wagons yards), Control of Train Movement & Signaling (types of Signaling systems- Mechanical & Electrical signaling systems- automatic block sections- green wave). Pre-req: CVLE 463.

CVLE 531 HARBOR ENGINEERING (3Crs.:3Lec,0Lab)
Theory of Waves, wave refraction & diffraction, wave forces on vertical walls, Port Planning, water & land areas, breakwaters, temporary & fixed breakwaters, submerged & ruble mound breakwaters, wall breakwaters composite breakwaters, gravity quay walls, plain concrete blocks Quay walls, cantilever & anchored sheet piles, Marine platforms supported by group piles. Pre-req: CVLE 432.

CVLE 534 ADVANCED HIGHWAY ENGINEERING (3Crs.:3Lec,0Lab)

Highway & Airports pavement design (flexible & rigid pavements), Stress Analysis in flexible & rigid pavements, pavement response under traffic load, failure of flexible & rigid pavements, highways pavement maintenance & rehabilitation (methods, programs, management), types & design, Hot mix Asphalt Concrete: Materials, Design Methods & Testing. Pre-req: CVLE 464.

CVLE 535 AIRPORTS ENGINEERING (3Crs.:3Lec,0Lab)

Principles of Airport Planning, Components of Airports (airside, landside), Aircraft characteristics, Airport operations, Airport System planning, Site selection, Land use, Airport terminal area & airport access, Airport Capacity & delays, Airport geometric design (Runways, Taxiways, Aprons), Safety Surfaces (Obstacle limitation surfaces: approach, take-off, transition, conical, horizontal), Airport pavement (types, design, construction). Pre-req: CVLE 464.

Elective Courses - Construction Management Sequence

CVLE 529 FEASIBILITY STUDY & MARKETING (3Crs.:3Lec,0Lab)

Economics: cost nature & concepts, cost definition, material, labor cost, factory overhead, direct cost, indirect cost, variable cost, fixed cost, semi-variable semi-fixed cost, differential & increment cost, & opportunity cost, cost measurement & equations, cost reports, profits, consumption, risk, financial institutions, long-term contract, Labor's law, Insurance.

D.Free Engineering Elective

The CE program includes 7-credit hour courses taken as Free Engineering Elective. The student in consultation with his/her advisor may choose the course from any engineering major in the university.

E.Internship (Approved Experience/ Independent Study)

This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.
Refer to the department policy for further details.

F.Final Year Project

After completing 110 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, & give a presentation on a significant, relevant, & comprehensive engineering problem. The FYP is intended to stimulate student creativity & critical thinking, & build skills in formulating, designing, developing, building, communicating, & managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.
Refer to the Final Year Project Policy for more details.

Study Plan

Bachelor of Engineering in Civil Engineering (150 Credits)

First Semester (17 Credits)			Crs.	Pre-co/requisites
MATH	281	Linear Algebra	3	Pre: MATH112
CVLE	210	Statics	3	
PHYS	282	Material Properties & Heat	3	
MCHE	201	Engineering Drawing & Graphics	3	
ENGL	001	English Language	2	
BLAW	001	Human Rights	1	
		Elective (General)	2	

Second Semester (17 Credits)			Crs.	Pre-co/requisites
MCHE	213	Dynamics	3	
MATH	282	Calculus	3	Pre:MATH111
CVLE	260	Engineering Surveying I	2	
PHYS	281	Electricity & Magnetism	3	Pre:PHYS120
COMP	208	Programming I	3	
ARAB	001	Arabic Language	2	
		Elective (General)	1	

Third Semester (17 Credits)			Crs.	Pre-co/requisites
CVLE	261	Engineering Surveying II	2	Pre: CVLE 260
CVLE	231	Engineering Geology	2	
MATH	283	Differential Equations	3	Pre: MATH 281, MATH 282
CHEM	207	Environmental Chemistry	2	Pre: CHEM110
INME	221	Engineering Economy	3	
CVLE	211	Mechanics of Materials	3	Pre: CVLE 210
ENGL	211	Advanced Writing	2	Pre: ENGL 001

Fourth Semester (17 Credits)			Crs.	Pre-co/requisites
CVLE	212	Elementary Structural Analysis	3	Pre: CVLE 211
CHEM	241	Principles of Chemistry	3	
MATH	284	Numerical Analysis	3	Pre: MATH 283
CVLE	270	Civil Engineering Drawings & Detailing	2	Pre: MCHE 201
ENGL	300	Speech Communications	2	Pre: ENGL 211
		Elective (General)	4	

Fifth Semester (17 Credits)			Crs.	Pre-co/requisites
CVLE	341	Hydraulics I	3	
CVLE	321	Construction Material & Technology	3	Pre: CVLE 211
CVLE	311	Structural Analysis I	3	Pre: CVLE 212
CVLE	371	Structural Modeling	2	Pre: CVLE 212
CVLE	333	Soil Mechanics	3	Pre: CVLE 211, CVLE 231
MATH	381	Probability & Statistics	3	Pre: MATH 282

Sixth Semester (15 Credits)			Crs.	Pre-co/requisites
CVLE	354	Environmental Engineering	2	Pre: CHEM207
CVLE	342	Hydraulics II	3	Pre: CVLE 341
CVLE	312	Structural Analysis II	3	Pre: CVLE 311
CVLE	322	Reinforced Concrete I	3	Pre: CVLE 211
MGMT	002	Entrepreneurship I	2	
		Elective (General)	2	

Seventh Semester (14 Credits)			Crs.	Pre-co/requisites
CVLE	441	Hydrology	2	Pre: CVLE342
CVLE	453	Sanitary Engineering	3	Pre: CVLE354
CVLE	421	Reinforced Concrete II	3	Pre: CVLE322, CVLE212
CVLE	423	Steel Design I	3	Pre: CVLE212
CVLE	463	Transportation Planning & Traffic Engineering	3	

Eighth Semester (12 Credits)			Crs.	Pre-co/requisites
CVLE	422	Reinforced Concrete III	3	Pre: CVLE 421
CVLE	432	Foundation Engineering	3	Pre: CVLE 333, CVLE 322
CVLE	424	Steel Design II	3	Pre: CVLE 423
CVLE	464	Highway Engineering	3	Pre: CVLE 333
Ninth Semester (14 Credits)			**Crs.**	**Pre-co/requisites**
INME	423	Project Planning & Management	3	
CVLE	499	Internship (Approved Experience / Independent Study)	1	
		Technical Elective	3	
		Technical Elective	3	
CVLE	501	Final Year Project I	1	See Footnote [2]
		Free Engineering Elective[1]	3	
Tenth Semester (10 Credits)			**Crs.**	**Pre-co/requisites**
		Technical Elective	3	
CVLE	502	Final Year Project II	3	Pre: CVLE 501
		Free Engineering Elective	4	See Footnote 1

[1] Selected from any Engineering program offered courses (as per restriction indicated in footnote (3) below).

[2] Must have completed 110 Credits including ENGL 300 in order to take a department technical elective or Final Year Project.

Courses offered for other majors only

The Civil & Environmental Engineering Department offers four courses for other engineering majors. These courses are described below.

CVLE 201 THEORY OF STRUCTURES FOR ARCHITECTS (2Crs.:1Lec,2Lab)
Theory & concepts of structures to emphasize an intuitive comprehension of the fundamental principles of structural behavior including loading, shear & bending moments. Calculation of internal forces in simple structures such as cantilevers, simples beams, & overhanging beams. Calculation of internal forces in truss members.

CVLE 202 SURVEYING FOR ARCHITECTS (2Crs.:1Lec,2Lab)
Technology discussion of the major topics in surveying engineering technology including field instrumentation, boundary surveying, topographic surveying. Measurement of distances, directions & angles, using the tape, level, compass, transit & theodlit. Computation of areas & traverses, lines & grades. Introduction to construction surveys, & an introduction to GPS measurement.

CVLE 301 CONCRETE & STEEL STRUCTURES (2Crs.:1Lec,2Lab)

Combined course addressing two technical fields:

• Review of concrete & steel structure systems. Reinforced concrete fundamentals, reviewing basics of reinforced concrete behavior & introducing methods of design used in current engineering practice. Basic mechanics of structural concrete introduced in examining bending, shear, & axial forces. Topic areas including beams, slab systems, columns, foundations, retaining walls, & an introduction to pre-stressed concrete.

• Review of statics & strengths of materials, review of tension, compression & bending steel members. Design of trusses, columns, & beams structural elements.

CVLE 303 SOIL MECHANICS & FOUNDATIONS, & TESTING & PROPERTIES OF MATERIALS (2Crs.:1Lec,2Lab)

Combined course addressing two technical fields:

• Introduction to soil mechanics: Soil formation & soil structure; soil composition; grain size analysis; plasticity of soils; effective stress concept; shear strength, stress distribution; bearing capacity of shallow foundation; theory of consolidation; settlement; soil exploration. Foundations: shallow, deep foundations, & pile caps.

• Introduction to testing & properties of materials: strength characteristics of building materials & material assemblies; stresses & strains; rigidity & deformation; temperature effects; torsion effects; combined loading of elements & systems.

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Academic staff

Chairperson	Ziad Osman
Professors	Soubhi Abou Chahine, Ali Haidar
Associate Professors	Hamza Issa, Chadi Nohra, Mohamed Tarnini
Assistant Professors	Hiba Abdallah, Hilal Misilmani, Abed Al Rahman El Fello, Youmni Ziadeh Bilal Youssef, Khaled Shahine, Nabil Abdel Karim; Rola Kassem Wassim Itani, Moustafa Refaey

Communications & Electronics Engineering Program

Mission

The educational mission of Communications & Electronics Engineering (CEE) Program is to deliver high quality undergraduate education which combines balanced theoretical & practical topics in Communications & Electronics Engineering. Graduates of the program will have a mastery of fundamental knowledge in a variety of Communications & Electronics Engineering fields, management, & entrepreneurial skills. Graduates will be qualified to pursue successful careers in their profession or graduate studies in different areas.

Objectives

The educational objectives of the program are determined to support career advancement of the graduates as they pursue their career goals. The graduates will:

1. Design, optimize & maintain communication systems in tune with community needs & environmental concerns
2. Be able to develop & integrate new technologies as they emerge
3. Engage in a technical/managerial role in diverse teams
4. Pursue entrepreneurial initiatives & launch startup companies
5. Communicate effectively & use resources skillfully in projects development

Learning Outcomes

Upon completion of the program graduates shall have:

a. An ability to apply knowledge of mathematics, science, & engineering
b. An ability to design & conduct experiments, as well as to analyze & interpret data
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, & sustainability
d. An ability to function on multi-disciplinary teams
e. An ability to identify, formulate, & solve engineering problems
f. An understanding of professional & ethical responsibility
g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, & societal context

i. A recognition of the need for, & an ability to engage in life-long learning
j. A knowledge of contemporary issues
k. An ability to use the techniques, skills, & modern engineering tools necessary for engineering practice

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Communications & Electronics Engineering consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 10 semesters.

Career opportunities

The Communications & Electronics Career Field encompasses the functions of installing, modifying, maintaining, repairing, & overhauling ground television, telephone & mobile equipment, ground weather equipment, air traffic control, aircraft control & warning, automatic tracking radar equipment, simulator & training systems, microwave, fixed & mobile radio equipment, space communications systems equipment, high-speed general & special purpose data processing equipment, automatic communications & cryptographic machine system, electromechanical equipment, & electronic equipment associated to all the previous mentioned systems. Most of these applications find place in several companies in Lebanon, the Arab world & the whole world in general, providing, hence, the possibility for the CEE program students to find jobs in the field they like most & almost everywhere in the world.

Program Overview

The Student's Study Plan is given to every CEE student upon his/her enrollment. The CEE curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences & Mathematics	26
General Engineering topics	15
II. CEE Program-Specific Requirements	**Credits**
A. Engineering topics from outside the program	17
B. CEE Core	55
C. CEE Technical Electives	6
D. Free Engineering Electives	6
E. Final Year Project	4
F. Internship	1

I. Common Requirements

The list of the Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II. CEE Program-Specific Requirements

A.Engineering topics from outside the major

This part of the CEE curriculum includes 17-credit-hours-courses offered by other engineering programs. These courses are listed in the table below.

Course	Title	Credits	Prerequisite
COMP 210	Programming II	3	Pre: COMP 208
POWE 210	Fundamentals of Electric Circuits	3	Pre: PHYS 281
COMP 211	Introductory Web Programming	3	Pre: COMP 208
COMP 221	Digital Systems I	2	
POWE 271	Electromagnetic Fundamentals	3	Pre: PHYS 281
POWE 214	Electric & Electronic Measurements	3	Pre: POWE 210

Descriptions of this group of courses are given below:

COMP 210 PROGRAMMING II (3Crs.: 2Lec,2Lab)
Pointers. Recursion. Character strings. Structures, union, & bit manipulation. File operations, sequential & random. Preprocessing directives. Function call by reference. Pre-req: COMP 208.

POWE 210 FUNDAMENTALS OF ELECTRIC CIRCUITS (3Crs.:3Lec,0Lab)
DC circuit analysis: reduction methods, mesh current & node voltage analysis methods, transformation methods, DC network theorems, capacitors & inductors, phasors & AC steady state circuit analysis, series & parallel resonance, power in AC circuits, balanced & unbalanced three-phase circuits.Pre-req: PHYS 281.

COMP 211 INTRODUCTORY WEB PROGRAMMING (3Crs.:2Lec,2Lab)
Introduction to HTML, Java, Java Script, JSP, ASP & PHP. Packages for web-page design. Pre-req: COMP 208.

COMP 221 DIGITAL SYSTEMS I (2Crs.:2Lec,0Lab)
Number systems & coding, Binary systems. Conversion from decimal to other bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions & circuits designs (HA, FA, & ALU). Combinational functions & circuits design (decoder, encoder, multiplexer & de-multiplexer). Sequential circuits definitions & designs (Latches, RS-FF, D-FF, JK-FF, T-FF). Simple buffer registers. Counters.

POWE 214 ELECTRIC & ELECTRONIC MEASUREMENTS (3Crs.:2Lec,2Lab)

Introduction to instrumentation & measurements (Errors, precision, accuracy, measurement statistics, etc.), Analog instrumentation (Permanent magnet moving coil PMMC, Moving Iron MI, Electrodynamometer), bridges (AC, DC), Oscilloscopes (functions & controls, voltage, time, & frequency measurements), Conversion (D/A, A/D, etc.), Electrical transducers, signal conditioning, data acquisition. Pre-req: POWE 210.

POWE 271 ELECTROMAGNETIC FUNDAMENTALS (3Crs.:3Lec,0Lab)

Vector calculus, electrostatics: Coulomb's law, Gauss's law, divergence theorem, energy & potential, conductors & dielectrics, electric dipole & polarization, capacitances, magnetostatics: Biot-Savart law, Ampere's law, Stoke's theorem, magnetic materials, magnetic dipole & magnetization, magnetic circuits, inductances, Faraday's law, time varying fields, Maxwell's equations. Pre-req: PHYS 281.

B.Communications & Electronics Engineering Program Core

The CEE program core courses are listed in the table below.

Course	Title	Credits	Prerequisite
COME 221	Electronic Circuits I	3	Pre: POWE 210
COME 212	Network Analysis	2	Pre: POWE 210
COME 212L	Electric Circuits Lab	1	Co: COME 212
COME 222	Electronic Circuits II	3	Pre: COME 221
COME 222L	Electronic Circuits Lab	1	Co: COME 222
COME 232*	Logic Design	2	Pre: COMP 221
COME 232L*	Logic Circuits Lab	1	Co: COME 232
COME 381	Signals & Systems	3	
COME 361	Modern Physics	2	
COME 372	Propagation & Antennas I	4	Pre: POWE 271
COME 382	Communication Theory & Systems I	4	Pre: COME 381
COME 384	Digital Signal Processing	3	Pre: COME 381
COME 332	Microprocessor Fundamentals	4	Pre: COMP 221
COME 471	Propagation & Antennas II	2	Pre: COME 372
COME471L	Propagation & Antennas Lab	1	Co: COME 471
COME 481	Communication Theory & Systems II	2	Pre: COME 382
COME 481L	Communication Lab	1	Co: COME 481
COME 431	Microprocessor Interfacing & Applications	2	Pre: COME 232

COME 472	Microwave Engineering	3	Pre: COME 372
COME 474	Acoustics	2	Pre: POWE 271
COME 587	Telephony Systems	3	Pre: COME 481
COME 573L	Microwave Lab	1	Pre: COME 472
COME 586	Communication Networks	2	Pre: COME 481
COME 588	Wireless Communications	2	Pre: COME 481
COME 588L	Communication Circuits Lab	1	Pre: COME 587

* These courses are equivalent to COMP 222 & COMP 222L.

Description of Core Courses

COME 212 NETWORK ANALYSIS (2Crs.:2Lec,0Lab)
Transient analysis, Laplace transform & its application to circuit analysis, two-port networks, frequency selective passive & active circuits. Pre-req: POWE 210.

COME 212L ELECTRIC CIRCUITS LAB (1Cr.:0Lec,2Lab)
The content of this lab is directly related to the courses POWE 210, COME 212. Co-req.: COME 212.

COME 221 ELECTRONIC CIRCUITS I (3Crs.:3Lec,0Lab)
Introduction to semiconductor physics, junction diodes: construction, I-V characteristics, circuit models, applications, special purpose diodes: Zener diodes. Bipolar junction transistors (BJT) & field effect transistors (FET): types, physical structures, basic configurations, characteristic curves, circuit models, biasing circuits, small-signal amplifiers. Pre-req.: POWE 210.

COME 222 ELECTRONIC CIRCUITS II (3Crs.:3Lec,0Lab)
BJT & FET amplifiers: Types, circuit models, frequency response, differential & multistage amplifiers, large signal analysis & power amplifiers, operational amplifiers: Characteristics, applications, imperfections, feedback amplifiers, sinusoidal oscillators & multi-vibrators. Pre-req.: COME 221.

COME 222L ELECTRONIC CIRCUITS LAB (1Cr.:0Lec,2Lab)
The content of this lab is directly related to the courses COME 221, COME 222.Co-req: COME 222.

COME 232 LOGIC DESIGN (2Crs.:2Lec,0Lab)
Flip - flops, counters using T or JK flip - flops, state machines, synchronous & asynchronous sequential networks, programmable logic devices: PLA, PAL, CPLD, FPGA, applications in design & implementation of combinational & sequential circuits, sequential circuits for arithmetic operations. Memory elements, adders, & multipliers. . Introduction to shift registers. Pre-req: COMP 221. This course is equivalent to COMP 222.

COME 232L LOGIC CIRCUITS LAB (1Cr.:0Lec,2Lab)

The content of this lab is directly related to the courses COMP 221, COME 232. Co-req: COME 232. This course is equivalent to COMP 222L.

COME 332 MICROPROCESSOR FUNDAMENTALS (4Crs.:3Lec,2Lab)

Basic computer organization, data representation, processor organization, ALU's, bus & stack organization, design of a simple hardwired processor, instruction sets & instruction formats, machine & assembly language programming, assembler functions & design, micro - programmed CPU, comparison between RISC & CISC processors, introduction to memory organization. I/O operations. Introduction to VHDL. Pre-req.: COMP 221.

COME 361 MODERN PHYSICS (2Crs.:2Lec,0Lab)

Special theory of relativity, quantum effects: Particle aspect of electromagnetic radiation, wave aspect of material particles. Atomic physics: Hydrogen atom, quantum numbers, many electrons atoms.

COME 372 PROPAGATION & ANTENNAS I (4Crs.:4Lec,0Lab)

Review of Maxwell's equations. Plane wave. Material media. Polarization. Pointing vector. Reflection & transmission. Normal & oblique incidence. Propagation of electromagnetic waves in the atmosphere. High frequency transmission lines. Matching techniques. Smith chart. Rectangular & cylindrical waveguides. Cavity resonators. Antenna parameters. Radiation potentials. Linear antennas: Elementary dipole, short dipole, linear dipole. Antenna arrays. Loop antenna. Other Types of Antennas. Pre-req.: POWE 271.

COME 381 SIGNALS & SYSTEMS (3Crs.:3Lec,0Lab)

Classification of continuous & discrete - time signals & systems. Fourier transform. Linear & time - invariant (LTI) systems: Impulse response, step response, transfer function. Band - pass signals: Hilbert transform, pre - envelope, complex envelope. Convolution & correlation functions. Energy & power spectral densities. Transmission of continuous random signals through LTI systems. Introduction to sampling theorem & reconstruction of signals. Application of taped delay line filters.

COME 382 COMMUNICATION THEORY & SYSTEMS I (4Crs.:4Lec,0Lab)

Introduction to communication systems. Linear modulation techniques: AM, DSB, SSB, VSB. AM transmission & super heterodyne receivers. Exponential modulation techniques: FM, NBFM, PM. Analog pulse modulation. Noise effects on linear & exponential modulation techniques. Study of several analog systems which may include: AM & FM radio broadcasting, stereo FM, TV broadcasting, telephony system, frequency-division multiplexing (FDM). Pulse code modulation. Delta modulation. Baseband coding transmission. Optimum detection. Correlation techniques. Probability of error of baseband modulation. Baseband power spectral analysis. Pre-req.: COME 381.

COME 384 DIGITAL SIGNAL PROCESSING (3Crs.:2Lec,2Lab)
Discrete - time signals & systems, LSI & causal systems, Z-Transform. Difference equations, IIR & FIR systems. Discrete time & frequency representation of systems. Discrete Fourier Transform (DFT). Digital filters design techniques, Chebychev & Butterworth. Computation of DFT & FFT. Pre-req: COME 381.

COME 431 MICROPROCESSOR INTERFACING & APPLICATIONS (2Crs.:1Lec,2Lab)
Microprocessor chips & LSI technology. Architecture & instruction set of a 16 bit microprocessor. Supporting chips: Buffers, decoders, system clock generator. Interfacing 16 bit microprocessor to memory & I/O devices. Interfacing techniques: Serial, parallel, timers. Direct memory access & DMA controllers. System development & design tools (hardware & software).Pre-req: COME 232.

COME 471 PROPAGATION & ANTENNAS II (2Crs.:2Lec,0Lab)
Microstrip lines. Special Antennas: Traveling wave antenna. Helical antenna. Yagi antenna. Aperture principles. Microwave antennas: Horn, parabolic, lens & microstrip. Antenna applications in remote sensing. Radar systems. Line of sight radio links. Satellite systems Pre-req.: COME 372.

COME 471L PROPAGATION & ANTENNAS LAB (1Cr.:0Lec,2Lab)
The contents of this lab are directly related to the courses COME 372, COME 471.Co-req.: COME 471.

COME 472 MICROWAVE ENGINEERING (3Crs.:3Lec,0Lab)
Scattering parameters. Microwave instrumentations: Reflection coefficient, transmission coefficient, S-parameters, powers, dielectric constant, & frequency. Microwave passive components using waveguide technology: T-junction, attenuators, isolators, circulators, couplers. Microstrip components: Power dividers, hybrid couplers. Microwave semiconductor devices: Microwaves Filters. Pre-req: COME 372.

COME 474 ACOUSTICS (2Crs.:2Lec,0Lab)
Acoustic waves. Reflection. Transmission & absorption, levels & loudness. Microphones & loudspeakers. Pre-req.: POWE 271.

COME 481 COMMUNICATION THEORY & SYSTEMS II (2Crs.:2Lec,0Lab)
Introduction to information theory. Passband power spectral analysis. Time-division multiplexing (TDM). Digital carrier modulation: ASK, PSK, DPSK, FSK, MSK, GMSK, QPSK, M - ary transmission. Bandwidth efficiency. Coherent & non-coherent detection. Noise effects on digital modulation techniques. Matched filters. Probability of error in carrier modulation. Study of several digital systems which may include: TDM system hierarchies & digital FAX. Pre-req.: COME 382.

COME 481L COMMUNICATIONS LAB (1Cr.:0Lec,2Lab)
The contents of this lab are directly related to the courses COME 382, COME 481.Co-req.: COME 481.

COME 573L MICROWAVE LAB (1Cr.:0Lec,2Lab)
The content of this lab is directly related to the course COME 472.Pre-req.: COME 472.

COME 587 TELEPHONY SYSTEMS (3Crs.:3Lec,0Lab)
Wire-line Telephony: Analog telephone components. Central office connection (local loop). Telephone switches: Space, time, & hybrid switches. Types of communication mediums. Multiplexing. Digital Transport Systems. Digital Access Technologies. Traffic Engineering. Introduction to cellular communications. Pre-req.: COME 481.

COME 586 COMMUNICATION NETWORKS (2Crs.:2Lec,0Lab)
Communication networks models, basic concepts. Signal transmission: Channel capacity, signal encoding technique, wired & wireless transmission, multiplexing techniques, packet switching. Data link control. Local Area Networks (LANs): Logical link control, medium access control. Fast & Gigabit Ethernet, Internetworking Devices, Unicast Routing Protocols, Wireless LANs. Pre-req.: COME 481.

COME 588 WIRELESS COMMUNICATIONS (2Crs.:2Lec,0Lab)
RF spectrum, Spread Spectrum Transmission, Wireless Multiplexing & Multiple Access techniques, OFDM, OFDMA, Ultra Wideband Radio, Near Field Communications, Infrared Communication Basics, implementation of Wireless networks (WLAN, WPAN, WMAN), error correcting codes. Pre-req.: COME 481.

COME 588L COMMUNICATION CIRCUITS LAB (1Cr.:0Lec,2Lab)
The content of this lab is directly related to the course COME 587.Pre-req.: COME 587.

C.Communication & Electronics Engineering Program Technical Elective
The CEE curriculum includes 6-credit-hour courses as technical electives. The courses are chosen from the courses listed in the table below, with their descriptions given thereafter.

Course	Title	Credits	Prerequisite
COME 421	Digital Integrated Circuits	2	COME 221
COME 461	Solid State Electronics	2	COME 361
COME 522	Radio Frequency Communication Circuits	2	COME 222, COME 471
COME 531	Embedded Systems	2	COME 431
COME 533	VLSI Design	2	COME 232
COME 562	Semiconductor Devices	2	COME 361
COME 585	Information Theory & Coding	2	COME 481

COME 572	Optical Communications	2	POWE 271
COME 574	Milimeter wave integrated circuits (MMIC) Design	2	COME 472
COME 582	Cellular Communications	2	COME 481

Description of Technical Elective Courses

COME 421 DIGITAL INTEGRATED CIRCUITS (2Crs.:2Lec,0Lab)
Overview of switching characteristics of bipolar & field effect transistors. BJT digital ICs: TTL, Schottky TTL, ECL, IIL. MOS digital ICs: NMOS, CMOS. A/D & D/A converters. Pre-req.: COME 221.

COME 461 SOLID STATE ELECTRONICS (2Crs.:2Lec,0Lab)
Principles of quantum mechanics: state functions & operators, Schrödinger wave equation, application to one dimensional problems, Bloch theorem, band theory, semiconductor characteristics, dielectrics, magnetism. Pre-req.: COME 361.

COME 522 RADIO FREQUENCY COMMUNICATION CIRCUITS (2Crs.:2Lec,0Lab)
Radio frequency (RF) passive integrated circuit components: resistors, capacitors, inductors. Noise in electronic circuits. Low noise amplifier (LNA) design. RF mixers. RF power amplifiers. RF phase locked loops. RF oscillators & synthesizers. Use of computer aided design tools for RF design & simulation. Pre-req.: COME 222 & COME 471.

COME 531 EMBEDDED SYSTEMS (2Crs.:2Lec,0Lab)
Overview of embedded systems: architecture, custom single purpose processors. Peripherals: Digital I/O, timers, counters, watchdog timers, interrupts, real time clocks, Serial protocols, interfacing, programming, interrupt driven routines, Applications. Pre-req.: COME 431.

COME 533 VLSI DESIGN (2Crs.:2Lec,0Lab)
MOS & BiCMOS technology. MOS & BiCMOS circuit design processes: MOS layers, Stick diagrams, design rules & layout. Basic VLSI circuit concepts: layer sheet resistance, layer area capacitance, delay unit, propagation delays, wiring capacitances. Structured design of combinational & sequential logic circuits. VLSI testability. Use of computer aided design tools for VLSI design & simulation. Pre-req.: COME 232.

COME 562 SEMICONDUCTOR DEVICES (2Crs.:2Lec,0Lab)
Carrier transport phenomena in semiconductors. Operation principles & device modeling of p-n junctions, metal-semiconductor contacts, bipolar & MOS transistors, & related devices. Silicon device fabrication technology: crystal growth, oxidation, diffusion, lithography, contacts & interconnections. Pre-req.: COME 361.

COME 572 OPTICAL COMMUNICATIONS (2Crs.:2Lec,0Lab)
Review of basic communication systems. Introduction to optical communication systems. Fiber characteristics. Impact of different types of dispersion on bit rates. Optical transmitters & receivers. Lasers. Optical amplifiers. Long haul & multi-channel systems. Pre-req.: POWE 271.

COME 574 MILLIMETER WAVE INTEGRATED CIRCUIT (MMIC) DESIGN (2Crs.:2Lec,0Lab)
The implementation of millimeter-wave (30GHz-300GHz) wireless systems in silicon-based technologies is an exciting research area that is about a decade old. The design of MMICs requires an interdisciplinary skill set that spans circuit design, electromagnetics & device physics. Through lectures, home-works & a class projects, this course will cover the principles of silicon-based MMIC design. Pre-req.: COME 472.

COME 582 CELLULAR COMMUNICATIONS (2Crs.:2Lec,0Lab)
Components of cellular network. Frequency reuse. Handoff. Cellular traffic engineering. CDMA, GSM, WiMAX, & LTE. Moving towards third generation services. Pre-req.: COME 481.

COME 585 INFORMATION THEORY & CODING (2Crs.:2Lec,0Lab)
Information & Entropy. Source coding: e.g. Huffman coding. Mutual Information. Channel Capacity. Channel coding theorem. Channel capacity theorem. Error control coding techniques: linear block codes, cyclic codes, convolutional codes. Viterbi decoder. Pre-req.: COME 481.

D.Free Engineering Elective
The CEE program includes 6-credit hour courses taken as Free Engineering Electives. The courses may be chosen by the student in consultation with his/her advisor from any engineering major.

E.Final Year Project
After completing 114 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in a semester & ending in the following semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, & give a presentation on a significant, relevant, & comprehensive engineering problem. The FYP is intended to stimulate student creativity & critical thinking, & build skills in formulating, designing, developing, building, communicating, & managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.
Refer to the Final Year Project Policy for more details.

F.Internship (Approved Experience/ Independent Study)
This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.
Refer to the department policy for further details.

Study Plan

Bachelor of Engineering in Communications & Electronics Engineering (150 Credits)

First Semester (17 Credits)			Crs.	Pre-co/requisites
COMP	208	Programming I	3	
MATH	282	Calculus	3	MATH111
CVLE	210	Statics	3	
PHYS	281	Electricity & Magnetism	3	PHYS120
MCHE	201	Engineering Drawing & Graphics	3	
ARAB	001	Arabic Language	2	

Second Semester (18 Credits)			Crs.	Pre-co/requisites
COMP	210	Programming II	3	Pre: COMP 208
MATH	281	Linear Algebra	3	MATH112
PHYS	282	Material Properties & Heat	3	
MCHE	213	Dynamics	3	
POWE	210	Fundamentals of Electric Circuits	3	Pre: PHYS 281
ENGL	001	English Language	2	
BLAW	001	Human Rights	1	

Third Semester (18 Credits)			Crs.	Pre-co/requisites
COMP	211	Introductory Web Programming	3	Pre: COMP 208
COME	221	Electronic Circuits I	3	Pre: POWE 210
MATH	283	Differential Equations	3	Pre: MATH 281, MATH 282
COMP	221	Digital Systems I	2	
ENGL	211	Advanced Writing	2	ENGL 001
POWE	271	Electromagnetic Fundamentals	3	Pre: PHYS281
		Elective(General)	2	

Fourth Semester (16 Credits)			Crs.	Pre-co/requisites
COME	212	Network Analysis	2	Pre: POWE 210
COME	212L	Electric Circuits Lab	1	Co: COME 212
MATH	284	Numerical Analysis	3	Pre: MATH 283
COME	222	Electronic Circuits II	3	Pre: COME 221
COME	222L	Electronic Circuits Lab	1	Co: COME 222
COME	232*	Logic Design	2	Pre: COMP 221
COME	232L*	Logic Circuits Lab	1	Co: COME 232
POWE	214	Electric & Electronic Measurements	3	Pre: POWE 210

* These courses are equivalent to COMP 222 & COMP 222L.

Fifth Semester (18 Credits)			Crs.	Pre-co/requisites
COME	381	Signals & Systems	3	
COME	361	Modern Physics	2	
MATH	381	Probability & Statistics	3	Pre: MATH 282
CHEM	241	Principles of Chemistry	3	
ENGL	300	Speech Communications	2	Pre: ENGL211
		Elective (General)	5	

Sixth Semester (18 Credits)			Crs.	Pre-co/requisites
COME	372	Propagation & Antennas I	4	Pre: POWE 271
COME	382	Communication Theory & Systems I	4	Pre: COME 381
COME	384	Digital Signal Processing	3	Pre: COME 381
COME	332	Microprocessor Fundamentals	4	Pre: COMP 221
MGMT	002	Entrepreneurship	2	
		Elective (General)	1	

Seventh Semester (12 Credits)			Crs.	Pre-co/requisites
COME	471	Propagation & Antennas II	2	Pre: COME 372
COME	471L	Propagation & Antennas Lab	1	Co: COME 471
COME	481	Communication Theory & Systems II	2	Pre: COME 382
COME	481L	Communication Lab	1	Co: COME 481
COME	431	Microprocessor Interfacing & Applications	2	Pre: COME 232
		Technical Elective	2	
		Free Engineering Elective	2	

Eighth Semester (13 Credits)			Crs.	Pre-co/requisites
COME	472	Microwave Engineering	3	Pre: COME 372
COME	474	Acoustics	2	Pre: POWE 271
INME	221	Engineering Economy	3	
		Free Engineering Elective	2	
		Free Engineering Elective	2	
ENGR	001	Engineering Ethics	1	

Ninth Semester (10 Credits)			Crs.	Pre-co/requisites
COME	587	Telephony Systems	3	Pre: COME 481
COME	499	Internship (Approved Experience / Independent Study)	1	
COME	573L	Microwave Lab	1	Pre: COME 472
COME	501	Final Year Project I	1	
CHEM	405	Solid State Chemistry	2	Pre: CHEM 241
		Technical Elective	2	

Tenth Semester (10 Credits)			Crs.	Pre-co/requisites
COME	502	Final Year Project II	3	Pre: COME 501
COME	586	Communication Networks	2	Pre: COME 481
COME	588	Wireless Communications	2	Pre: COME 481
COME	588L	Communication Circuits Lab	1	Pre: COME 587
		Technical Elective	2	

Courses offered for other majors

The CEE program offers six courses for other engineering majors. Some of these courses have pre-requisites. These courses are described below:

COME 212 NETWORK ANALYSIS (2Crs.:2Lec,0Lab)
Transient analysis, Laplace transform & its application to circuit analysis, two-port networks, frequency selective passive & active circuits. Pre-req.: POWE 210.

COME 221 ELECTRONIC CIRCUITS (3Crs.:3Lec,0Lab)
Introduction to semiconductor physics, junction diodes: construction, I-V characteristics, circuit models, applications, special purpose diodes: Zener diodes. Bipolar junction transistors (BJT) & field effect transistors (FET): types, physical structures, basic configurations, characteristic curves, circuit models, biasing circuits, small-signal amplifiers. Pre-req.: POWE 210.

COME 332 MICROPROCESSOR FUNDAMENTALS (4Crs.:3Lec,2Lab)
Basic computer organization, data representation, processor organization, ALU's, bus & stack organization, design of a simple hardwired processor, instruction sets & instruction formats, machine & assembly language programming, assembler functions & design, micro - programmed CPU, comparison between RISC & CISC processors, introduction to memory organization. I/O operations. Pre-req.:COMP 221. This course is equivalent to COMP 324.

COME 361 MODERN PHYSICS (2Crs.:2Lec,0Lab)
Special theory of relativity, quantum effects: Particle aspect of electromagnetic radiation, wave aspect of material particles. Atomic physics: Hydrogen atom, quantum numbers, many electrons atoms.

COME 381 SIGNALS & SYSTEMS (3Crs.:3Lec,0Lab)
Classification of continuous & discrete - time signals & systems. Fourier transform. Linear & time - invariant (LTI) systems: Impulse response, step response, transfer function. Band - pass signals: Hilbert transform, pre - envelope, complex envelope. Convolution & correlation functions. Energy & power spectral densities. Transmission of continuous random signals through LTI systems. Introduction to sampling theorem & reconstruction of signals. Application of taped delay line filters.

COME 388 COMMUNICATION ENGINEERING (3Crs.:2Lec,2Lab)
Introduction to analog & digital communication systems, fundamentals of analog modulation techniques: Fourier transform, AM, FM, pulse modulation techniques, & different detection techniques. Pre-req.: COME 222.

Elective University Requirement Course

The CEE program offers one course as General (University) Elective. The course is described below.

COME 001 CONTROL OF ACOUSTICAL NOISE POLLUTION (2Crs.:2Lec)
Sources of acoustical noise, acceptable levels of noise, different methods for noise control in buildings & factories.

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Computer Engineering Program

Mission

The mission of Computer Engineering (CE) Program is to prepare students for rewarding careers & higher education, engage in scientific research pushing the frontiers of the field even further, & get involved in local community issues requiring specialist participation.

Objectives

The educational objectives of the program are determined to support career advancement of the graduates as they pursue their career goals. The graduates will:

1. Possess the highest level of technical robustness in the field of Computer Engineering that will earn them recognition & esteem among their colleagues.
2. Have the knowledge & skills to invent novel technology, provide creative designs, & suggest innovative solutions to challenging problems.
3. Stay abreast of emerging technologies, continually learning new theory & skills to nourish ever-developing careers.
4. Demonstrate good citizenship, fulfilling their professional responsibilities towards their communities, Lebanon, & the world at large.
5. Excel on multi-disciplinary & multi-cultural teams, & effectively employ their oral & written communication skills to resolve problems.

Learning Outcomes

Upon completion of the program graduates shall have:

a. An ability to apply knowledge of mathematics, science, & engineering
b. An ability to design & conduct experiments, as well as to analyze & interpret data
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, & sustainability
d. An ability to function on multi-disciplinary teams
e. An ability to identify, formulate, & solve engineering problems
f. An understanding of professional & ethical responsibility
g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, & societal context
i. A recognition of the need for, & an ability to engage in life-long learning
j. A knowledge of contemporary issues
k. An ability to use the techniques, skills, & modern engineering tools necessary for engineering practice

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Computer Engineering consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 6 semesters.

Career Opportunities

The computer engineering career encompasses opportunities in a wide range of environments such as industrial, military, communications, aerospace, business, scientific, & medical. Specific jobs include the functions of designing, installing, modifying, maintaining, repairing, & overhauling computer systems, digital control subsystems, logic circuits, & microprocessor-based interfaces. Furthermore, the graduates are able to analyze, design, test, & evaluate network systems, including local area networks (LAN), wide area networks (WAN), Internet, intranet, sensor networks, & other data communications systems. Additionally, they can develop, create, & modify general security schemes, including cryptography, intrusion detection & prevention, counter attacks for phishing, snooping, sniffing, & viruses, as well as computer applications software or specialized utility programs at large. Also, they are capable of doing research, design, development, & testing of operating systems-level software, compilers, & network distribution. Moreover, they have the competencies to design, develop, administer large-scale database systems & set standards for operations, programming, & security. Finally, they can supervise the manufacturing & installation of computer or computer-related equipment & components.

Program Overview

The Student's Study Plan is given to every CE student upon his/her enrollment. The CE curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences & Mathematics	26
General Engineering topics	15
II. CE Program-Specific Requirements	**Credits**
A. Engineering topics (maybe taken from outside the program)	6
B. Computer Engineering Core	60
C. Technical Electives	12
D. Free Engineering Electives	6
E. Final Year Project	4
F. Practical Training/Independent Study	1
***: The 60 CE Core**	**Credits**
Common with Electrical Engineering	18
Common with Computer Science	21
Computer Engineering	21

I.Common Requirements

The list of the Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II.CE Program-Specific Requirements

A.Engineering topics from outside the major

This part of the CE curriculum includes 6 credits offered by other engineering programs. These courses are listed in the following table:

Course	Title	Credits	Prerequisite
POWE 210	Fundamentals of Electric Circuits	3	Pre: PHYS 281
COME 221	Electronic Circuits I	3	Pre: POWE 210
		6	

B.Computer Engineering Program Core

Course	Title	Credits	Prerequisite
COMP 210*	Programming II	3	Pre: COMP 208
COMP 211*	Introductory Web Programming	3	Pre: COMP 208
COMP 221*	Digital Systems I	2	
COMP 222*	Digital Systems II	2	Pre: COMP 221
COMP 222L*	Digital Systems II LAB	1	Pre: COMP 221
COMP 231	Discrete Structures	3	Pre: MATH 282
COMP 232**	Data Structures	3	Pre: COMP 210
COMP 311**	Object Oriented Programming	3	Pre: COMP 210
COMP 324*	CPU Design	4	Pre: COMP 222
COMP 333**	Computer Algorithms	3	Pre: COMP 231
COMP 344**	Data Base Systems	3	Pre: COMP 232
COMP 361*	Control Systems for Computer Engineers	3	Pre: MATH 283
COMP 423	Computer Architecture	3	Pre: COMP 324
COMP 431	Queuing & Modeling	3	Pre: MATH 381
COMP 442**	Software Engineering	3	Pre: COMP 210
COMP 443**	Operating Systems	3	Pre: COMP 210
COMP 448**	Compilers	3	Pre: COMP 311
COMP 453*	Transmission & Processing of Digital Signals	3	Pre: COMP 231
COMP 458	Computer Networks	3	Pre: COMP 333

COMP 521	Microprocessor-based Systems	3	Pre: COMP 324
COMP 531	Cryptography & Information Security	3	Pre: COMP 333
		60	

*:The following table lists the credits that are equivalent and/or common with the CE & EE programs.

Course	Title	Credits	Prerequisite
COMP 210	Programming II	3	
COMP 211	Introductory Web Programming	3	CMPS 246
COMP 221	Digital Systems I	2	
COMP 222	Digital Systems II	2	COME 232
COMP 222L	Digital Systems II LAB	1	COME 232L
COMP 324	CPU Design	4	COME 332
COMP 361	Control Systems for Computer Engineers	3	POWE 341
		18	

**: The following table lists the credits that are equivalent to courses offered by the Computer Science program.

Course	Title	Credits	Prerequisite
COMP 232	Data Structures	3	CMPS 347
COMP 311	Object Oriented Programming	3	CMPS 242
COMP 333	Computer Algorithms	3	CMPS 441
COMP 344	Data Base Systems	3	CMPS 342
COMP 442	Software Engineering	3	CMPS 344
COMP 443	Operating Systems	3	CMPS 442
COMP 448	Compilers	3	CMPS 348
		21	

The following table lists the credits that are offered for the CE program only.

Course	Title	Credits	Prerequisite
COMP 231	Discrete Structures	3	Pre: MATH 282
COMP 423	Computer Architecture	3	Pre: COMP 324
COMP 431	Queuing & Modeling	3	Pre: MATH 381
COMP 453	Transmission & Processing of Digital Signals	3	Pre: COMP 231
COMP 458	Computer Networks	3	Pre: COMP 453

COMP 521	Microprocessor-based Systems	3	Pre: COMP 324
COMP 531	Cryptography & Information Security	3	Pre: COMP 333
		21	

Description of Core Courses

COMP 210 PROGRAMMING II (3Crs.:2Lec, 2Lab)
Pointers. Recursion. Character strings. Structures, union, & bit manipulation. File operations, sequential & random. Preprocessing directives. Functions (call by reference). Pre-req.: COMP 208.

COMP 211 INTRODUCTORY WEB PROGRAMMING (3Crs.:2Lec, 2Lab)
Introduction to HTML, CSS & JavaScript. Packages for web-page design. Pre-req.: COMP 208.

COMP 221 DIGITAL SYSTEMS I (2Crs.:2Lec,0Lab)
Number systems & coding, Binary systems. Conversion from decimal to other bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions & circuits designs (HA, FA, & ALU). Combinational functions & circuits design (decoder, encoder, multiplexer & de-multiplexer). Sequential circuits definitions & designs (Latches, RS-FF, D-FF, JK-FF, T-FF). Simple buffer registers & Counters.

COMP 222 DIGITAL SYSTEMS II (2Crs.:2Lec,0Lab)
Latches & flip-flops. Synchronous & Asynchronous sequential systems. Registers & Counters. Control & Data path units. Serial data transfer for multiple register. Types of RAM & ROM. Cache concept. ALU functions & circuits (addition, subtraction, increment, decrement, transfer, AND, OR, XOR, NOT, etc.). Binary multiplier. BCD functions & circuits. Flags. Control unit. None binary logic. Logical fault tolerant. Pre-req.: COMP 221.

COMP 222L DIGITAL SYSTEMS II LAB (1Cr.:0Lec,2Lab)
The content of this lab is directly related to the courses COMP 221. Pre-req.: COMP 221.

COMP 231 DISCRETE STRUCTURES (3Crs.:3Lec,0Lab)
Logic & predicates. Mathematical induction. Sets & Power sets. Functions & Relations. Partial & total orders. Sequences. Counting. Multinomial theorems. Inclusion/exclusion principle. Recurrence relations & generating functions. Hardness of problems. Tress & Graphs. Groups, Rings & Fields. Lattices. Pre-req.: MATH 282.

COMP 232 DATA STRUCTURES (3Crs.:2Lec,3Lab)
Complexity measures & big O. Elementary data types. Arrays. Linked lists. Queues. Stacks. Trees: traversal, Binary search trees. Binary heaps, Balanced trees: AVL trees, B trees. Binomial queues. Fibonacci queue. Hashing. File Structure Pre-req.: COMP 210.

COMP 311 OBJECT ORIENTED PROGRAMMING (3Crs.: 2Lec,2Lab)

Object–oriented design versus structured design. Classes & objects. Inheritance. Polymorphism. Information hiding & abstract data types. Overloading. Generic functions & classes. Exception handling. Pre-req.: COMP 210.

COMP 324 CPU DESIGN (4Crs.:3Lec,2Lab)

This course introduces the design of a generic central processing unit (CPU), focusing on its role as the core of computer systems. Topics include arithmetic logic unit design, control unit design, registers, address, data, & control buses, with reference to standard implementations. Single & multi-core processors. Machine & assembly languages of a standard microprocessor are used to illustrate the design & its interface with upper layers such as operating systems, control drivers, & compilers. Pre-req.: COMP 222.

COMP 333 COMPUTER ALGORITHMS (3Crs.: 2Lec,3Lab)

The P=NP question. Time complexity of algorithms. The classes PNP. Solving recurrences. Divide and-conquer. Greedy algorithms. Dynamic programming. Graph algorithms. Geometric algorithms. Algorithms on matrices & polynomials. Number theoretic algorithms. Reductions between problems. Theory of NP completeness. Examples of NP complete problems. Some approximation algorithms. Pre-req.: COMP 231.

COMP 344 DATABASE SYSTEMS (3Crs.: 2Lec, 3Lab)

Components of database systems: DBMS functions. Database architecture & data integrity. Data modeling: conceptual models, relational data model, conceptual schema, relational schema, relational algebra & relational calculus. Database query languages: SQL functional dependency, decomposition, normal forms. Higher normal forms. Transaction processing: Transactions; Failure & recovery systems; Physical database design: Storage & file structure; Indexed files; Hashed files; Signature files; B-trees. Query processing. Query optimization. Pre-req.: COMP 232.

COMP 361 CONTROL SYSTEMS FOR COMPUTER ENGINEERS (3Crs.:2Lec, 2Lab)

Types of control systems. Advantages & limitations of using digital processors in control systems. System representation: transfer function, block diagram, signal-flow-graph. Time domain analysis: steady state & transient analysis. Frequency domain analysis. Writing programs for solving problems in control systems. Pre-req.: MATH 283.

COMP 423 COMPUTER ARCHITECTURE (3Crs.:2Lec,2Lab)

Organization vs Architecture. Fundamentals of computer design, Von-Neuman machine. Computer evolution & performance. Computer function & interconnection. Memory systems (Internal, external & cache). Input/Output modules. Instruction Sets: Characteristics, functions, addressing modes & formats. RISC & CISC. Assembly & machine languages. Processor implementation techniques. Pipelining. Performance enhancements. Pre-req.: COMP 324.

COMP 431 QUEUING & MODELING (3Crs.:2Lec,2Lab)
Random variables, Performance measures. Markov processes. Birth/death processes. Solving Markov models. Continuous & discrete queuing models: M/M/1, M/M/m, M/M/m/m, M/M/1/K, M/G/1. Little's law. Networks of queues. Burke's theorem. Jackson's theorem. Stochastic Petri nets. GSPN. Pre-req.: MATH 381.

COMP 442 SOFTWARE ENGINEERING (3Crs.:2Lec,3Lab)
Concepts of software development. Life-cycle of software. Requirements & specification. Data model. Process model. Design & coding. Verification, validation & testing. Software evolution. Pre-req.: COMP 210.

COMP 443 OPERATING SYSTEMS (3Crs.:2Lec,3Lab)
Overview, functionalities & characteristics of OS, CPU states, I/O channels, memory hierarchy, process, operations on processes, UNIX process control & management, PCB, signals, forks & pipes, Interrupt processing, operating system organization, OS kernel, Job & processor scheduling, scheduling algorithms, critical sections, mutual exclusion, synchronization, deadlock, Semaphores, Interprocess Communication (IPC), Message Passing, Deadlock: prevention, detection, avoidance, banker's algorithm, Memory organization & management, storage allocation, Virtual memory concepts, paging & segmentation, address mapping, File organization. Pre-req.: COMP 210.

COMP 448 COMPILERS (3Crs.:2Lec,3Lab)
Introduction to language translation. Language translation phases. Generators. Lexical analysis: Regular expressions; NFA; DFA. Syntactic analysis: Formal definition of grammars; BNF & EBNF; bottom-up vs. top-down parsing; Tabular vs. recursive-descent parsers; Error handling; Models of execution control. Declaration, modularity, & storage management: Code generation. Introduction to Optimization. Pre-req.: COMP 311.

COMP 453 TRANSMISSION & PROCESSING OF DIGITAL SIGNALS (3Crs.:2Lec,2Lab)
Sampling & discrete time signals. The z-transform. Quantization. Histograms. Recursive & non- recursive digital filters. Frequency response & the Discrete Fourier Transform. Processing in 2 dimensions. Finite precision implementation errors. Encoding digital signals. Modulation. Multiplexing. The physical layer of the OSI model. Synchronous & asynchronous transmission. The RS232 interface. Modems. Error detection with checksums. Cyclic redundancy checks. Pre-req.: COMP 231.

COMP 458 COMPUTER NETWORKS (3Crs.:2Lec,2Lab)
The OSI Model. Data link layer. Frame format: character stuffing, bit stuffing. Error control. Automatic-repeat request & sliding-window protocols. Data-link protocols: HDLC, BSC, PPP. The MAC sublayer. Local area networks: Ethernet, token ring & FDDI, wireless LANs. Circuit switching versus packet switching. Routing algorithms. Pre-req.: COMP 333.

COMP 521 MICROPROCESSOR-BASED SYSTEMS (3Crs.:2Lec,2Lab)

Interfacing microprocessors to memory & I/O devices. Supporting chips: buffers, decoders, system clock generator. Interfacing techniques: serial, parallel, timer, Interrupts & interrupt controller. DMA. I/O ports. Memory shadows & expending. Hardware software co-design. Computer applications. Pre-req.: COMP 324.

COMP 531 CRYPTOGRAPHY & INFORMATION SECURITY (3Crs.:2Lec,2Lab)

Measures of information. Elementary ciphers. Complexity measures. Designing a generic block cipher. Modes of operation. Attacks against block ciphers. Message digests. Cryptographic hash functions. Public key. cryptography. Diffie-Hellman key exchange. RSA. Digital signature schemes. Forging digital signatures. Pseudo-random bit generators. Authentication techniques. Applications. Pre-req.: COMP 333.

C.Computer Engineering Program Technical Electives

The CE curriculum includes 12 credits as technical electives. The courses are chosen from the courses listed in the following table:

Course	Title	Credits	Prerequisite
COMP 410	e-government	3	Pre: COMP 211
COMP 438	Performance Evaluation	3	Pre: MATH 283
COMP 444	System Programming	3	Pre: COMP 324
COMP 462	Artificial Intelligence	3	Pre: COMP 231
COMP 464	Operations Research for Computer Engineering	3	Pre: COMP 231
COMP 477	Emerging Trends in Computer Engineering	3	Pre: COMP 222
COMP 510	Internet Engineering	3	Pre: COMP 458
COMP 511	Cloud Computing	3	Pre: COMP 458
COMP 512	Web Programming	3	Pre: COMP 211
COMP 532	Information Theory & Coding	3	Pre: COMP 333, MATH 381
COMP 533	Computer Graphics	3	Pre: COMP 210
COMP 534	Pattern Recognition	3	Pre: COMP 231
COMP 535	Digital Image Processing	3	Pre: COMP 333
COMP 541	Software Development	3	Pre: COMP 311
COMP 455	Mobile Computing	3	Pre: COMP 210
COMP 556	Sensor Networks	3	Pre: COMP 458
COMP 561	Digital Control	3	Pre: COMP 361

POWE 214	Electric & Electronic Measurements	3	Pre: POWE 210
MCHE 461	Applied Robotics	3	Pre: MCHE 213 & (MCHE 302 or COME 431 or COMP 324

Description of Technical Elective Courses

COMP 410 e-GOVERNMENT (3Crs.: 2Lec, 2Lab)

This course introduces the technology of e-government with an in-depth analysis of successful & influential implementations in the region & globally. Several topics are covered in the course: technical & business challenges for deploying e-government solutions, e-government Web architectures & their requirements, hosting e-government service models, developing effective e-government administrators, & managing the security & privacy risks of implementing e-government services in the cloud. Pre-req.: COMP 211.

COMP 438 PERFORMANCE EVALUATION (3Crs.:3Lec,0Lab)

Work load performance indices. Single & multiple job processing models. Scheduling policies. Paging techniques. Network protocols. Routing policies. Pre-req.: MATH 283.

COMP 444 SYSTEM PROGRAMMING (3Crs.: 2Lec, 2Lab)

Programming in assembly language, macro assembler, loaders, linkers, languages for system programming. COMP324.

COMP 455 MOBILE COMPUTING (3Crs.: 2Lec, 2Lab)

This course covers the fundamental concepts in mobile computing with a focus on implementing mobile phone programming components such as graphical user interfaces, data storage & management modules using lightweight databases, & mobile network services. Students will also learn how to consume cloud services in their mobile applications. The course will focus on one of the prominent mobile development platforms, typically the iOS or Android platforms. Pre-req.: COMP 210.

COMP 462 ARTIFICIAL INTELLIGENCE (3Crs.:2Lec,2Lab)

Fundamental issues. Rule-based systems, logic programming, Search & constraint satisfaction. Knowledge representation & reasoning. Search: algorithms. Knowledge representation & reasoning: temporal & spatial reasoning, uncertainty, knowledge representation for diagnosis. Machine learning & neural networks. Pre-req.: COMP 231.

COMP 464 OPERATIONS RESEARCH FOR COMPUTER ENGINEERS (3Crs.:3Lec,0Tut)

Linear programming: Graphical solution; Simplex method; Duality & sensitivity analysis; Polynomial-time solutions. Decision making & game theory. Network flows. Optimization techniques. Non-linear programming. Transportation. Project management PERT/CPM. Pre-req.: COMP 231.

COMP 477 EMERGING TRENDS IN COMPUTER ENGINEERING (3Crs.: 2Lec, 2Lab)
This course covers current technology in computer Engineering. Topics will vary every year. Pre-req.: COMP324.

COMP 510 INTERNET ENGINEERING (3Crs.: 2Lec, 2Lab)
This course provides a comprehensive coverage of the major advancements in the Internet architecture with a focus on routing protocols & their design & a deep analysis of the internals of the Transmission Control Protocol (TCP) & the Internet Protocol (IP). The course also discusses recent developments on the Internet such as software-defined networking. Pre-req.: COMP 458.

COMP 511 CLOUD COMPUTING (3Crs.: 2Lec, 2Lab)
This course provides an extensive coverage of the fundamental concepts & implementation models in cloud computing with a focus on emerging networking & security aspects. The course content is divided into a set of modules, each of which is supported by practical hands-on lab assignments on real & simulated cloud platforms. The main topics covered are: fundamental cloud computing terminology & concepts, virtualization & virtual machines, the elastic & pay-as-you-go utility model of the cloud, security risks, challenges, & solutions in cloud architectures & services, the Software as a Service (SaaS), Platform as a Service (PaaS) & Infrastructure as a Service (IaaS) Cloud Models, public Cloud, private Cloud, & Hybrid Cloud implementation models. Pre-req.: COMP 458.

COMP 512 WEB PROGRAMMING (3Crs.:2Lec,2Lab)
Server-side programming : Web Servers, Web-Server Scripting language (PHP/ASP/ JSP), Web-Site development using CMS. Pre-req.: COMP 211.

COMP 532 INFORMATION THEORY & CODING (3Crs.:3Lec,0Lab)
Zero-memory & Markov information sources. Entropy. Block codes. Minimum-redundancy codes. Bounds on the average length of the code. Information channels. Channel capacity. Error detection. Shannon's fundamental theorem. Hamming distance. Decoding schemes. Error correcting codes: parity check codes, cyclic codes. Pre-req.: COMP 333 & MATH 381.

COMP 533 COMPUTER GRAPHICS (3Crs.:2Lec,2Lab)
Open GL, Computer graphique algorithmes, Global illumination. Ray tracing. The graphics pipeline. Transformations. Texture mapping. Shadows. Sampling. Hidden line & surface removal, clipping Splines. Coloring. Animation. Pre-req.: COMP 210.

COMP 534 PATTERN RECOGNITION (3Crs.:3Lec,0Tut)
Reconstruction from projections. Scene understanding. Matching & recognition. Methods for reconstructing three-dimensional scene information using techniques such as depth from stereo, structure from motion, & shape from shading. Motion & video analysis. Three-dimensional object recognition. Pre-req.: COMP 231.

COMP 535 DIGITAL IMAGE PROCESSING (3Crs.:3Lec,0Lab)
Image formation & perception. Image representation. Transformations on digital images. Enhancement & restoration. Segmentation. Encoding & data compression. Pre-req.: COMP 333.

COMP 541 SOFTWARE DEVELOPMENT (3Crs.:1Lec,4Lab)
Covers current technology in computer software. Topics will vary every year. Pre-req.: COMP311.

COMP 556 SENSOR NETWORKS (3Crs.:2Lec,2Lab)
Wireless communication fundamentals, Short range radio communication standards (IEEE802.15.x protocols, e.g., Bluetooth, ZigBee), Architecture of wireless sensor networks (Node structure, types, network topologies), Operating systems for wireless sensor networks (TinyOS, Contiki), Network supported process measurements, MAC protocols for sensor networks, Routing protocols for sensor networks, Transport protocols for sensor networks. Pre-req.: COMP 458.

COMP 561 DIGITAL CONTROL (3Crs.:2Lec,2Lab)
Compensation of control system. Design of compensators. Nonlinear control systems: phase-plane analysis & describing-function analysis. State-space representations. Linear state-space equations & their solutions. Computing the fundamental matrix. Properties of the state-space models: stability, controllability, observability. Pole placement & observers principles. Digital systems: advantages & disadvantages of using a digital processor. Sampling & reconstruction. Analysis of discrete-time systems. Design of digital controllers. Pre-req.: COMP 361.

POWE 214 ELECTRIC & ELECTRONIC MEASURMENTS (3Crs.:2Lec,2Lab)
Introduction to instrumentation & measurements (Errors, precision, accuracy, measurement statistics, etc.), Analog instrumentation (Permanent magnet moving coil PMMC, Moving Iron MI, Electrodynamometer), bridges (AC, DC), Oscilloscopes (functions & controls, voltage, time, & frequency measurements), Conversion (D/A, A/D, etc.), Electrical transducers, signal conditioning, data acquisition. Pre-req.: POWE 210.

MCHE 461 APPLIED ROBOTICS (3Crs.:2Lec,2Lab)
Robot architecture, subsystems, & applications; mechanisms & drives; forward & inverse kinematics; trajectory planning; dynamics & control; actuators & drive electronics; sensors & interface; mobile robots & navigation; intelligence; collaborative learning; team project. Pre-req.: MCHE 213 & either MCHE 302 or COME 431 or COMP 324.

Study Plan

Bachelor of Engineering in Computer Engineering (150 Credits)

First Semester (17 Credits)			Crs.	Pre-co/requisites
COMP	208	Programming I	3	
MATH	282	Calculus	3	MATH111
CVLE	210	Statics	3	
PHYS	281	Electricity & Magnetism	3	PHYS120
MCHE	201	Engineering Drawing & Graphics	3	
ARAB	001	Arabic Language	2	

Second Semester (16 Credits)			Crs.	Pre-co/requisites
COMP	210	Programming II	3	Pre: COMP 208
MATH	281	Linear Algebra	3	MATH112
MCHE	213	Dynamics	3	
PHYS	282	Materials Properties & Heat	3	
ENGL	001	English Language	2	
BLAW	001	Human Rights	1	
		Elective (General)	1	

Third Semester (18 Credits)			Crs.	Pre-co/requisites
COMP	221	Digital Systems I	2	
COMP	231	Discrete Structures	3	Pre: MATH 282
MATH	283	Differential Equations	3	Pre: MATH 281,MATH 282
COMP	211	Introductory Web Programming	3	Pre: COMP 208
CHEM	241	Principles of Chemistry	3	
ENGL	211	Advanced Writing	2	Pre:ENGL001
		Elective (General)	2	

Fourth Semester (14 Credits)			Crs.	Pre-co/requisites
COMP	232	Data Structures	3	Pre: COMP 210
POWE	210	Fundamentals of Electric Circuits	3	Pre:PHYS281
MATH	284	Numerical Analysis	3	Pre:MATH283
COMP	222	Digital Systems II	2	Pre: COMP 221
COMP	222L	Digital Systems II LAB	1	Pre: COMP 221
ENGL	300	Speech Communication	2	Pre:ENGL211

Fifth Semester (14 Credits)			Crs.	Pre-co/requisites
COMP	311	Object Oriented Programming	3	Pre: COMP 210
COMP	361	Control Systems for Computer Engineers	3	Pre: MATH 283
COME	221	Electronic Circuits I	3	Pre:POWE210
COMP	333	Computer Algorithms	3	Pre: COMP 231
		Elective (General)	2	

Sixth Semester (15 Credits)			Crs.	Pre-co/requisites
MGMT	002	Entrepreneurship	2	
COMP	344	Data Base Systems	3	Pre: COMP 232
MATH	381	Probability & Statistics	3	Pre: MATH 282
COMP	324	CPU Design	4	Pre: COMP 222
		Elective (General)	3	

Seventh Semester (15 Credits)			Crs.	Pre-co/requisites
COMP	423	Computer Architecture	3	Pre: COMP 324
COMP	431	Queuing & Modeling	3	Pre: MATH 381
COMP	443	Operating Systems	3	Pre: COMP 210
COMP	453	Transmission & Processing of Digital Signals	3	Pre: COMP 231
		Technical Elective I	3	

Eighth Semester (14 Credits)			Crs.	Pre-co/requisites
COMP	448	Compilers	3	Pre: COMP 311
COMP	458	Computer Networks	3	Pre: COMP 333
COMP	442	Software Engineering	3	Pre: COMP 210
CHEM	405	Solid State Chemistry	2	CHEM110
		Technical Elective II	3	

Ninth Semester (15 Credits)			Crs.	Pre-co/requisites
COMP	501	Final Year Project I	1	
INME	221	Engineer Economy	3	
COMP	499	Internship (Approved Experience / Independent Study)	1	
COMP	531	Cryptography & Information Security	3	
		Technical Elective III	3	
		Free Engineering Elective	3	
ENGR	001	Engineering Ethics	1	

Tenth Semester (12 Credits)			Crs.	Pre-co/requisites
COMP	521	Microprocessor-Based Systems	3	Pre: COMP 324
COMP	502	Final Year Project II	3	Pre: COMP 501
		Technical Elective IV	3	
		Free Engineering Elective	3	

Courses offered for other majors

The CE program offers four courses for other engineering majors. The courses are described below.

COMP 208 PROGRAMMING I (3Crs.: 2Lec,2Lab)
Computer fundamentals. Computer system components: hardware & software. Problem solving & flowcharts/pseudocode. High level programming: data types, structured programming constructs, input & output, expressions & assignments, selection, repetition, arrays.

COMP 210 PROGRAMMING II (3Crs.: 2Lec,2Lab): Pointers
Recursion. Character strings. Structures, union, & bit manipulation. File operations, sequential & random. Preprocessing directives. Function call by reference. Pre-req: COMP 208.

COMP 211 INTRODUCTORY WEB PROGRAMMING (3Crs.:2Lec,2Lab)
Introduction to HTML, Java, Java Script, JSP, ASP & PHP. Packages for web-page design. Pre-req: COMP 208.

COMP 221 DIGITAL SYSTEMS I (2Crs.:2Lec,0Lab)
Number systems & coding, Binary systems. Conversion from decimal to other bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions & circuits designs (HA, FA, & ALU). Combinational functions & circuits design (decoder, encoder, multiplexer & de-multiplexer). Sequential circuits definitions & designs (Latches, RS-FF, D-FF, JK-FF, T-FF). Simple buffer registers. Counters.

Elective University Requirement Courses

The CE program offers two courses as General (University) Electives. The courses are described below.

COMP 007 Website Development (2Crs.:2Lec,0Lab)
This course covers the basic concepts needed to develop a website. The topics include: Internet & Web concepts, Creating web pages, Configuring images & multimedia on web pages, Web design best practices, Accessibility, usability & search engine optimizations, Obtaining a domain name & web host, Publishing to the Web.

COMP 008 Programming basics (2Crs.:2Lec,0Lab)
This course introduces students to the craft of computer programming. The student will analyze problems; prepare flow charts, & write, run, & debug structured programs. By the end of the course, the student will know how to build application programs for medical, business, entertainment, & educational purposes.

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Electric Power & Machines Program

Mission

The Electrical Engineering Department offers a Bachelor of Engineering in Electrical Power & Machines. The EPM program focuses on both the theoretical & practical aspects of power engineering by addressing the fundamental concepts of engineering mathematics, physical sciences, electrical machines, power electronics, power system analysis, & high voltage engineering. The department plays a vital role in providing Lebanon & the region with qualified electrical power engineers. The department also offers Master & Ph. D. degrees in power engineering to cater for working professionals in electric power companies, utilities, manufacturing establishments & the energy sector in Lebanon.

Objectives

The educational objectives of the program are determined to support career advancement of the graduates & as they pursue their career goals, the graduates will:

1. Build a foundation of basic knowledge required for electrical power engineers
2. Improve the analysis & solving problem skills related electrical power engineers
3. Develop the research, & design of power electronic circuits, automated systems, & electrical power systems.
4. Enhance the professional & communication skills.

Learning Outcomes

Upon completion of the program graduates shall have:

a. An ability to apply knowledge of mathematics, science, & engineering
b. An ability to design & conduct experiments, as well as to analyze & interpret data
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, & sustainability
d. An ability to function on multi-disciplinary teams
e. An ability to identify, formulate, & solve engineering problems
f. An understanding of professional & ethical responsibility
g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, & societal context
i. A recognition of the need for, & an ability to engage in life-long learning
j. A knowledge of contemporary issues
k. An ability to use the techniques, skills, & modern engineering tools necessary for engineering practice

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Electric Power Engineering consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 6 semesters.

Career Opportunities

Electrical power engineers are involved in a wide variety of technology ranging from huge global positioning systems which can pinpoint the location of a moving vehicle to gigantic electrical power generators. These engineers are responsible for designing, developing, testing as well supervising the production of electrical & electronic equipment & machinery. Electric motors, controls of machinery, lights & wiring in building complexes, vehicles, aircrafts, power generations, control & transmission devices which are used by electric utilities are all examples of equipment built by these engineers. Electrical power engineers may choose to specialize in various areas like power generation, transmission & distribution, manufacture of electrical equipment or a one particular specialty within these areas. These engineers are involved in designing new products, writing requirements for their performance, as well as developing maintenance schedules & charts. Testing equipment & machinery, solving operations problems, estimating time & cost of electrical & electronic products also come under their job.

Program Overview

The Student's Study Plan is given to every EPM student upon his/her enrollment. The EPM curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences & Mathematics	26
General Engineering topics	15
II. EPM Program-Specific Requirements	**Credits**
A. Engineering topics from outside the major	17
B. Electric Power Engineering Core	55
C. Electric Power Engineering Technical Electives	6
D. Free Engineering Electives	6
E. Final Year Project	4
F. Internship	1

I.Common Requirements

The list of the Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II.EPM Program-Specific Requirements

A.Engineering topics from outside the major

This part of the EPM curriculum includes 17-credits courses offered by other engineering programs. These courses are listed in the table below.

Course	Title	Credits	Prerequisite
COMP 221	Digital System I	2	
COME 221	Electronic Circuit I	3	Pre: POWE 210
COME 222	Electronic Circuit II	3	Pre: COME 221
COME 212	Network Analysis	2	Pre: POWE 210
COME 212L	Electric Circuits Lab	1	Co: COME 212
COME 222L	Electronics Circuits Lab	1	Co: COME 222
COME 232	Logic Design	2	Pre: COMP 221
COME 232L	Logic Circuit Lab	1	Pre: COMP 221
COME 431	Microprocessor Interfacing & Applications	2	Pre: COME 232

Descriptions of this group of courses are given below:

COMP 221 DIGITAL SYSTEMS I (2Crs.:2Lec,0Lab)

Number systems & coding, Binary systems. Conversion from decimal to other bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions & circuits designs (HA, FA, & ALU). Combinational functions & circuits design (decoder, encoder, multiplexer & de-multiplexer). Sequential circuits definitions & designs (Latches, RS-FF, D-FF, JK-FF, T-FF). Simple buffer registers. Counters.

COME 221 ELECTRONIC CIRCUITS I (3Crs.: 3Lec,0Lab)

Introduction to semiconductor physics, junction diodes: construction, I-V characteristics, circuit models, applications, special purpose diodes: Zener diodes. Bipolar junction transistors (BJT) & field effect transistors (FET): types, physical structures, basic configurations, characteristic curves, circuit models, biasing circuits, small-signal amplifiers. Pre-req.: POWE 210.

COME 222 ELECTRONIC CIRCUITS II (3Crs.:3Lec,0Lab)

BJT & FET amplifiers: Types, circuit models, frequency response, differential & multistage amplifiers, large signal analysis & power amplifiers, operational amplifiers: Characteristics, applications, imperfections, feedback amplifiers, sinusoidal oscillators & multivibrators. Pre-req.: COME 221.

COME 212 NETWORK ANALYSIS (2Crs.:2Lec,0Lab)
Transient analysis, Laplace transform & its application to circuit analysis, two-port networks, frequency selective passive & active circuits. Pre-req.: POWE 210.

COME 212L ELECTRIC CIRCUITS LAB (1Cr.:0Lec,2Lab)
The content of this lab is directly related to the courses COME 212. C0-req.: COME 212.

COME 222L ELECTRONIC CIRCUITS LAB (1Cr.:0Lec,2Lab)
The content of this lab is directly related to the courses COME 221, COME 222.Co-req.: COME222.

COM 232 LOGIC DESIGN (2Crs.:2Lec,0Lab)
Flip - flops, counters using T or JK flip - flops, state machines, synchronous & asynchronous sequential networks, programmable logic devices: PLA, PAL, CPLD, FPGA, applications in design & implementation of combinational & sequential circuits, sequential circuits for arithmetic operations. Memory elements, adders, & multipliers. . Introduction to shift registers. Pre-req.: COMP 221.This course is equivalent to COMP222.

COME 232L LOGIC CIRCUITS LAB (1Cr.:0Lec,2Lab)
The content of this lab is directly related to the courses COMP 221, COME 232. Co-req.: COME 232.This course is equivalent to COMP222L.

COME 431 MICROPROCESSOR INTERFACING & APPLICATIONS (2Cr.:1Lec,2Lab):
Microprocessor chips & LSI technology. Architecture & instruction set of a 16 bit microprocessor. Supporting chips: Buffers, decoders, system clock generator. Interfacing 16 bit microprocessor to memory & I/O devices. Interfacing techniques: Serial, parallel, timers. Direct memory access & DMA controllers. System development & design tools (hardware & software).Pre-req.: COME 232.

B.Electric Power & Machine Engineering Core

The Electric Power & Machine Engineering core courses are listed in the table below.

Course	Title	Credits	Prerequisite
POWE 210	Fundamental of Electric Circuits	3	Pre: PHYS 281
POWE 271	Electro-Magnetics	3	Pre: PHYS 281
POWE 214	Electrical & Electronic Measurements	3	Pre: POWE 210
POWE 331	Electric Machines I	3	Pre: POWE 210, POWE 271
POWE 321	Electric Power I	3	Pre: POWE 210, POWE 271
POWE 341*	Control I	3	Pre: MATH 283
POWE 332	Power Electronic I	3	Pre: COME 221

POWE 334	Electric Machines II	3	Pre: POWE 331
POWE 322	Electric Power II	3	Pre: POWE 321
POWE 431	Power Electronic II	3	Pre: POWE 332
POWE 421	Protection I	3	Pre: POWE 321
POWE 441	Control II	2	Pre: POWE 341
POWE 443	Instrumentation	2	Pre: POWE 214
POWE 422	Power System CAD	2	Pre: POWE 322
POWE 424	Protection II	2	Pre: POWE 421
POWE 426	Power System Analysis	3	Pre: POWE 322
POWE 531	Electrical Drives	3	Pre: POWE 334
POWE 541	Automation	3	Co: POWE 334
POWE 522	High Voltage	3	Co: POWE 424, POWE 426
POWE 532	Special Machines	2	Pre: POWE 334

* This course is equivalent to COMP 361.

Description of Core Courses

POWE 210 FUNDAMENTAL OF ELECTRIC CIRCUITS (3Crs.:3Lec,0Lab)
DC circuit analysis: reduction methods, mesh current & node voltage analysis methods, source transformation, DC network theorems, capacitors & inductors, phasors & AC steady state circuit analysis, series & parallel resonance, power in AC circuits, Fourier series technique applied to circuit analysis, balanced & unbalanced three-phase circuits. Pre-req.: PHYS 281.

POWE 214 ELECTRIC & ELECTRONIC MEASUREMENTS (3Crs.:2Lec,2Lab)
Introduction to instrumentation & measurements (Errors, precision, accuracy, measurement statistics, etc.), Analog instrumentation (Permanent magnet moving coil PMMC, Moving Iron MI, Electrodynamometer), bridges (AC, DC), Oscilloscopes (functions & controls, voltage, time, & frequency measurements), Conversion (D/A, A/D, etc.), Electrical transducers, signal conditioning, data acquisition. Pre-req.: POWE 210.

POWE 271 ELECTROMAGNETIC (3Crs.:3Lec,0Lab): Vector calculus, electrostatics
Coulomb's law, Gauss's law, divergence theorem, energy & potential, conductors & dielectrics, electric dipole & polarization, capacitances, magnetostatics: Biot-Savart law, Ampere's law, Stoke's theorem, magnetic materials, magnetic dipole & magnetization, inductances, Faraday's law, time varying fields, Maxwell's equations. Pre-req.: PHYS 281.

POWE 321 ELECTRIC POWER I (3Crs.:2Lec,2Lab)
Power system structure, high-voltage transmission systems, DC versus AC transmission, load characteristics, over-head transmission lines: parameters, solutions, & electrical performance, reactive power compensation & voltage control of transmission lines, underground power cables. Pre-req.: POWE 210 & POWE 271.

POWE 322 ELECTRIC POWER II (3Crs.:2Lec,2Lab)
Physical interpretation of transmission line equations, mechanical analysis & design of overhead transmission lines, line insulators, corona discharge & limiting factors in the design of extra high voltage transmission lines, distribution system design, distribution system equipment, layout of distribution systems, reactive power control in power systems, power factor correction in industrial plants. Pre-req.: POWE 321.

POWE 331 ELECTRIC MACHINES I (3Crs.:2Lec,2Lab)
Principles of energy conversion, concept of energy & co-energy, single phase transformers: construction, theory of operation, equivalent circuit, power flow, regulation & testing, auto transformer, three phase transformers: connections, special connections of transformers, DC Machines: construction, theory of operation, induced voltage & developed torque, armature reaction, commutation, equivalent circuits, generator & motor (types & characteristics). Pre-req.: POWE 210 & POWE 271.

POWE 332 POWER ELECTRONICS I (3Crs.:2Lec,2Lab)
Power Switches: Diodes, Thyristor, Triac, Diac, GTO, BJT, MOSFET, IGBT, characteristics, mode of operations, selection of switches based on power & frequency, power computation for AC sources, power computation for non-sinusoidal periodic waveform, Fourier analysis & total harmonic distortion, power losses, Rectifying circuits: single-phase & three-phase, uncontrolled, half controlled & fully controlled rectifiers for R & RL loads. Effect of source impedance & overlap angle. Pre-req.: COME 221.

POWE 334 ELECTRIC MACHINES II (3Crs.:2Lec,2Lab)
Machine winding, rotating field, Synchronous generator: construction, theory of operation, induced voltage, equivalent circuit, voltage regulation, electrical & mechanical diagrams, parallel operation, three-phase induction motors: Construction, theory of operation, equivalent circuit, power flow, regulation starting & testing. Pre-req.: POWE 331.

POWE 341 CONTROL I (3Crs.:2Lec,2Lab)
Introduction to control systems, control system components, transfer function, block diagram, signal flow graph, time domain analysis of control systems, Routh-Hurwitz stability criteria, relative stability of feedback, control system, root locus analysis, root locus design, frequency response analysis, Nyquist criterion of stability. MATLAB / SIMULINK is used in class assignment & lab to simulate & analyze feedback control systems. Pre-req.: MATH 283. This course is equivalent to COMP 361.

POWE 421 PROTECTION I(3Crs.:2Lec,2Lab)
Modern analysis of power networks: simulation of power system elements, network topology & Z bus formulation technique, symmetrical fault analysis, unbalanced fault analysis, instrument transformers for protection purposes, protection fundamentals, relay & switchgear characteristics, over-current relays. Pre-req.: POWE 321.

POWE 422 POWER SYSTEM CAD (2Crs.:1Lec,2Lab)
Standard software: simulation & graphics, packages (SPICE, MATLAB, EMTP, AUTOCAD). Development of some simple routines to perform the following examples: load flow, short circuit analysis. Pre-req.: POWE 322.

POWE 424 PROTECTION II(2Crs.:2Lec,0Lab)
Line protection: distance protection: high voltage & extra high voltage line protection, carrier schemes, for high voltage & extra high voltage lines, basics of differential relays Protective relaying applications: generator protection, substation transformer protection, bus-bar protection. Pre-req.: POWE421.

POWE 426 POWER SYSTEM ANALYSIS (3Crs.:2Lec,2Lab)
Power flow analysis & applications, economic operation of power systems, load forecasting, reliability & generation planning, power system security: assessment & analysis of the effect of disturbing loads connected to the power system, power system stability, & voltage stability. Pre-req.: POWE 322.

POWE 431 POWER ELECTRONICS II (3Crs.:2Lec,2Lab)
Three-phase & single phase AC voltage controllers for R & RL loads, effect of impedance, type of three phase connections (delta or star), introduction to induction motor speed control & static VAR control,. DC to DC Converters: linear voltage regulation, design consideration for buck, boost & cuk converters, modes of operation, effect of ripples, single, two & four quadrants operation. Switched capacitor converter. Single phase & three phase inverters: the full bridge converter, square wave inverter, total harmonic distortion & Fourier analysis, amplitude & harmonic control, Multilevel inverter, PWM for bipolar & unipolar switching, Voltage control through pulse amplitude & pulse width modulation, three phase PWM inverter. Introduction to induction motor control by PWM technique. Pre-req.: POWE 332.

POWE 441 CONTROL II (2Crs.:2Lec,0Lab)
Sensitivity & the root locus, design of lag, lead, & lag-lead compensators. PID controllers & design of feedback control systems using frequency response, state variable representation, state-space approach, transition matrix, controllability & observability, design of state variable control systems. MATLAB / SIMULINK is used in class assignment & lab to simulate & analyze feedback control systems. Pre-req.: POWE 341.

POWE 443 INSTRUMENTATION (2Crs.:2Lec,0Lab)
Power meters, Energy meters, Electrostatic meters, Thermocouples, Current transformers, voltage transformers, measurement sensors & transducers, microcontrollers, embedded control systems, application projects for industrial control. Pre-req.: POWE 214.

POWE 522 HIGH VOLTAGE (3Crs.:2Lec,2Lab)
Electrical transients in networks with distributed parameters (traveling waves on transmission lines), protection against lightning & insulation coordination, electrical transients in power systems, principles of system grounding & applications to industrial plants, protective grounding systems, breakdown mechanisms in solids, liquids & dielectrics, high voltage generation, measurements & testing techniques. Co-req.: POWE 424 & POWE 426.

POWE 531 ELECTRICAL DRIVES (3Crs.:2Lec,2Lab)
Definition of electric drives & its components, types of loads, quadrant operation, variable loads, dynamics of motor load combination, selection of electric motors, speed control, starting, breaking, load cycle & motor rating, applications. DC series, shunt, separately excited, characteristics curves & speed control methods (by external resistance, armature voltage, field voltage & rectification circuits) chopper fed DC drives, first second & fourth quadrant drive. Induction motors: performance characteristics, classical drives (varying rotor resistance or supply voltage or supply voltage & frequency) & modern drives (introduction to slip power control, slip power recovery, stator voltage-current & frequency control). Pre-req.: POWE 334.

POWE 532 SPECIAL MACHINES (2Crs.:1Lec,2Lab)
Single phase Induction motor: construction, theory, methods of starting, equivalent circuit, parameters calculation using open circuit & short circuit tests. Variable Reluctance machines: Switched Reluctance, Synchronous Reluctance, & Stepper motor. Hysteresis Motor, Linear machine: Induction, Synchronous reluctance & dc. Permanent magnet motors, servo motors. Pre-req.: POWE 334.

POWE 541 POWER SYSTEM AUTOMATION (3Crs.:2Lec,2Lab)
Hard wired logic: components, two & three wire logic, sequential control, ladder diagram, applications. Software logic & PLC. Co-req.: POWE 334.

C.Electric Power & Machine Engineering Technical Elective

The EPM curriculum includes two 6-creidt hour courses as technical electives. The courses are chosen from the courses listed in the table below. with their descriptions given thereafter.

Course	Title	Credits	Prerequisite
POWE 428	Electrical Design In Commercial & Industrial Buildings	2	Pre: POWE 322.
POWE 437	Introduction to Photovoltaic & Wind Renewable Energy	2	Pre: POWE 332, POWE 334
POWE 444	Digital Control	2	Pre: POWE 441
POWE 533	Specialized Modes of Machine Operation	2	Pre: POWE 334
POWE 523	Power System Planning	2	Pre: POWE 426
POWE 534	Advanced Topics In Power Electronics	2	Pre: POWE431
POWE 524	Power System Control & Operation	2	Pre: POWE441 & POWE426
POWE 536	Solid-State Drives	2	Pre: POWE431

Description of Technical Elective Courses

POWE 428 ELECTRICAL DESIGN IN COMMERCIAL & INDUSTRIAL BUILDINGS (2Crs.:2Lec,0Lab)
Load characteristics, local distribution grid: system design & analysis, wiring for residential & industrial buildings. Hazards in industry & electrical safety considerations, power quality of utility & building systems, Building Management Systems. Illumination. Pre-req.: POWE 322.

POWE 437 INTRODUCTION TO PHOTOVOLTAIC & WIND RENEWABLE ENERGY (2Crs:2Lec,0Lab)
This is an introductory course to renewable energy which focuses on the modeling, analysis, design, construction, efficiency & application of the photovoltaic system & wind energy system. Business & career opportunities in renewable energy systems. Pre-req.: POWE 322, POWE 334.

POWE 444 DIGITAL CONTROL (2Crs.:2Lec,0Lab)
Digital control system components, difference equations & Z transform, sampling theorem, stability, digital filter design, introduction to state space method in digital systems. MATLAB/SIMULINK is used in class assignment & lab to simulate & analyze feedback control systems. Pre-req.: POWE 441.

POWE 523 POWER SYSTEM PLANNING (2Crs.:2Lec,0Lab)
Short & long term load forecasting, power system expansion planning: transmission & distribution, generation & transmission reliability analysis, outage simulation & optimum reliability level, estimation of outage costs: residential & industrial, power system security. Pre-req.: POWE 426.

POWE 524 POWER SYSTEM CONTROL & OPERATION (2Crs.:2Lec,0Lab)
Control problems in interconnected power systems, modelling power system components & dynamic simulation, excitation control systems, Q-V control channel, generation control systems, P-f control channel, review of energy management systems, real time modelling: the SCADA system, system security monitoring & control. Pre-req.: POWE 441 & POWE 426.

POWE 533 SPECIALIZED MODES OF MACHINE OPERATION (2Crs.:2Lec,0Lab)
Induction machine modes of operation: generation, plugging & braking, unbalanced operation. Induction regulator: single & three-phase, Selsyns & Synchros, Single phase induction motors: construction, theory of operation, types & characteristics, unsymmetrical operation of two phase induction motor, ac tachogenerator. Pre-req.: POWE 334.

POWE 534 ADVANCED TOPICS IN POWER ELECTRONICS (2Crs.:2Lec,0Lab)
Twelve pulse converters, switching mode power supplies, current source inverters, Switching & conduction losses in power switches, cooling of switching devices, protection of power switches, induction furnace, harmonic analysis, Active power filters, Multi-level inverters. Pre-req.:POWE 431.

POWE 536 SOLID STATE DRIVES (2Crs.:2Lec,0Lab)
DC drives: ac to dc converter drives, dc to dc converter drive, coordinated control, performance. AC drives: ac voltage controller drives, Slip energy recovery, inverter fed drives. Vector controlled Induction machines. MATLAB/SIMULINK is used in class assignment & lab to simulate & analyze electric drive systems. Pre-req.: POWE 431

D.Free Engineering Elective
The EPM program includes a 6-credit hour course taken as Free Engineering Elective. The course may be chosen by the student in consultation with his/her advisor from any engineering major.

E.Final Year Project
After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester & ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, & give a presentation on a significant, relevant, & comprehensive engineering problem. The FYP is intended to stimulate student creativity & critical thinking, & build skills in formulating, designing, developing, building, communicating, & managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.
Refer to the Final Year Project Policy for more details.

F.Internship (Approved Experience/ Independent Study)
This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.
Refer to the department policy for further details.

Study Plan

Bachelor of Engineering in Electrical Power & Machines (150 Credits)

First Semester (17 Credits)			Crs.	Pre-co/requisites
MATH	282	Calculus	3	MATH111
CVLE	210	Statics	3	
PHYS	281	Electricity & Magnetism	3	PHYS120
MCHE	201	Engineering Drawing & Graphics	3	
COMP	208	Programming I	3	
ARAB	001	Arabic Language	2	

Second Semester (18 Credits)			Crs.	Pre-co/requisites
MATH	281	Linear Algebra	3	MATH112
MCHE	213	Dynamics	3	
PHYS	282	Properties of Materials, Mechanics, & Heat	3	
POWE	210	Fundamentals of Electric Circuits	3	Pre: PHYS 281
BLAW	001	Human Rights	1	
ENGL	001	English Language	2	
		Elective (General)	3	

Third Semester (16 Credits)			Crs.	Pre-co/requisites
MATH	283	Differential Equations	3	Pre: MATH 281,MATH 282
COMP	221	Digital Systems I	2	
COME	221	Electronic Circuits I	3	POWE 210
INME	221	Engineering Economy	3	
ENGL	211	Advanced Writing	2	Pre:ENGL001
POWE	271	Electromagnetics	3	Pre: PHYS 281

Fourth Semester (18 Credits)			Crs.	Pre-co/requisites
COME	222	Electronic Circuits II	3	Pre: COME 221
COME	212L	Electric Circuit Lab	1	Co: COME 212
POWE	214	Electrical & Electronic Measurements	3	Pre: POWE 210
COME	212	Network Analysis	2	Pre: POWE 210
COME	222L	Electronics Circuits Lab	1	Co: COME 222
COME	232	Logic Design	2	Pre: COMP 221
COME	232L	Logic Circuit Lab	1	Co: COME 232
MATH	284	Numerical Analysis	3	Pre: MATH 283
ENGL	300	Speech Communication	2	Pre: ENGL 211

Fifth Semester (17 Credits)			Crs.	Pre-co/requisites
COME	431	Microprocessor Interfacing & Applications	2	Pre: COME 232
POWE	331	Electric Machines I	3	Pre: POWE 210,POWE 271
POWE	321	Electric Power I	3	Pre: POWE 210,POWE 271
POWE	341*	Control I	3	Pre: MATH 283
MATH	381	Probability & Statistics	3	Pre: MATH 282
		Elective (General)	3	

* This course is equivalent to COMP 361.

Sixth Semester (16 Credits)			Crs.	Pre-co/requisites
POWE	332	Power Electronic I	3	Pre: COME 222
POWE	334	Electric Machine II	3	Pre: POWE 331
POWE	322	Electric Power II	3	Pre: POWE 321
MGMT	001	Entrepreneurship I	2	
		Free Engineering Elective	3	
		Elective (General)	2	

Seventh Semester (16 Credits)			Crs.	Pre-co/requisites
POWE	431	Power Electronic II	3	Pre: POWE 332
POWE	421	Protection I	3	Pre: POWE 321
POWE	441	Control II	2	Pre: POWE 341
POWE	443	Instrumentation	2	Pre: POWE 214
CHEM	241	Principles of Chemistry	3	
		Free Engineering Elective	3	

Eighth Semester (14 Credits)			Crs.	Pre-co/requisites
POWE	422	Power System CAD	2	Pre: POWE 322
POWE	424	Protection II	2	Pre: POWE 421
POWE	426	Power System Analysis	3	Pre: POWE 322
CHEM	405	Solid State Chemistry	2	CHEM110
		Technical Elective	4	
ENGR	001	Engineeing Ethics	1	

Ninth Semester (10 Credits)			Crs.	Pre-co/requisites
POWE	531	Electrical Drives	3	Pre: POWE 334
POWE	501	Final Year Project	1	
POWE	541	Automation	3	Co: POWE 334
POWE	499	Internship (Approved Experience / Independent Study)	1	
		Technical Elective	2	

Tenth Semester (8 Credits)			Crs.	Pre-co/requisites
POWE	502	Final Year Project	3	Pre: POWE 501
POWE	532	Special Machines	2	Pre: POWE 334
POWE	522	High Voltage	3	Co: POWE 424,POWE 426

Courses offered for other majors

The Electrical Engineering Department offers four courses for other engineering majors. These courses are described below.

POWE 210 ELECTRIC CIRCUITS (3Crs.:3Lec,0Lab)
DC circuit analysis: reduction methods, mesh current & node voltage analysis methods, source transformation, DC network theorems, capacitors & inductors, phasors & AC steady state circuit analysis, series & parallel resonance, power in AC circuits, balanced three-phase circuits. Pre-req.: PHYS 281.

POWE 238 POWER ELECTRONICS (2Crs.:2Lec,0Lab)
Basic electronic components; overview of analog & digital electronic circuits; semiconductors & the PN Junction; diode circuits & applications; rectification – half- & full-wave; bipolar junction transistors, IGBT, & MOSFET operation & circuits; motor drives; operational amplifiers; applications. Pre-req.: POWE 210.

POWE 238L CIRCUITS & ELECTRONICS LAB (1Cr.:0Lec,2Lab)
Passive electronic components; laboratory instruments; voltage-divider & bridge circuits; RC filters & lead-lag networks; LEDs; Zener regulator; diode rectifier circuits; BJT, IGBT, & MOSFET applications; op-amp circuits; filters & oscillators. Pre-req.: POWE 210; Co-req.: POWE 238.

POWE 333 ELECTRIC MACHINES & DRIVES (3Crs.:3Lec,0Lab)
Single-Phase & 3-phase Transformers; Power Transmission & Distribution; DC Machines, Motors; Synchronous Generators; Poly-Phase Induction Motors. Pre-req.: POWE 210.

Elective University Requirement Course

The EPM program offers one course as General (University) Elective. The course is described below.

POWE 001 ELECTRIC SAFETY (2Crs.:2Lec, 0Lab)
Hazards of electrical installations, safety requirements, recognition, evaluation & controlling electrical hazards, physiological effects of electrical current, good wiring practices, color coding & grounding, load calculation, selecting proper overcurrent protective devices, children protection, emergency systems, fire alarm systems.

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Chairperson	Ziad Osman
Professors	Soubhi Abou Chahine, Ali Haidar,
Associate Professors	Hamza Issa, Mohamed Tarnini, Chadi Nohra
Assistant Professors	Ahmad El-Haj, Hilal El-Moslmani, Rola Kassem, Wassim Itani Nabil Abdel Karim, Hiba Abdallah, Youmni Ziadeh, Rayan Mina, Bilal .

Biomedical Engineering Program

Mission

The educational mission of Biomedical Engineering (BME) Program is to deliver high quality undergraduate education which combines balanced theoretical & practical topics in Biological, Medical & Electrical systems. Graduates of the program will have a mastery of fundamental knowledge in a variety of Biomedical Engineering fields, management, & entrepreneurial skills. Graduates will be qualified to pursue successful careers in their profession or graduate studies in different areas.

Objectives

The educational objectives of the program are determined to support career advancement of the graduates as they pursue their career goals. The graduates will:

- Design, optimize & maintain biomedical systems in tune with community needs & environmental concerns
- Be able to develop & integrate new technologies as they emerge
- Engage in a technical/managerial role in diverse teams
- Pursue entrepreneurial initiatives & launch startup companies
- Communicate effectively & use resources skillfully in projects development

Learning Outcomes

Upon completion of the program graduates shall be able to:

(a) An ability to apply knowledge of mathematics, science, & engineering
(b) An ability to design & conduct experiments, as well as to analyze & interpret data
(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, & sustainability
(d) An ability to function on multi-disciplinary teams
(e) An ability to identify, formulate, & solve engineering problems
(f) An understanding of professional & ethical responsibility
(g) An ability to communicate effectively
(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, & societal context

(i) A recognition of the need for, & an ability to engage in life-long learning
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills, & modern engineering tools necessary for engineering practice

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Biomedical Engineering consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 10 semesters.

Career opportunities

Biomedical engineers are responsible for the creation of artificial organs, automated patient monitoring, blood chemistry sensors, advanced therapeutic & surgical devices, application of expert systems & artificial intelligence to clinical decision making, design of optimal clinical laboratories, medical imaging systems, computer modeling of physiological systems, biomaterials design, & biomechanics for injury & wound healing, among many others.

Program Overview

The Student's Study Plan is given to every BME student upon his/her enrollment. The BME curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences & Mathematics	26
General Engineering topics	15
II. BME Program-Specific Requirements	**Credits**
G. Basic Electrical Engineering	42
H. BME Core	36
I. BME Technical Electives	6
J. Final Year Project	4
K. Internship	1

I.Common Requirements
The list of the Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II.BME Program-Specific Requirements
A. Basic Electrical Engineering
This part of the BME curriculum includes 42-credits courses offered by the Electrical & Computer Engineering Department. These courses are listed in the table below.

Course	Title	Credits	Prerequisite
POWE 210	Fundamentals of Electric Circuits	3	Pre: PHYS 281
COME 212	Network Analysis	2	Pre: POWE 210
COME 212L	Electric Circuits Lab	1	Pre: POWE 210, Co: COME 212
COMP 221	Digital Systems I	2	
POWE 271	Electromagnetic Fundamentals	3	Pre: PHYS 281
POWE 214	Electric & Electronic Measurements	3	Pre: POWE 271
COME 221	Electronic Circuits I	3	Pre: POWE 210
COME 222	Electronic Circuits II	3	Pre: COME 221
COME 222L	Electronic Circuits Lab	1	Pre: COME 221, CO: COME 222
COME 232	Logic Design	3	Pre: COMP 221
COME 232L	Logic Circuits Lab	1	Pre: COMP 221, Co: COME 232
COMP 210	Programming II	3	Pre: COMP 208
COME 381	Signals & Systems	3	
COME 384	Digital Signal Processing	3	Pre: COME 381
COME 431	Microprocessor Interfacing & Applications	2	Pre: COMP 232
COMP 534	Pattern Recognition	3	
COMP 535	Digital Image Processing	3	

Descriptions of this group of courses are given below:

POWE 210 FUNDAMENTALS OF ELECTRIC CIRCUITS (3Crs.: 3Lec, 0Lab)
DC circuit analysis: reduction methods, mesh current & node voltage analysis methods, transformation methods, DC network theorems, capacitors & inductors, phasors & AC steady state circuit analysis, series & parallel resonance, power in AC circuits, balanced & unbalanced three-phase circuits. Pre-req: PHYS 281.

COME 212 NETWORK ANALYSIS (2Crs.: 2Lec, 0Lab)
Transient analysis, Laplace transform & its application to circuit analysis, two-port networks, frequency selective passive & active circuits. Pre-req: POWE 210.

COME 212L ELECTRIC CIRCUITS LAB (1Cr.: 0Lec, 2Lab)
The content of this lab is directly related to the courses POWE 210, COME 212. Co-req.: COME 212.

COMP 210 PROGRAMMING II (3Crs.: 2Lec, 2Lab)
Pointers. Recursion. Character strings. Structures, union, & bit manipulation. File operations, sequential & random. Preprocessing directives. Function call by reference. Pre-req: COMP 208.

COMP 221 DIGITAL SYSTEMS I (2Crs.: 2Lec, 0Lab)
Number systems & coding, Binary systems. Conversion from decimal to other bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions & circuits designs (HA, FA, & ALU). Combinational functions & circuits design (decoder, encoder, multiplexer & de-multiplexer). Sequential circuits definitions & designs (Latches, RS-FF, D-FF, JK-FF, T-FF). Simple buffer registers. Counters.

POWE 214 ELECTRIC & ELECTRONIC MEASUREMENTS (3Crs.: 2Lec, 2Lab)
Introduction to instrumentation & measurements (Errors, precision, accuracy, measurement statistics, etc.), Analog instrumentation (Permanent magnet moving coil PMMC, Moving Iron MI, Electrodynamometer), bridges (AC, DC), Oscilloscopes (functions & controls, voltage, time, & frequency measurements), Conversion (D/A, A/D, etc.), Electrical transducers, signal conditioning, data acquisition. Pre-req: POWE 271.

COME 221 ELECTRONIC CIRCUITS I (3Crs.: 3Lec, 0Lab)
Introduction to semiconductor physics, junction diodes: construction, I-V characteristics, circuit models, applications, special purpose diodes: Zener diodes. Bipolar junction transistors (BJT) & field effect transistors (FET): types, physical structures, basic configurations, characteristic curves, circuit models, biasing circuits, small-signal amplifiers. Pre-req.: POWE 210.

COME 222 ELECTRONIC CIRCUITS II (3Crs.: 3Lec, 0Lab)
BJT & FET amplifiers: Types, circuit models, frequency response, differential & multistage amplifiers, large signal analysis & power amplifiers, operational amplifiers: Characteristics, applications, imperfections, feedback amplifiers, sinusoidal oscillators & multi-vibrators. Pre-req.: COME 221.

COME 222L ELECTRONIC CIRCUITS LAB (1Cr.: 0Lec, 2Lab)
The content of this lab is directly related to the courses COME 221, COME 222.Co-req: COME 222.

COME 232 LOGIC DESIGN (2Crs.: 2Lec, 0Lab)
Flip - flops, counters using T or JK flip - flops, state machines, synchronous & asynchronous sequential networks, programmable logic devices: PLA, PAL, CPLD, FPGA, applications in design & implementation of combinational & sequential circuits, sequential circuits for arithmetic operations. Memory elements, adders, & multipliers. Introduction to shift registers. Pre-req: COMP 221. This course is equivalent to COMP 222.

COME 232L LOGIC CIRCUITS LAB (1Cr.: 0Lec, 2Lab)

The content of this lab is directly related to the courses COMP 221, COME 232. Co-req: COME 232. This course is equivalent to COMP 222L.

POWE 271 ELECTROMAGNETIC FUNDAMENTALS (3Crs.: 3Lec, 0Lab)

Vector calculus, electrostatics: Coulomb's law, Gauss's law, divergence theorem, energy & potential, conductors & dielectrics, electric dipole & polarization, capacitances, magnetostatics: Biot-Savart law, Ampere's law, Stoke's theorem, magnetic materials, magnetic dipole & magnetization, inductances, Faraday's law, time varying fields, Maxwell's equations. Pre-req: PHYS 281.

COME 381 SIGNALS & SYSTEMS (3Crs.: 3Lec, 0Lab)

Classification of continuous & discrete - time signals & systems. Fourier transform. Linear & time - invariant (LTI) systems: Impulse response, step response, transfer function. Band - pass signals: Hilbert transform, pre - envelope, complex envelope. Convolution & correlation functions. Energy & power spectral densities. Transmission of continuous random signals through LTI systems. Introduction to sampling theorem & reconstruction of signals. Application of taped delay line filters.

COME 384 DIGITAL SIGNAL PROCESSING (3Crs.: 2Lec, 2Lab)

Discrete - time signals & systems, LSI & causal systems, Z-Transform. Difference equations, IIR & FIR systems. Discrete time & frequency representation of systems. Discrete Fourier Transform (DFT). Digital filters design techniques, Chebychev & Butterworth. Computation of DFT & FFT. Pre-req: COME 381.

COME 431 MICROPROCESSOR INTERFACING & APPLICATIONS (2Crs.: 1Lec, 2Lab)

Microprocessor chips & LSI technology. Architecture & instruction set of a 16 bit microprocessor. Supporting chips: Buffers, decoders, system clock generator. Interfacing 16 bit microprocessor to memory & I/O devices. Interfacing techniques: Serial, parallel, timers. Direct memory access & DMA controllers. System development & design tools (hardware & software).Pre-req: COME 232.

COMP 534 PATTERN RECOGNITION (3Crs.: 3Lec)

Reconstruction from projections. Scene understanding. Matching & recognition. Methods for reconstructing three-dimensional scene information using techniques such as depth from stereo, structure from motion, & shape from shading. Motion & video analysis. Three-dimensional object recognition.

COMP 535 DIGITAL IMAGE PROCESSING (3Crs.: 3Lec)

Image formation & perception. Image representation. Transformations on digital images. Enhancement & restoration. Segmentation. Encoding & data compression.

B.Biomedical Engineering Program Core

The BME program core courses are listed in the table below.

Course	Title	Credits	Prerequisite
HESC 201	Human Anatomy & Physiology	3	
HESC 202	Health Care Profession & Bio Ethics	1	
BIOL 231	Biology I	3	
BIOL 231L	Biology I Lab	1	Co: BIOL 231
PHYS 352	Biophysics	3	
CHEM 234	Organic Chemistry	3	
CHEM 234L	Organic Chemistry Lab	1	Co: CHEM 234
BIME 310	Biomedical Instrumentation I	3	Pre: POWE 214
BIME 411	Biomedical Instrumentation II	3	Pre: BIME 310
BIME 441	Biomedical Sensors	3	Pre: COME 222
BIME 411L	Biomedical Instrumentation Lab	1	Pre: BIME 310, Co: BIME 411
BIME 421	Biomedical Imaging I	3	Pre: COMP 534, COMP 535
BIME 421L	Biomedical Imaging I Lab	1	Co: BIME 421
BIME 422	Biomedical Imaging II	3	Pre: BIME 421
BIME 422L	Biomedical Imaging II Lab	1	Co: BIME 422
BIME 432	Biological Materials	3	Pre: BIOL 231

Description of Core Courses

HESC 201 HUMAN ANATOMY & PHYSIOLOGY (3Cr: 2Lec, 2Lab, 0Tut)

This course studies the structure (brief anatomy) & function (detailed physiology) of the following body systems: muscular, nervous, endocrine, blood, lymphatic, cardiovascular, respiratory, digestive, urinary, & reproductive. The student is also introduced to topics in metabolism, nutrition, & general heredity within a physiological & homeostatic environment.

HESC 202 HEALTHCARE PROFESSION & BIOETHICS (1Cr: 1Lec, 0Lab, 0Tut)

The major centers around the globe that have a health profession in interest are involved with understanding the significance of healthcare law & bioethics. The major components of this course are: Introduction to medical law, ethics, & bioethics; The legal system & its environment; Importance of the legal system for the physician & the healthcare professional; Today's healthcare environment; The CLS–Patient relationship; Professional liability & medical/biomedical malpractice; Public duties of the healthcare professional; Workplace law & ethics; The medical record; Ethical & bioethical issues in medicine; Ethical issues relating to life.

BIOL 231 BIOLOGY I (3Crs.: 3Lec)

This course introduces the students to fundamental concepts in biology. Topics to be covered include the cellular & chemical basis of life, organization of life, energy transfer through living organisms, evolution, diversity of life with emphasis on the animal & plant kingdoms & their interaction with the environment.

BIOL 231L BIOLOGY I LABORATORY (1Cr.: 2Lab)

Laboratory includes applications & experiments related to the topics discussed in Biology I course. Co-req.: BIOL 231.

PHYS 352 BIOPHYSICS (3Crs.: 3Lec)

Fluids: Circulation of the blood, blood pressure, power produced by heart. Heat: transfer of heat, transport of molecules by diffusion, respiratory system, surfactants & breathing, diffusion & contact lenses. Thermodynamics of living systems, energy from food, regulation of body temperature, evaporation, resistance to cold, heat & soil. Sound: hearing & the ear, clinical uses of sound, ultrasonic waves. Electricity: the nervous system, electricity in plants, electricity in bone, electric fish, electrocardiograph, physiological effects of electricity, sensory aids. Optics: structure of the eye, accommodation, eye & the camera, retina, defects in vision, fiber optics. X-rays: computerized tomography CT. Lasers: lasers surgery. Nuclear Physics: magnetic resonance imaging, radiation therapy, food preservation by radiation, isotopic tracers.

CHEM 234 ORGANIC CHEMISTRY (3Cr.: 3Lec)

The course provides the necessary background in organic chemistry in the context of living cells. Nomenclature of chemical compounds, chemical bonding & structure, conformations & stereochemistry, organic reactivity & catalysis, organic acids & bases. Nucleophilic substitution, phosphoryl transfer, nucleophilic carbonyl addition, acyl substitution, electrophilic, oxidation, reduction & radical reactions.

CHEM 234L ORGANIC CHEMISTRY LABORATORY (1Cr.: 3Lab)

Experimental work related to the topics discussed in CHEM 234. Co-req.: CHEM 234.

BIME 441 BIOMEDICAL SENSORS (3Crs.: 2Lec, 2Lab)

Introduction to biomedical sensors. Sensors are used for measuring: pressure, temperature, blood flow, motion, PH… Acquisition of biomedical signals, EEG,ECG, EMG…Signal conditioning & noise. Pre-req.: COME 222

BIME 310 BIOMEDICAL INSTRUMENTTION I (3Crs.: 3Lec)

Basic concepts of medical instrumentation, amplifiers & signal processing, biopotential electrodes, biopotential amplifiers, blood pressure & sound ,phono cardiography, cardiac catheterization, measurement of flow & volume of blood indicator-dilution methods, electromagnetic & ultrasonic flow meters, plethysmograph, measurements of the respiratory system, chemical biosensors. Pre-req.: POWE214

BIME 411 BIOMEDICAL INSTRUMENTTION II (3Crs.: 3Lec)
Clinical laboratory instrumentation:spectrophotometry,photometers,fluorometry,automated chemical analyzers, chromatography, electrophoresis, & hematology. Pre-req.: BIME 310

BIME 411L BIOMEDICAL INSTRUMENTTION LAB (1Cr: 2Lab)
The content of this lab is directly related to the courses BIME 310, BIME 411.Co-req: BIME 411

BIME 421 BIOMEDICAL IMAGING I (3Crs.: 3Lec)
This course introduces imaging tools like X-ray, computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine (PET & SPECT), & ultrasound. Introduction to medical image processing & analysis. Pre: COMP 534, COMP 535.

BIME 421L BIOMEDICAL IMAGING I LAB (1Cr, 2Lab)
The content of this lab is directly related to the courses BIME 421. Co-req: BIME 421

BIME 422 BIOMEDICAL IMAGING II (3Crs.: 3Lec)
This course covers magnetic resonance imaging schematics for CT, MRI pulse sequences, MRI instrumentation & equipment, MRI safety. X-ray image geometry, magnification radiography, X-ray site protection. Fluoroscopy, catheterization & endoscopy. Pre: BIME 421

BIME 422 BIOMEDICAL IMAGING II LAB (1Cr, 2Lab)
The content of this lab is directly related to the courses BIME 421, BIME 422
Co-req: BIME 422

BIME 432 BIOLOGIOCAL MATERIALS (3Crs.:2Lec, 2Lab)
Properties of materials used in medicine, biodegradation & toxic kinetic, sterilization processes, cytotoxicity, interactions with blood, genotoxicity, carcinogenicity. Regulatory aspects of biomaterials. Pre-req.: BIOL 231.

C.Biomedical Engineering Program Technical Elective

The BME curriculum includes 6-credit hour courses as technical electives. The courses are chosen from the courses listed in the table below, with their descriptions given thereafter.

Course	Title	Credits	Prerequisite
BIME 511	Cell & Tissue Engineering	3	Pre: BIOL 231
BIME 514	Medical Equipment	3	Pre: BIME 411
BIME 541	Telemedicine	3	Pre: BIOL 337, BIME 411

Description of Technical Elective Courses

BIME 511 CELL & TISSUE ENGINEERING (3Crs.:3Lec, 0Lab)

Applying engineering principles, combined with molecular cell biology, to develop a fundamental understanding of property-function relationships in cells & tissues. Exploiting this understanding to manipulate cell & tissue properties to alter, restore, maintain, or improve cell & tissue functions; & to design bio-artificial tissue substitutes. Pre: BIOL 231

BIME 514 MEDICAL EQUIPMENT (3Crs.:3Lec, 0Lab)

Inspection & preventive maintenance program, hospital & home patient equipment, lab equipment, ventilators, hemodialysis machine, anesthesia machine, diagnosis imaging & radiology machines. Pre: BIME 411

BIME 541 TELEMEDICINE (3Crs.:3Lec, 0Lab)

Describes & analyses the role of information & communications technologies in enabling remote patient care, health professional collaboration at a distance, & in supporting patient-self management. This is considered with reference to technological, clinical, sociological & policy perspectives. Pre : BIOL 337, BIME 411

d.Final Year Project

After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester & ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, & give a presentation on a significant, relevant, & comprehensive engineering problem. The FYP is intended to stimulate student creativity & critical thinking, & build skills in formulating, designing, developing, building, communicating, & managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.
Refer to the Final Year Project Policy for more details.

e.Internship (Approved Experience/ Independent Study)

This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.
Refer to the department policy for further details.

f.Master Courses

RSCH 690 Research Methodology (3Cr.)

Research: a way of thinking, entering into research & research methodology, steps for conducting a successful research: formulating a research problem, conceptualizing a research design, constructing an instrument for data collection, selecting samples, writing a research proposal, collecting data, processing & displaying data, writing a research report. Research at Beirut Arab University: enrollment, intramural grants, incentives … The course contains a project that will help students start their master thesis or project. Research Methodology

BIME 631 LIFE SUPPORT ENGINEERING (3Crs.:3Lec,0Lab)
The course aims at providing the students with fundamental criteria to design & optimize life support systems partially or totally sustaining vital internal organs functions. Insight into technology materials, energy sources & transfer, control features, with reference to application duration of the support will be given together with the evaluation of the patient to machine interaction. Pre: BIME 411

BIME 632 NEURAL ENGINEERING (3Crs.:3Lec,0Lab)
Applying engineering to neuroscience including areas as neural tissue engineering, models of neural function, & neural interface technology. Focusing mainly on the neural interfaces & prosthetics. Pre: BIOL 231

BIME 600 Project-Independent Study (3 Cr)
This course requires participation, under the supervision of a faculty member, in a research study. Before registering, the student must create a proposal regarding the nature of the research, the specific goals of the research, & the desired final report outcome; this proposal must be submitted to & approved by the supervising faculty member & the department before registering.

BIME 699 Master's THESIS (6Crs.)
The Master's project aims to develop an understanding of the field of study beyond the undergraduate degree with emphasis on the conduct of original research, the application of theory into practice through real life models, & the effective communication of information through the appropriate channels. A comprehensive knowledge, as well as training in data interpretation & analytical skills is essential. One of the key goals for the Master's project is to give students the tools & confidence to carry out independent research. In addition, the student must possess the ability to express thoughts clearly, both verbally & in written form.

Study Plan

Bachelor of Engineering in Biomedical Engineering (150 Credits)

First Semester (18 Credits)			Crs.	Pre-co/requisites
COMP	208	Programming I	3	
MATH	282	Calculus	3	
CVLE	210	Statics	3	
PHYS	281	Electricity & Magnetism	3	
MCHE	201	Engineering Drawing & Graphics	3	
BLAW	001	Human Rights	1	
ENGL	001	English Language	2	

Second Semester (17 Credits)			Crs.	Pre-co/requisites
COMP	210	Programming II	3	Pre: COMP 208
MATH	281	Linear Algebra	3	
PHYS	282	Material Properties & Heat	3	
MCHE	213	Dynamics	3	
POWE	210	Fundamentals of Electric Circuits	3	Pre: PHYS 281
		Elective (General)	2	

Third Semester (17 Credits)			Crs.	Pre-co/requisites
BIOL	231	Biology I	3	
BIOL	231L	Biology I Lab	1	Co: BIOL 231
COME	221	Electronic Circuits I	3	Pre: POWE 210
MATH	283	Differential Equations	3	Pre: MATH 281, MATH 282
COMP	221	Digital Systems I	2	
ENGL	211	Advanced Writing	2	
POWE	271	Electromagnetic Fundamentals	3	Pre: PHYS281

Fourth Semester (17 Credits)			Crs.	Pre-co/requisites
COME	212	Network Analysis	2	Pre: POWE 210
COME	212L	Electric Circuits Lab	1	Co: COME 212
MATH	284	Numerical Analysis	3	Pre: MATH 283
COME	222	Electronic Circuits II	3	Pre: COME 221
COME	222L	Electronic Circuits Lab	1	Co: COME 222
COME	232*	Logic Design	3	Pre: COMP 221
COME	232L*	Logic Circuits Lab	1	Co: COME 232
POWE	214	Electric & Electronic Measurements	3	Pre: POWE 271

* These courses are equivalent to COMP 222 & COMP 222L.

Fifth Semester (18 Credits)			Crs.	Pre-co/requisites
COME	381	Signals & Systems	3	
HESC	201	Human Anatomy & Physiology	3	
MATH	381	Probability & Statistics	3	Pre: MATH 282
CHEM	405	Solid State Chemistry	2	
ENGL	300	Speech Communications	2	Pre: ENGL211
ARAB	001	Arabic Language	2	
		Elective (General)	3	

Sixth Semester (18 Credits)			Crs.	Pre-co/requisites
HESC 202	202	Health Care Profession & Bio Ethics	1	
PHYS 352	352	Biophysics	3	
CHEM	234	Organic Chemistry	3	Pre: COME 381
CHEM	234L	Organic Chemistry Lab	1	Co: CHEM 234
BIME	310	Biomedical Instrumentation I	3	Pre: POWE 214
COMP	534	Pattern Recognition	3	
COME	384	Digital Signal Processing	3	Pre: COME 381
		Elective (General)	1	

Seventh Semester (18 Credits)			Crs.	Pre-co/requisites
COMP	535	Digital Image Processing	3	
BIME	411	Biomedical Instrumentation II	3	Pre: BIME 310
BIME	411L	Biomedical Instrumentation Lab	1	Co: BIME 411
BIME	441	Biomedical Sensors	3	Pre: COME 222
BIME	421	Biomedical Imaging I	3	Pre: COMP 534, COMP 535
BIME	421L	Biomedical Imaging I Lab	1	Co: BIME 421
COME	431	Microprocessor Interfacing & Applications	2	Pre: COMP 232
		Elective (General)	2	

Eighth Semester (11 Credits)			Crs.	Pre-co/requisites
BIME	422	Biomedical Imaging II	3	Pre: BIME 421
BIME	422L	Biomedical Imaging II Lab	1	Co: BIME 422
BIME	432	Biological Materials	3	Pre: BIOL 231
INME	221	Engineering Economy	3	
ENGR	001	Engineering Ethics	1	

Ninth Semester (8 Credits)			Crs.	Pre-co/requisites
BIME	499	Internship	1	
COME	501	Final Year Project I	1	
ENVI	302	Environmental Pollution	3	
		Technical Elective	3	

Tenth Semester (8 Credits)			Crs.	Pre-co/requisites
COME	502	Final Year Project II	3	Pre: COME 501
MGMT	002	Entrepreneurship	2	
		Technical Elective	3	

DEPARTMENT OF INDUSTRIAL ENGINEERING & ENGINEERING MANAGEMENT

Academic staff

Chairperson	Hadi Abou Chakra
Assistant Professors	Akram Tannir, Ramzi Fayad
Full- time Instructors	Zeidoun Zeidan
Part-time Lecturers	Rola Sammoura,
Part-time Instructors	Abdel kader Elsaiidi, Amina Al Ashii

Mission

The Department of Industrial Engineering & Engineering Management (INME) mission is to provide graduates who are technically competent; have basic management & inter-personal skills; contemporary & relevant engineering education to design & improve operations in industry, business, & government for the global economy of the 21st century; & promote life-long learning.

Objectives

The department offers a bachelor degree in industrial engineering (IE). The IE program has the following objectives:

1.Graduates will be able to identify & implement effective solutions to real problems by applying contemporary industrial engineering tools & cutting-edge technology in production, quality, safety, supply chain, optimization, economic, manufacturing, service & information systems.

2.Graduates will be able to formulate problems accurately, generate alternative solutions, evaluate those alternatives, & present the best solutions to clients or decision makers in a fashion that facilitates decision-making processes.

3.Graduates will be able to assume leadership roles with strong communication skills & will be able to work competently & ethically alone & as team members.

Learning Outcomes

Upon completion of the program graduates shall be able to:

a.an ability to apply knowledge of mathematics, science, & engineering
b.an ability to design & conduct experiments, as well as to analyze & interpret data
c.an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, & sustainability
d.an ability to function on multidisciplinary teams
e.an ability to identify, formulate, & solve engineering problems
f.an understanding of professional & ethical responsibility
g.an ability to communicate effectively
h.the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, & societal context
i.a recognition of the need for, & an ability to engage in life-long learning
j.a knowledge of contemporary issues

k.an ability to use the techniques, skills, & modern engineering tools necessary for engineering practice.

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Industrial Engineering & Engineering Management consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 10 semesters.

Career Opportunities

Industrial engineering differs from other branches of engineering in essentially two ways. First, it applies to all types of industrial, commercial, & government activities. Second, it is a branch of engineering that is explicitly concerned with people as well as things. Industrial engineers learn to make decisions concerning the best use of people, material, & equipment in achieving an organization's aims. They are spread across nearly all kinds of manufacturing. Recent data show that employment offers are especially plentiful in automotive, electronic equipment, management consulting, chemicals, & food processing. Students develop skills in mathematics, the sciences, communications, & humanities. Therefore, an industrial engineering (IE) degree qualifies professionals for a diverse array of jobs, including: Engineering Project Manager, Senior Lead Analyst, Cost Systems Analyst, Construction Management Engineer & Industrial Management Engineer. This specialist ensures that industrial emissions are moving safely through the production system. A growing trend in IE work, especially consulting, is in the services sector of the economy — banking, transportation, distribution services, & government.

Program Overview

The Student's Study Plan is provided to every IE student upon his/her enrollment. The IE curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences & Mathematics	26
General Engineering topics	15
II. IE Program-Specific Requirements	**Credits**
A. Industrial Engineering core	69
B. Industrial Engineering Electives	9
C. Free Engineering Electives	6
D. Final Year Project	4
E. Internship	1

I.Common Requirements

The list of the Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II.IE Program-Specific Requirements

A.Industrial Engineering Core Courses

The Industrial Engineering core courses are listed in the table below.

Course	Title	Credits	Prerequisite
INME204	Introduction to Industrial Engineering	2	
INME211	Engineering Materials & Technology	3	
INME212	Metal Shaping	3	Pre: INME211
INME214	Manufacturing Processes	3	Pre: INME211
INME222	Operations Research	3	Pre: MATH282
INME312	Computer Aided Design & Manufacturing	3	Pre: INME331 & MATH284
INME321	Management Information Systems	3	Co: INME222
INME322	Organization Design	3	
INME324	Production & Operation Management	3	Co: INME222
INME331	Engineering Design	3	Pre: INME212 & INME214
INME332	Industrial Measurements & Inspection	3	Pre: INME214
INME333	Facility Planning & Design	3	
INME341	Engineering Safety	2	
INME421	Reliability	3	Pre: MATH381
INME422	Engineering Logistics & Supply Chain	3	Pre: INME324
INME423	Project Planning & Management	3	
INME431	System Modeling & Simulation	3	Pre: INME324
INME432	Failure Analysis	3	Pre: INME331
INME433	Maintenance Planning & Technology	3	Pre: INME332
INME434	Statistical Quality & Process Control	3	Pre: MATH381
INME442	Ergonomics	2	
INME521	Total Quality Management & Six Sigma	3	Pre: INME421
INME522	Management of Global Operations	3	
INME531	Production Systems & Automations	3	Pre: INME333

Description of Core Courses

INME 204 INTRODUCTION TO INDUSTRIAL ENGINEERING (2Crs.:2Lec,0Lab)
The course is designed to familiarize first year students with the concept of Industrial Engineering. Introduction to selected topics in Industrial Engineering, including: facilities design, project management, production & operation management, & industrial financial.

INME 211 ENGINEERING MATERIALS TECHNOLOGY (3Crs.:2Lec,2Lab)
Introduction to material & material properties, iron & steel. Structure of metals, principles of materials properties, theory of elasticity, metal alloys, strengthening by heat treatment, material selection for different engineering applications & micro structure of materials, polymers & composites. Phase Diagram, Diffusion of Materials.

INME 212 METAL SHAPING (3Crs.:2Lec,2Lab)
Fundamentals of casting & metal casting processes. Metal forming: bulk & sheet metalworking. Material removal processes. Pre-req.: INME 211.

INME 214 MANUFACTURING PROCESSES (3Crs.:3Lec,0Lab)
Joining & assembly processes such as welding, brazing, soldering, & fastening. Applications of nontraditional machining processes & thermal cutting processes. Economics & product design considerations in machining. Manufacturing processes of polymers & composites. Particulate consolidation processing of metals. Pre-req.: INME 211.

INME 221 ENGINEERING ECONOMY (3Crs.:3Lec,0Lab)
Basics principles & techniques of economic analysis of engineering project, time value of money, cost allocation & estimation, evaluation of engineering projects & investments, depreciation, inflation, bond & loan financing, after tax cash flow analysis, sensitivity analysis, selection cost.

INME 222 OPERATIONS RESEARCH (3Crs.:3Lec,0Lab)
Introduction to operations research models, linear programming, (simplex method & sensitivity analysis), goal programming, transportation, assignment, & deterministic dynamic programming, Queuing theory, dynamic programming, markov decision process, Waiting line & queuing theory, Deterministic & Probabilistic Inventory Model, software applications & demonstrations. Pre-req.: MATH 282.

INME 312 COMPUTER AIDED DESIGN & MANUFACTURING (3Crs.:1Lec,4Lab)
Geometric/solid modeling, design optimization, graphical & computational features of CAD, engineering analysis & design execution & implementation, manual code programming G code, finite element analysis (FEA), contemporary design techniques for solving & analyzing applied design problems using FEA. Pre-req.: INME 331 & MATH 284.

INME 321 MANAGEMENT INFORMATION SYSTEMS (3Crs.:3Lec,0Lab)
Introduction to Management Information Systems (MIS) & examines the role of information systems in supporting a wide range of organizational functions, use of information systems in supporting administrative operations, decision-making, & overall strategic initiatives & corporate philosophies. Pre-req.: INME 222.

INME 322 ORGANIZATION DESIGN (3Crs.:3Lec,0Lab)
Study of design, innovation, change & implementation issues in organizations, structure & process approaches in both new & existing manufacturing & service settings & in green field & redesign situations, team work, participation, reward systems, employee involvement, union management relations, new technology, are also included, case studies, visitors & video examples are used for instruction.

INME 324 PRODUCTION & OPERATION MANAGEMENT (3Cr.:3Lec,0Lab)
Fundamentals of forecasting time series & linear regression, capacity of production systems, inventory control, aggregate planning, material requirement planning MRP, enterprise resource-planning ERP, Just in time JIT & lean operation, decision theory & decision tree. Co-req.: INME 222.

INME 331 ENGINEERING DESIGN (3Crs.:3Lec,0Lab)
General principle of machine design, basic design principle of machine elements, fasteners & fittings, shaft, clutches, gears. Pre-req.: INME 212 & INME 214.

INME 332 INDUSTRIAL MANAGEMENT & INSPECTION (3Crs.:3Lec,0Lab)
Theory of measurements with emphasis on standardization, dimensional & geometrical tolerance on part components, principles of amplification in measurements including mechanical, & different monitoring systems, vibration monitoring analysis of signals, application of Matlab software to analyze vibration signal. Pre-req.: INME 214.

INME 333 FACILITY PLANNING & DESIGN (3Crs.:3Lec,0Lab)
Fundamentals of developing efficient layouts of various production/service systems, travel chart, layout procedures, Time Study, Facility Location, single-facility & multi-facility location problem, material handling system design for production facilities, & flow analysis techniques.

INME 341 ENGINEERING SAFETY (2Crs.:2Lec,0Lab)
Construction & manufacturing safety, engineering principles to control hazards, maintaining optimally safe systems, applications of engineering principles to process safety & hazards analysis, mitigation, & prevention.

INME 421 RELIABILITY (3Crs.:3Lec,0Lab)
Life distribution & their applications in reliability, system reliability models, design by reliability & probabilistic design, reliability analysis through FMECA & FTA, reliability estimation & measurement by testing for binomial, exponential & Weibull distribution. Pre-req.: MATH 381.

INME 422 ENGINEERING LOGISTICS & SUPPLY CHAIN (3Crs.:3Lec,0Lab)
Introduction to supply chain management, supply chain integration, strategic partnering, decision support systems, information technology, customer value & service, supply chain design, product design for logistics, managing inventory in the supply chain, distribution management, international logistics, supply chain integration, strategic partnering, decision support systems. Pre-req.: INME 324.

INME 423 PROJECT PLANNING & MANAGEMENT (3Crs.:3Lec,0Tut)
Principles of project planning, project identification, time frame, project objectives, network construction (activity on arrows, activity on nodes), CPM & PERT applications, cost estimation, earned value analysis, project quality management, crashing of schedules, resource allocation & leveling, computer-based project management.

INME 431 SYSTEM MODELING & SIMULATION (3Crs.:2Lec,2Lab)
Principles of simulation, Systems concepts, modeling, design & analysis of network flows for material & information, modeling of discrete & continuous systems, advanced system modeling, case studies with verification & validation. Application of simulation software to. Pre-req.: INME324.

INME 432 FAILURE ANALYSIS (3Crs.:3Lec,0Lab)
Brittle fracture, ductile fracture, stress residual, Groffith's theory & Irwin's theory, crack initiation, crack propagation & spreading, fraction toughness, reasons of failures, procedures of failure analysis, metallurgical failure analysis, fatigue, creep, case studies. Pre-req.: INME 331.

INME 433 MAINTENANCE PLANNING & TECHNOLOGY (3Crs.:3Lec,0Lab)
Maintenance strategy, maintenance organization, maintenance systems, condition based maintenance, maintenance awareness in design, cost of maintenance team, effectiveness, & case studies. Pre-req.: INME 332.

INME 434 STATISTICAL QUALITY & PROCESS CONTROL (3Crs.:3Lec,0Lab)
Quality control, quality improvement techniques, Pareto diagrams, cause-effect diagrams, scatter diagrams, run charts, cause & effect diagrams, statistical process control using control charts for variables & attributes, & acceptance sampling plans by attributes & variables. Pre-req.: MATH 381.

INME 442 ERGONOMICS (2Crs.:2Lec,0Lab)
The biology of work: anatomical & physiological factors underlying the design of equipment & work places. Biomechanical factors governing physical workload & motor performance, circadian rhythms & shift work, measurement & specification of heat, light, & sound with respect to design of the work environment.

INME 521 TOTAL QUALITY MANAGEMENT & SIX SIGMA (3Crs.:3Lec,0Lab)
Analytical & management tools necessary to solve manufacturing quality problems & implement effective quality systems, voice of the customer analysis, customer satisfaction, TQM, the six Sigma problem-solving methodology, Quality system (ISO standards), Taguchi's quality engineering, measurement system analysis, implementation of statistical process control & quality function deployment. Pre-req.: INME 421.

INME 522 MANAGEMENT OF GLOBAL OPERATIONS (3Crs.:3Lec,0Lab)
Introduction to international operations & multi-national enterprises, study of factors affecting operations in a global environment with focus on international economic issues.

INME 531 PRODUCTION SYSTEMS AUTOMATION (3Crs.:3Lec,0Lab)
Types of automation, production systems, Time Study, system efficiency, mathematical models, automation strategies, cost analysis of automated production line, assembly systems, Manual Assembly Lines, & group technology. Pre-req.: INME333.

B.Industrial Engineering Technical Elective Courses

The IE curriculum includes three 3-creidt hour courses as technical electives. The courses are chosen from the courses listed in the table below with their descriptions given thereafter.

Course	Title	Credits	Prerequisite
INME414	Industrial Scheduling	3	INME324
INME416	Industrial Packaging	3	INME214, INME331
INME418	Plastic Engineering	3	INME214
INME512	Intermediate Stochastic Operation Research	3	INME222
INME514	Business Process Re-engineering	3	MATH381
INME516	Advanced Manufacturing Processes	3	INME214
INME518	Strategic Manufacturing Planning	3	INME214/333
INME535	Advanced Engineering Statistics	3	MATH381
INME537	Analysis of variance & Design of Experiments	3	MATH381
INME539	Reverse Engineering & Prototyping	3	INME331

Description of Technical Elective Courses

INME 414 INDUSTRIAL SCHEDULING (3Crs.:3Lec,0Lab)
basic scheduling models for single machine, parallel machines, flow shops & flexible flow shops, applications in production & services will be used throughout & algorithms will be explained from theoretical & applied perspectives. Pre-req.: INME324.

INME 416 INDUSTRIAL PACKAGING (3Crs.:3Lec,0Lab)
Packaging materials' selection, Manufacturing of food packaging, packaging machinery, packaging line, filling systems, packaging materials & containers. Pre-req.: INME331.

INME 418 PLASTICS ENGINEERING (3Crs.:3Lec,0Lab)
Plastic materials & their processing, review of the pertinent organic chemistry of polymer materials, classification, properties, characteristics & applications of plastics; applications, process parameters, quality, economics & tooling considerations. Pre-req.: INME214.

INME 512 INTERMEDIATE STOCHASTIC OPERATIONS RESEARCH (3Crs.:3Lec,0Lab)
Review of Probability & Introduction to Stochastic Processes, Markov Processes, Chapman-Kolmogorov equations, Brownian motion, Point Processes, Poisson & Birth-Death Processes, Renewal Processes. Pre-req.: INME222.

INME 514 BUSINESS PROCESS RE-ENGINEERING (3Crs.: 3Lec,0Lab)
Topics include business Process diagnosis, design, & development, organizational restructuring, process simplification, job optimization, management systems modeling, performance improvement. Pre-req.: MATH381.

INME 516 ADVANCED MANUFACTURING PROCESSES (3Crs.: 3Lec,0Lab)
Advanced topics in manufacturing materials & processes, including metallic/ nonmetallic materials & their fabrication, non-materials, rapid prototyping, & materials' testing. Pre-req.: INME214.

INME 518-STRATEGIC MANUFACTURING PLANNING (3Crs.:3Lec,0Lab)
Formulate a framework for developing & implementing a manufacturing strategy, develop a framework for the strategic management of manufacturing, technical tools & frameworks that directly apply to operational decisions & that can be useful in adding value to manufacturing firms. Pre-req.: INME214 & INME333

INME 535-ADVANCED ENGINEERING STATISTICS (3Crs.:3Lec,0Lab)
Topics cover advanced statistical tools for engineering that analyze multivariate statistical data. Those include Factor & Component Analysis, Stepwise Regression models & diagnosis, Discriminant & Logistic Regression, MANOVA. Pre-req.: MATH381.

INME 537 ANALYSIS OF VARIANCE & DESIGN OF EXPERIMENTS (3Crs.:3Lec,0Lab)
Comparing several treatments-one factor experiments, completely randomized design, analysis of fixed effects model, matrix approach to the analysis, analysis of random effects model, randomized block & related designs, latin square design. Pre-req.: MATH381.

INME 539 REVERSE ENGINEERING & PROTOTYPING (3Crs.:3Lec,0Lab)
Concept, techniques, analysis & applications of engineering design, fundamentals of design & design principles, conceptual design, importance of sketching, use of computer aided drafting & computer aided design packages, reverse engineering principles, design projects & case studies. Pre-req.: INME331.

C.Free Engineering Elective
The Industrial Engineering program includes a 6-credit hour course taken as Free Engineering Elective. The course may be chosen by the student in consultation with his/her advisor from any engineering major.

D.Final Year Project
After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, & give a presentation on a significant, relevant, & comprehensive engineering problem. The FYP is intended to stimulate student creativity & critical thinking, & build skills in formulating, designing, developing, building, communicating, & managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.
Refer to the Final Year Project Policy for more details.

E.Internship (Approved Experience/ Independent Study)
This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.
Refer to the department policy for further details.

Study Plan

Bachelor of Engineering in Industrial Engineering (150 Credits)

First Semester (18 Credits)			Crs.	Pre-co/requisites
COMP	208	Programming I	3	
MATH	282	Calculus	3	MATH111
PHYS	281	Electricity & Magnetism	3	PHYS120
CVLE	210	Statics	3	
MCHE	201	Engineering Graphics & Visualization	3	
BLAW	001	Human Rights	1	
ARAB	001	Arabic Language	2	

Second Semester (15 Credits)			Crs.	Pre-co/requisites
MATH	281	Linear Algebra	3	MATH112
PHYS	282	Materials properties & Heat	3	
MCHE	213	Dynamics	3	
INME	204	Introduction to Industrial Engineering	2	
ENGL	001	English Language	2	
		Elective (General)	2	

Third Semester (16 Credits)			Crs.	Pre-co/requisites
MATH	283	Differential Equations	3	Pre: MATH 281 & MATH 282
CHEM	207	Environmental Chemistry	2	CHEM110
ENGL	211	Advanced Writing	2	
INME	221	Engineering Economy	3	
INME	211	Engineering Materials & Technology	3	
		Elective (General)	1	
		Elective (General)	2	

Fourth Semester (16 Credits)			Crs.	Pre-co/requisites
MATH	284	Numerical Analysis	3	
ENGL	300	Speech Communications	2	
INME	212	Metal Shaping	3	Pre: INME 211
INME	214	Manufacturing Processes	3	Pre: INME 211
INME	222	Operations Research	3	Pre: MATH 282
		Elective (General)	2	

Fifth Semester (17 Credits)			Crs.	Pre-co/requisites
MATH	293	Probability & Statistics	3	
CHEM	241	Principle of Chemistry	3	
INME	331	Engineering Design	3	Pre: INME 212 & INME 214
INME	333	Facility Planning & Design	3	
INME	341	Engineering Safety	2	
INME	321	Management Information Systems	3	Pre: INME 222

Sixth Semester (16 Credits)			Crs.	Pre-co/requisites
MGMT	002	Entrepreneurship	2	
INME	322	Organization Design	3	
INME	312	Computer Aided Design & Manufacturing	3	Pre: INME 331 & MATH 284
INME	324	Production & Operation Management	3	Co: INME 222
INME	332	Industrial Measurements & Inspection	3	Pre: INME 214
		Elective (General)	2	

Seventh Semester (12 Credits)			Crs.	Pre-co/requisites
INME	431	System Modeling & Simulation	3	Pre: INME 324
INME	433	Maintenance Planning & Technology	3	Pre: INME 332
INME	421	Reliability	3	Pre: MATH 381
INME	423	Project Planning & Management	3	

Eighth Semester (14 Credits)			Crs.	Pre-co/requisites
INME	432	Failure Analysis	3	Pre: INME 331
INME	422	Engineering Logistics & Supply Chain	3	Pre: INME 324
INME	434	Statistical Quality & Process Control	3	Pre: MATH 381
INME	442	Ergonomics	2	
		Technical Elective	3	

Ninth Semester (13 Credits)			Crs.	Pre-co/requisites
INME	499	Internship (Approved Experience / Independent Study)	1	
INME	501	Final Year Project I	1	
INME	531	Production Systems & Automations	3	Pre: INME 333
INME	521	Total Quality Management & Six Sigma	3	Pre: INME 421
		Technical Elective	3	
		Free Engineering Elective	2	

Tenth Semester(13 credits)			Crs.	Pre-co/requisites
INME	502	Final Year Project II	3	Pre: INME 501
INME	522	Management of Global Operations	3	
		Technical Elective	3	
		Free Engineering Elective	4	

DEPARTMENT OF MECHANICAL ENGINEERING

Academic staff

Chairperson	Ali Hammoud
Associate Professors	Ahmed Abdel-Naby, Mohamad Khamis
Assistant Professors	Ossama Mokhaimar, Mohamed Darwish, Semaan Amine Mohammad Kanaan, Amr Ibrahim, Amine Abou Moughlbay Hassan Assoum, Mohamad Ali
Part-time Lecturers	Bilal Taher, Ziad Naga, Mazen Badawiyeh, Khodor Yassin, Nagham Ismail Atef Al Khatib

Mission

The Mechanical Engineering Department is devoted to educating exemplary mechanical engineers by instituting best learning practices that drives knowledge, build skills & competencies, & inspire the learner to define a purpose, develop a passion to forever learn, cultivate a sense of responsibility toward the profession, society & the environment, & attain the ability to confront challenges, & in so doing contribute to the advancement of the community, immediate & beyond.

Objectives

The educational objectives of the ME program are determined to support career advancement of the graduates & as they pursue their career goals, the graduates will:

1. Be competent to handle complex engineering tasks & provide innovative solutions through the integration of best practices.
2. Be recognized for their ability to pursue graduate studies in mechanical engineering & related interdisciplinary areas
3. Demonstrate leadership in their fields of expertise & service to local & international communities

Learning Outcomes

Upon completion of the program, graduates shall develop:

a. an ability to apply knowledge of mathematics, science, & engineering
b. an ability to design & conduct experiments, as well as to analyze & interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, & sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, & solve engineering problems
f. an understanding of professional & ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, & societal context
i. a recognition of the need for, & an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, & modern engineering tools necessary for engineering practice

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Mechanical Engineering consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 10 semesters.

Career Opportunities

Mechanical engineers attain a broad spectrum of skills sought by almost every profession. Industries, enterprises, & service providers requiring mechanical engineering skills include: power generation & distribution, building & construction, medicine & pharmacology, aerospace, automotive, food, process, security, computers & electronics, renewable energy, consulting, entertainment, water resources, sports, environmental institutions, & government. Most importantly, you can imagine something that never was & make it a reality! There is so much work to be done to guarantee the future of mankind & mechanical engineers can tap the possibilities through the spirit of innovation & entrepreneurism.

Program Overview

The Student's Study Plan is given to every ME student upon his/her enrollment. The ME curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences & Mathematics	26
General Engineering topics	15
II. ME Program-Specific Requirements	**Credits**
A. Engineering topics from outside the major	15
B. Mechanical Engineering Core	60
C. Mechanical Engineering Technical Electives	6
D. Free Engineering Electives	3
E. Final Year Project	4
F. Internship	1

I.Common Requirements

The list of the Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II.ME Program-Specific Requirements

A.Engineering topics from outside the major

This part of the ME curriculum includes 15-credits courses offered by other engineering programs. These courses are listed in the table below.

Course	Title	Credits	Prerequisite
INME 211	Engineering Materials & Technology	3	
INME 214	Manufacturing Processes	3	
POWE 210	Electric Circuits	3	Pre: PHYS 281
POWE 238	Electronics	2	Pre: POWE 210
POWE 238L	Circuits & Electronics Lab	3	Co: POWE 238
POWE 333	Electric Machines & Drives	1	Pre: POWE 210

Descriptions of this group of courses are given below.

INME 211 ENGINEERING MATERIALS & TECHNOLOGY (3Crs.:2Lec,2Lab)
Introduction to material & material properties, iron & steel. Structure of metals, principles of materials properties, theory of elasticity, metal alloys, strengthening by heat treatment, material selection for different engineering applications & micro structure of materials, ferrous materials, non-ferrous materials, polymers & composites.

INME 214 MANUFACTURING PROCESSES (3Crs.:3Lec,0Lab)
Joining & assembly processes such as welding, brazing, soldering, & fastening. Applications of nontraditional machining processes & thermal cutting processes. Economics & product design considerations in machining. Manufacturing processes of polymers & composites. Particulate consolidation processing of metals. Pre-req.: INME 211.

POWE 238 CIRCUITS & ELECTRONICS LAB (1Cr.:0Lec,2Lab)
Passive electronic components; laboratory instruments; voltage-divider & bridge circuits; RC filters & lead-lag networks; LEDs; Zener regulator; diode rectifier circuits; BJT, IGBT, & MOSFET applications; op-amp circuits; filters & oscillators. Pre-req.: POWE 210; Co-req.: POWE 238.

POWE 210 FUNDAMENTAL OF ELECTRIC CIRCUITS (3Crs.:3Lec,0Lab)
DC circuit analysis: reduction methods, mesh current & node voltage analysis methods, transformation methods, DC network theorems, capacitors & inductors, phasors & AC steady state circuit analysis, series & parallel resonance, power in AC circuits, balanced & unbalanced three-phase circuits. Pre-req.: PHYS 281.

POWE 238 POWER ELECTRONICS (2Crs.:2Lec,0Lab)
Basic electronic components; overview of analog & digital electronic circuits; semiconductors & the PN Junction; diode circuits & applications; rectification – half- & full-wave; bipolar junction transistors, IGBT, & MOSFET operation & circuits; motor drives; operational amplifiers; applications. Pre-req.: POWE 210.

POWE333 ELECTRIC MACHINES & DRIVES (3Crs.:3Lec,0Lab)
Single-Phase & 3-phase Transformers; Power Transmission & Distribution; DC Machines, Motors; Synchronous Generators; Poly-Phase Induction Motors. Pre-req.: POWE 238.

B.Mechanical Engineering Core Courses
The Mechanical Engineering core courses are listed in the table below.

Course	Title	Credits	Prerequisite
MCHE 201	Engineering Drawing & Graphics	3	
MCHE 204	Foundation of Mechanical Engineering	3	
MCHE 213	Dynamics	3	
MCHE 216	Dynamics of Machinery I	3	Pre: MCHE 213
MCHE 302	Measurement & Instrumentation	3	Pre: POWE 238
MCHE 302L	Measurement & Instrumentation Lab	1	Co: MCHE 302
MCHE 311	Mechanics of Materials	3	Pre: CVLE 210; Co: INME211
MCHE 312	Machine Design I	3	Pre: MCHE 311
MCHE 317	Dynamics of Machinery II	3	Pre: MCHE 216
MCHE 321	Thermodynamics I	3	Pre: PHYS 282
MCHE 322	Thermodynamics II	3	Pre: MCHE 321
MCHE 331	Fluid Mechanics I	3	Pre: PHYS 282;
MCHE 332	Fluid Mechanics II	3	Pre: MCHE 331
MCHE 411	Machine Design II	3	Pre: MCHE 312
MCHE 412	Dynamic Systems- Modeling & Analysis	3	MATH 283 MCHE 216
MCHE 414	Applied Mechatronics	3	Pre: MCHE 302, POWE 333
MCHE 421	Heat Transfer	3	Pre: MATH 284, MCHE 321
MCHE 422	Refrigeration & Air Conditioning	3	Pre: MCHE 421
MCHE 429	Thermo-fluids Lab	2	Pre: MCHE 332; Co: MCHE 421
MCHE 511	Dynamic Systems- Control	3	Pre: MCHE 412
MCHE 521	Thermal Power Stations	3	Pre: MCHE 421
MCHE 531	Pump Technology	3	Pre: MCHE 332
MCHE 532	Fluid Systems Design	3	Pre: MCHE 332

Description of Core Courses

MCHE 201 ENGINEERING DRAWING & GRAPHICS (3Crs.:2Lec,2Lab)
Constructional Geometry-constructing tangents. Plane curves & polygons. Orthographic drawing & theory of sketching shapes & surface identification. Orthographic projection of views. Sectional views & conventions. Pictorial drawing. Applications of Auto-CAD for 2D drawings.

MCHE 204 FOUNDATION OF MECHANICAL ENGINEERING (3Crs.:3Lec,0Lab)
The purpose of this course is to introduce students to the field of Mechanical Engineering (ME) & prospective job opportunities. It also gives students a "panoramic view" of the three areas of concentration in the ME curriculum: Thermo-fluid systems, Mechanical systems, & Automotive engineering. Major principles of hydrostatics, thermodynamics, internal combustion engines, & mechanics of materials are introduced. Issues of report writing are also emphasized.

MCHE 213 DYNAMICS (3Crs.:3Lec,0Tut)
Kinematics of a particle. Kinetics of a particle & system of particles: Free-body diagram & concept of equilibrium, Newton's laws of motion, Work & energy principle, Linear impulse & momentum principle. Planar motion & kinematics of rigid bodies.

MCHE 216 DYNAMICS OF MACHINERY-I (3Crs.:3Lec,0Lab)
Principles of motion generation & introduction to the concepts of mobility, degrees of freedom & kinematic chains. Kinematics analysis of linkage mechanisms. Types & synthesis of cam-follower mechanisms for specified follower motion. Synthesis of linkage mechanisms for motion, path & function generation. Computer-aided analysis project. Pre-req.: MCHE 213.

MCHE 302 MEASUREMENT & INSTRUMENTATION (3Cr.:3Lec,0Lab)
Elements of a measurement system. Classification of sensors, sensor characteristics, sensor types. Statistical analysis of data, curve fitting, & uncertainty analysis. Physical principles. Interfacing concepts - amplification, filtering, A/D conversion, etc. Team project to design & build a measurement instrument. Pre-req.: POWE 238.

MCHE 302L MEASUREMENT & INSTRUMENTATION LAB (1Cr.:0Lec,2Lab):
Introduction to LABVIEW. Experiments to measure various physical quantities. Data acquisition & analysis using NI-ELVIS platform. Typical laboratory experiments involve building signal conditioning circuits for thermocouples, thermistors, photodiodes, strain gauges, accelerometers, etc. Team project to formulate & develop a measurement system. Co-req.: MCHE 302.

MCHE 311 MECHANICS OF MATERIALS (3Crs.:3Lec,0Lab)
Introduction to the mechanics of deformable bodies considering linear material response. Load-stress, stress-strain, & strain-displacement relations. Tension/ compression of rods & trusses, torsion of shafts, bending in beams, bucking of columns, & pressure vessels. Analysis of combined loading. Mohr circle analysis. Stress-strain transformations. Statically indeterminate structures. Pre-req.: CVLE 210; Co-req.: INME 211.

MCHE 312 MECHANICAL DESIGN-I (3Crs.:3Lec,0Lab)
Overview of the mechanical design process. Analytical concepts & tools for the design of machine elements. Failure theories. Design for strength under static & fatigue loading. Design for rigidity. Design of shafts. Design of non-permanent joints & power screws. Design of permanent joints. Design of mechanical springs. Computer aided applications. Pre-req.: MCHE 311.

MCHE 317 DYNAMICS OF MACHINERY II (3Crs.:3Lec,0Lab)
Types of gears, gear tooth terminology & relations for spur gearing. Kinematic analysis of ordinary & planetary gear trains. Kinetostatic analysis of rigid mechanisms. Balancing of mechanisms & rotating machinery. Flywheel design. Pre-req.: MCHE 216.

MCHE 321 THERMODYNAMICS I (3Crs.:3Lec,0Lab)
Introduction & basic concepts. Properties of pure substances. Energy analysis of closed systems. Mass & energy analysis of control volumes. Second law of Thermodynamics. Heat engines & Carnot cycle. Refrigerators & heat pumps. Entropy. Gas power cycles & ideal cycles for reciprocating engines. Vapor refrigeration cycles. Introduction to psychrometry. Pre-req.: PHYS 282.

MCHE 322 THERMODYNAMICS II (3Crs.:3Lec,0Lab)
Rankine cycle. Reheat & regenerative steam power generation plants. Gas turbines & Brayton cycle including regeneration, inter-cooling, & reheat. Cogeneration & combined cycles. Thermodynamic analysis of power plants. Steam flow through nozzles. Steam flow through turbines, Classification of steam turbines, Forces exerted on different types of turbine blades. Computer applications. Pre-req.: MCHE 321.

MCHE 331 FLUID MECHANICS I (3Crs.:3Lec,0Lab)
Fluid static, Forces on immersed surfaces, buoyancy & stability of floating bodies, Fluid Flow kinematics, fluid masses subjected to acceleration, vortex motion, hydrodynamics, momentum equation, Euler's & Bernoulli's equations, fluid flow in pipelines. Pre-req.: PHYS 282.

MCHE 332 FLUID MECHANICS II (3Crs.:3Lec,0Lab)
Fluid flow kinematics for three-dimensional fluid motions. Elementary hydrodynamics. Basic & combined flow field applications. Dynamics of compressible & incompressible flow. Continuity equation. Navier-Stokes equations, Dimensional analysis using PI-Theorem. Boundary layers. Lift & drag Forces. Fluid film lubrication. Pre-req.: MCHE 331.

MCHE 411 MECHANICAL DESIGN II (3Crs.:3Lec,0Lab)
Power transmission systems. Analysis & synthesis of various types of gear trains. Geometry & force analysis of helical, bevel & worm gears & gear trains. Design of gear drives for strength using AGMA standards for spur, helical, bevel & worm gearing. Selection of rolling bearings. Design of belt & chain drives. Design of clutches & brakes. Computer-aided applications. Team project to formulate & design a mechanical system for a useful purpose. Pre-req.: MCHE312.

MCHE 412 DYNAMIC SYSTEMS – MODELING & ANALYSIS (3Crs.:3Lec,0Lab)
Introduction to dynamic modeling of mechanical, electrical, thermal & fluid systems. State-space equations. Analysis of linear systems. Time- & frequency-domain analysis. Laplace transform techniques. Nonlinear systems. Introduction to dynamic systems characteristics & performance. Simulation using Matlab & Simulink. Pre-req.: MATH 283 & MCHE 216.

MCHE 414 APPLIED MECHATRONICS (3Crs.:2Lec,2Lab)
Introduction to designing mechatronic systems & embedded technology platforms for real-time control. Microcontroller programming. Programmable timers. A/D & D/A conversion. Hardware/software development tools. Digital logic. Team project to develop & commission an MCU controlled mechatronic system. Pre-req.: MCHE 302 & POWE 333.

MCHE 421 HEAT TRANSFER (3Crs.:3Lec,0Lab)
Concepts & laws of conduction, convection & radiation heat transfer & their application to solving engineering thermal problems. Steady & transient heat conduction. Heat generation. Extended surfaces. External & internal forced convection of laminar & turbulent flows. Natural convection. Heat exchanger principles. Thermal radiation, view factors, & radiation exchange between gray bodies. Boiling & condensation. Pre-req.: MATH 284 & MCHE 321.

MCHE 422 REFRIGERATION & AIR CONDITIONING (3Crs.:3Lec,0Lab)
Introduction to refrigeration methods: Air refrigeration, steam jet, thermoelectric, absorption, vapor compression system, psychometric processes & cycles, cooling & heating loads, duct design, air conditioning systems, noise criteria, fan selection, air outlet types & selection. Pre-req.: MCHE 421.

MCHE 429 THERMO-FLUIDS LAB (2Crs.:0Lec,4Lab)
Experiments relevant to thermodynamics, heat transfer, thermal processes, fluid systems & hydraulic machines. Measurement of thermal conductivity, convective heat transfer coefficients, & heat by radiation. Testing various heat exchangers. Renewable energy measures. Assessment of desalination systems. Forces on submerged surfaces. Vortex motion. Stability of floating bodies. Elementary hydrodynamics. Basic flow fields & combined flow. Major & minor loss in pipes, pipes in series & parallel connections. Pre-req.: MCHE 332;Co-req.: MCHE421.

MCHE 511 DYNAMIC SYSTEMS –CONTROL (3Crs.:2Lec,2Lab)
Modeling of systems in various energy domains. Transfer function. Block reduction techniques & signal flow graph models. Time-domain analyses & the root-locus method. Frequency-domain methods. Stability analysis. Design of PID controllers & dynamic compensators. Frequency response & Bode plots. Control experiments that includes: DC Motor, HVAC system, & inverted pendulum. Applications using Matlab. Team project to model & control of a dynamic system. Pre-req.: MCHE 412.

MCHE 521 THERMAL POWER STATIONS (3Crs.:3Lec,0Lab)
Systems & cycles used in electrical power generation. Overview of plants operating on fossil fuel, nuclear energy & solar energy, steam turbine, combined cycle plants. Nuclear power generation & the steam generation systems, heat recovery systems, the condenser systems, pumps & cooling tower. Pre-req.: MCHE 421.

MCHE 531 PUMP TECHNOLOGY (3Crs.:3Lec,0Lab)
Water piping system calculations. Pump classifications. Centrifugal pump construction. Pump performance curves, operating points, discharge regulation, similarity, speed variation, & cavitation. Pumps in series & parallel. Multi-stage pumps, axial flow pumps. Viscosity effect on the pump performance. Effect of air entraining vortex from pump suction side on the pump performance. Priming of pumps. Manual testing of pump performance (head-capacity, power & efficiency). Pump station design project. Pre-req.: MCHE 332

MCHE 532 FLUID SYSTEM DESIGN (3Crs.:3Lec,0Lab)
Specifications of pumps. Design, operation selection, & maintenance of water pumps. Pump stations design. Specifications of fans, compressors, & blowers. Design, operation & fans selection for ventilation systems. Fire pump specifications & safety codes. Mechanical specification codes & standards. Application of thermo-fluids system design in water heating radiators system including boiler & heat exchanger. Chiller piping system applications. Project-1 in design, calculation, & drawing of cold & hot water piping systems in buildings. Project-2 implementing thermo fluid systems in ventilation systems in buildings. Pre-req.: MCHE 531.

C.Mechanical Engineering Technical Elective
The ME curriculum includes two 3-creidt hour courses as technical electives. The courses are chosen from the courses listed in the table below with their descriptions given thereafter.

Course	Title	Credits	Prerequisite
MCHE 461	Applied Robotics	3	Pre: MCHE 213 & either MCHE 302 or COMP 431
MCHE 512	Engineering Vibrations	3	Pre: MCHE 412
MCHE 513	Finite Element Analysis – Theory & Applications	3	MCHE 312 or CVLE 312

MCHE 514	Programmable Logic Controllers	3	Pre: MCHE 302
MCHE 517	Design of Planar Mechanisms	3	Pre: MCHE 317
MCHE 518	Product Design & Development	3	Pre: MCHE 411
MCHE 523	Thermal Equipment Design	3	Pre: MCHE 421
MCHE 525	Renewable Energy Technologies	3	Pre: MCHE 321
MCHE 526	Energy Management	3	Pre: MCHE 321
MCHE 527	Gas Turbines Technology	3	Pre: MCHE 322
MCHE 533	Hydraulic Machinery & Stations	3	Pre: MCHE 332
MCHE 534	Pipe-line Engineering	3	Pre: MCHE 332
MCHE 535	Hydraulic Circuits	3	Pre: MCHE 331
MCHE 536	Hydraulic Equipment	3	Pre: MCHE 535
MCHE 537	Pneumatic Circuits & Applications	3	Pre: MCHE 331
MCHE 538	Compressed Air Technology	3	Pre: MCHE 331
MCHE 539	Gas Dynamics	3	Pre: MCHE 321 & MCHE 331
MCHE 561	Robotic Control & Intelligent Systems	3	Pre: MCHE 461
MCHE 562	Sensors & Actuators	3	Pre: MCHE 302
MCHE 563	Applied Engineering Optimization	3	Pre: MCHE 411
MCHE 564	Automotive Engineering	3	
MCHE 565	Technology Ventures	3	Pre: MGMT 002 & INME 221
MCHE 571	Refrigeration & HVAC Applications	3	Pre: MCHE 422
MCHE 572	Water Desalination Technologies	3	MCHE 421
MCHE 573	Operation & management of Thermal Power Stations	3	Pre: MCHE 521
MCHE 581	Computational Fluid Dynamics	3	Pre: MCHE 332 & MCHE 421

Description of Technical Elective Courses

MCHE 461 APPLIED ROBOTICS (3Crs.:2Lec,2Lab)

Robot architecture, subsystems, & applications; mechanisms & drives; forward & inverse kinematics; trajectory planning; dynamics & control; actuators & drive electronics; sensors & interface; mobile robots & navigation; intelligence; collaborative learning; team project. Pre-req.: MCHE 213 & either MCHE 302 or COMP 431.

MCHE512 ENGINEERING VIBRATIONS (3Crs.:3Lec,0Lab)
Introduction to vibration & the free response, forced response of un-damped & damped systems, vibration isolation, vibration absorbers, multiple degree of freedom systems, vibration measurement, distributed parameter systems. Pre-req.: MCHE412

MCHE 513 FINITE ELEMENT ANALYSIS –THEORY & APPLICATIONS (3Crs.:3Lec,0Lab)
Introduction to the theoretical basis of finite element method & its application in solving engineering problems. Topics covered include: Overview of the finite element solution; basic finite elements; modeling considerations; static, modal & dynamic analysis of structures & mechanical systems; solution of field problems; commercial finite element software package. Project. Pre-req.: MCHE312 or CVLE 312.

MCHE 514 PROGRAMMABLE LOGIC CONTROLLERS (3Crs.:2Lec,2Lab)
PLC operation. PLC memory; Ladder logic; structured logic, flowchart-based, & state-based design; instruction list & structured text programming; Interface of sensors, actuators, & I/O devices; selecting PLC; development of PLC-based systems; lab experiments. Projects. Pre-req.: MCHE302.

MCHE 517 DESIGN OF PLANAR MECHANISMS (3Crs.:3Lec,0Lab)
Kinematics chains, creation of mechanisms, & mobility analysis, synthesis of single- & multi-loop mechanisms for various motion requirements, synthesis of multi-loop mechanisms, synthesis of geared-linkage mechanisms, Synthesis of mechanisms for instantaneous motion generation, Optimum synthesis of mechanisms. Computer-aided analysis & synthesis. Project. Pre-req.: MCHE 317.

MCHE 518 PRODUCT DESIGN & DEVELOPMENT (3Crs.:3Lec,0Lab)
Modern tools & methods involving product design & development process. Product planning; Idea generation; concept generation; concept selection; functional analysis; engineering design process for systems & components; economic & environmental considerations; reliability analysis; product safety; Team project to transform idea into a product. Pre-req.: MCHE 411.

MCHE 523 THERMAL EQUIPMENT DESIGN (3Crs.:3Lec,0Lab)
The course introduces codes & classifications of shell & tube heat exchangers specially TEMA designation. Description of plate type heat exchangers, spiral type heat exchangers, direct contact heat exchangers is introduced. Issues regarding inspection, testing, & modeling of various thermal systems are covered in the course. Computer programs & software applications for rating, design & simulation are integrated into the assignment & course project report. Pre-req.: MCHE 421.

MCHE 525 RENEWABLE ENERGY TECHNOLOGIES (3Crs.:3Lec,0Lab)
The course provides students with the fundamentals, design tools, & state-of-the-art alternative energy technologies. Emphasis is given to solar energy fundamentals, design & performance evaluation of solar collectors, passive & active applications of solar energy, thermal & electric energy storage. Other alternative energy technologies

such as wind, hydro, geothermal, ocean thermal energy conversion are introduced. The economics of alternative energy & their potential in the Arab region is highlighted. Pre-req.: MCHE 321.

MCHE 526 ENERGY MANAGEMENT (3Crs.:3Lec,0Lab)
The course introduces the concepts & techniques of energy management & conservation based on the national statistics of energy supply & demand. Scope of the energy problems & approaches to provide solutions; energy auditing; improving energy utilization in space conditioning & steam, hot water & compressed air systems; energy savings opportunities in refrigeration & cooling systems; insulation; & electrical energy conservation are highlighted. Pre-req.: MCHE 321.

MCHE 527 GAS TURBINES TECHNOLOGY (3Crs.:3Lec,0Lab)
Gas Turbine engine, performance of compressors, turbines & combustors; Gas Turbine thermodynamic cycles; Combustors fuels & emissions; Gas Turbine applications & implications to the user, Gas turbine maintenance strategies, Gas turbine procurement, condition monitoring, usage & retention. Pre-req.: MCHE 322.

MCHE 533 HYDRAULIC MACHINERY & STATIONS (3Crs.:3Lec,0Lab)
Hydraulic turbines, Pelton wheel, Francis, propeller & Kaplan turbines, construction, design factors, discharge regulation & part load performance, model testing, cavitations & turbine selection, hydropower plants, types, capacity, number of units, pump storage projects, hydro-power plants in Lebanon. Pre-req.: MCHE 332.

MCHE 534 PIPE-LINE ENGINEERING (3Crs.:3Lec,0Lab)
Pipes in parallel & series, three pipe reservoirs , Pipe Network single- & two- phase flow for incompressible flow in pipelines, Water Hammer, pipes, fittings, valves, accessories, standards, pipeline installation, operation, monitoring & maintenance. Pre-req.: MCHE 332.

MCHE 535 HYDRAULIC CIRCUITS (3Crs.:2Lec,2Lab)
Design of basic hydraulic circuits, elements of hydraulic circuits & design factors, Positive displacement oil pumps as sources of hydraulic power, oil reservoirs, pipes, control valves: pressure, direction & flow control, fluid power actuators: hydraulic cylinders, hydraulic motors, standard symbols according to ANSI Standard & graphical representation, basic hydraulic circuits & applications in practice. Pre-req.: MCHE 331.

MCHE 536 HYDRAULIC EQUIPMENT (3Crs.:3Lec,0Lab)
Hydraulic system design, design problems & analysis, applications: hydraulic presses, shearing machines, hydraulic cranes, hydraulic lifts, loaders, excavators, mixers, concrete pump, pile drilling machine, hydraulic equipment maintenance & troubleshooting. Pre-req.: MCHE 535.

MCHE 537 PNEUMATIC CIRCUITS & APPLICATIONS (3Crs.:3Lec,0Lab)
Elements of pneumatic circuits & design factors, Compressed air characteristics, System components, Compressors, Air reservoirs, Actuators, Cylinders, Motors, Pneumatic system control, Standard symbols & graphical representation, Basic pneumatic circuits & applications in practice. Pre-req.: MCHE 331.

MCHE 538 COMPRESSED AIR TECHNOLOGY (3Crs.:3Lec,0Lab)
Compressed air system definition & its applications in industry, System components: Compressors, Air reservoirs, Pipes, Air treatment devices: dryers, filters. System leakage resources & Control. Maintenance & Troubleshooting. Pre-req.: MECE 331.

MCHE 539 GAS DYNAMICS (3Crs.:3Lec,0Lab)
One-dimensional steady motion with area change, flow in ducts with friction, flow with heating & cooling, normal & oblique shock waves, applications & analysis in aero jet engines & components. Pre-req.: MCHE 321 & MCHE 331.

MCHE 561-ROBOTIC CONTROL & INTELLIGENT SYSTEMS (3Crs.:3Lec,0Lab)
Robotics & robot subsystems & architectures. Kinematics & workspace of serial & parallel-drive manipulators. Static force & torque analysis. Trajectory planning, dynamics & control. Metrics of robot performance. Walking machines & mobile robots. Intelligent systems. Computer-aided analysis. Project. Pre-req.: MCHE461.

MCHE 562 SENSORS & ACTUATORS (3Crs.:3Lec,0Lab)
Introduction to contemporary sensor & actuator technologies. Smart sensor & actuator materials (piezoelectric, shape memory alloys, electro-rheological, etc.). Application Specific Integrated Circuits (ASIC). Smart sensors & sensor fusion. Project. Pre-req.: MCHE302.

MCHE 563 APPLIED ENGINEERING OPTIMIZATION (3Crs.:3Lec,0Lab)
Problem definition, objective functions & constraint; local vs. global optimization methods; deterministic vs. stochastic methods; linear & non-linear programming methods; gradient-based methods; combinatorial optimization techniques: Genetic algorithm, simulated annealing, tabu search, & ant colony; applications to various mechanical engineering problems; computer-aided solutions; project. Pre-req.: MCHE 411.

MCHE 564 AUTOMOTIVE ENGINEERING (3Crs.:3Lec,0Lab)
Studies of automotive components, modules, & systems - engines, fuel systems, ignition systems, cooling, lubrication, power boosting, transmission, steering, braking, suspension & damping, starting & recharging, emission control; latest trends in automotive technology.

MCHE565 TECHNOLOGY VENTURES (3Crs.:3Lec,0Lab)
This course teaches students how to articulate a well-reasoned, easily understood business plan, understand the product realization process, set & achieve targets, prepare budgets, find capital by effectively communicating the idea to those who can finance it, hire the right mix of marketing & technical talent, know the market by engaging in real time market research, & focus on the customer; team project. Pre-req.: MGMT 002 & INME 221.

MCHE 571 REFRIGERATION & HVAC APPLICATIONS (3Crs.:2Lec,2Lab)
Evaporator types & selection, condenser types & selection, compressor types & selection, expansion devices types & selection, refrigeration piping design, HVAC specifications codes & standards, air refrigeration system, absorption refrigeration system, ventilation applications design, cold store design. Pre-req.: MCHE 422.

MCHE572 WATER DESALINATION TECHNOLOGIES (3Lec,0Lab)
This course surveys the state-of-the-art in water purification by desalination & filtration. Fundamentals & thermal analyses of desalination plants are introduced; existing desalination technologies including MED, MSF, & RO systems; factors affecting the performance or the affordability of desalination technologies; economics, operation & maintenance; treatment of corrosion & scale deposits & industrial waste water treatment. Pre-req.: MCHE 421.

MCHE 573 OPERATION & MANAGEMENT OF THERMAL POWER STATIONS (3Crs.:3Lec,0Lab)
Various systems & cycles used in producing electrical power. An overview on various types of plants operating on fossil fuels & nuclear energy. Emphasis is on gas turbine, steam turbine, combined cycle plants & traditional steam-generation plants burning fossil fuel such as natural gas or oil. Boiler room operation & management, water treatment, boiler devices & their control systems, boiler testing & maintenance, turbine governing systems types & operation, variable load management & power plants economics & power distribution systems. Pre-req.: MCHE 521.

MCHE 581 COMPUTATIONAL FLUID DYNAMICS (3Crs.:3Lec,0Lab)
Introduction to the methods & analysis techniques used in computational solutions of fluid mechanics & heat transfer problems; finite difference method; partial differential equations; discretization approaches; stability, consistency, & convergence; finite-volume formulations; explicit & implicit methods; code & solution verification; incompressible flows; validation & uncertainty quantification; simulation & design using commercial CFD code. Pre-req.: MCHE 332 & MCHE 421.

D.Free Engineering Elective
The ME program includes a 3-credit hour course taken as Free Engineering Elective. The course may be chosen by the student in consultation with his/her advisor from any engineering major.

E.Final Year Project
After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester & ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, & give a presentation on a significant, relevant, & comprehensive engineering problem. The FYP is intended to stimulate student creativity & critical thinking, & build skills in formulating, designing, developing, building, communicating, & managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.
Refer to the Final Year Project Policy for more details.

F.Internship (Approved Experience/ Independent Study)
This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.
Refer to the department policy for further details.

Study Plan

Bachelor of Engineering in Mechanical Engineering (150 Credits)

First Semester (17 Credits)			Crs.	Pre-co/requisites
COMP	208	Programming I	3	
MATH	281	Linear Algebra	3	
CHEM	241	Principles of Chemistry	3	Pre: MATH 112
PHYS	282	Material Properties & Heat	3	
MCHE	201	Engineering Graphics & Visualization	3	
ARAB	001	Arabic Language	2	

Second Semester (17 Credits)			Crs.	Pre-co/requisites
MCHE	204	Foundation of Mechanical Engineering	3	
MATH	282	Calculus	3	Pre: MATH 111
CVLE	210	Statics	3	
PHYS	281	Electricity & Magnetism	3	
CHEM	405	Solid State Chemistry	2	Pre: PHYS 120
BLAW	001	Human Rights	1	
ENGL	001	English Language	2	

Third Semester (16 Credits)			Crs.	Pre-co/requisites
POWE	210	Electric Circuits	3	Pre: PHYS 281
INME	211	Engineering Materials & Technology	3	
MATH	283	Differential Equations	3	Pre: MATH 281, MATH 282
MCHE	213	Dynamics	3	
ENGL	211	Advanced Writing	2	Pre: ENGL 001
		Elective (General)	2	

Fourth Semester (16 Credits)			Crs.	Pre-co/requisites
MCHE	216	Dynamics of Machinery I	3	Pre: MCHE 213
INME	214	Manufacturing Processes	3	Pre: INME 211
MATH	284	Numerical Analysis	3	Pre: MATH 283
POWE	238	Power Electronics	2	Pre: POWE 210
POWE	238L	Circuits & Electronics Lab	1	Co: POWE 238
ENGL	300	Speech Communications	2	Pre: ENGL 211
		Elective (General)	2	

Fifth Semester (16 Credits)			Crs.	Pre-co/requisites
MCHE	317	Dynamics of Machinery II	3	Pre: MCHE 216
MCHE	321	Thermodynamics I	3	Pre: PHYS 282
MCHE	331	Fluid Mechanics I	3	Pre: PHYS 282
MCHE	311	Mechanics of Materials	3	Pre: CVLE 210 Co: INME 211
MGMT	002	Entrepreneurship I	2	
		Elective (General)	2	

Sixth Semester (15 Credits)			Crs.	Pre-co/requisites
MCHE	322	Thermodynamics II	3	Pre: MCHE 321
MCHE	332	Fluid Mechanics II	3	Pre: MCHE 331
MCHE	302	Measurement & Instrumentation	3	Pre: POWE 238
MCHE	302L	Measurement & Instrumentation Lab	1	Co: MCHE 302
MCHE	312	Machine Design I	3	Pre: MCHE 311
		Elective (General)	2	

Seventh Semester (15 Credits)			Crs.	Pre-co/requisites
MCHE	421	Heat Transfer	3	Pre: MATH 284 & MCHE 321
MCHE	411	Machine Design II	3	Pre: MCHE 312
POWE	333	Electric Machines & Drives	3	Pre: POWE 238
MATH	381	Probability & Statistics	3	Pre: MATH 282
MCHE	429	Thermo-fluids Lab	2	Pre: MCHE 332, Co: MCHE 421
ENGR	001	Engineering Ethics	1	

Eighth Semester (12 Credits)			Crs.	Pre-co/requisites
MCHE	412	Dynamic Systems- Modeling & Analysis	3	Pre: POWE 210, MCHE 213
MCHE	422	Refrigeration & Air Conditioning	3	Pre: MCHE 421
MCHE	414	Applied Mechatronics	3	Pre: MCHE 302, POWE 333
INME	221	Engineering Economics	3	

Ninth Semester (14 Credits)			Crs.	Pre-co/requisites
MCHE	499	Internship (Approved Experience / Independent Study)	1	
MCHE	531	Pump Technology	3	Pre: MCHE 332
MCHE	521	Thermal Power Stations	3	Pre: MCHE 421
MCHE	511	Dynamic Systems- Control	3	Pre: MCHE 412
MCHE	501	Final Year Project I	1	
		Technical Elective	3	

Tenth Semester (12 Credits)			Crs.	Pre-co/requisites
MCHE	502	Final Year Project II	3	Pre: MCHE 501
MCHE	532	Fluid Systems Design	3	Pre: MCHE 531
		Technical Elective	3	
		Free Engineering Elective	3	

Courses offered for other majors

The Mechanical Engineering Department offers three courses for other engineering majors. These courses are described below.

MCHE 202 MECHANICAL ENGINEERING FOR BUILDINGS (3Crs.:3Lec,0Lab)

Water supply for buildings; pumping systems; waste systems; sump pumps; heat losses & thermal insulation; ventilation & air conditioning; sound insulation; elevators & escalators, & fire fighting.

MCHE 301-HVAC & SANITATION FOR ARCHITECTS (2Crs.:1Lec,2Lab)

This course addresses two technical fields, HVAC & Sanitation. HVAC: Introduction to air conditioning & mechanical installations in buildings & indoor spaces, general consideration, various heating & cooling systems, ventilation & air conditioning of various types, Installations & control of systems. Sanitation: Sanitary engineering issues, dampness: Sources & methods of insulation, water supply treatment & distribution, sanitary fixtures, installation & connections, treatment of soiled water, rainwater drainage & storm sewers.

MCHE 407 THERMAL & HYDRO POWER STATIONS (3Crs.:3Lec,0Lab)

Thermal Power Stations: Introduction to power generation; modern power plant layouts; gas fired, combined cycle, nuclear, & renewable energy; thermodynamic principles including Carnot cycle, Rankine cycle, Brayton cycle, & combined cycles; combustion processes, steam generations & boiler systems; steam turbines systems; gas turbine systems, combined cycle power plants & cogeneration; condensers & cooling technologies. Fluid Mechanics & Hydraulics Applications: Introduction to fluid mechanics & application fields, fluid Properties; fluid statics: pressure measurements & forces on submerged surfaces; fluid flow kinematics: velocity, acceleration, flow field types & applications; fluid dynamics: mass & energy conservation, continuity, Bernoulli's equation, fluid flow measurements, flow through pipes; fluid mechanics & hydraulic applications: pumps, turbines & fluid system design (water supply & fire fighting system).

DEPARTMENT OF CHEMICAL & PETROLEUM ENGINEERING

Academic staff

Chairperson Dr. Hadi Abou Chakra
Assistant Professors Dr. Rami Harkous
Full-time Instructors Eng. Hussein Elgharib, Eng. Sharif Mustafa

Petroleum Engineering program

Mission

The Chemical & Petroleum Engineering Department is devoted to educating exemplary petroleum engineers by instituting best learning practices that drives knowledge, build skills & competencies, & inspire the learner to define a purpose, develop a passion to forever learn, cultivate a sense of responsibility toward the profession, society & the environment, & attain the ability to confront challenges, & in so doing contribute to the advancement of the community, immediate & beyond.

Objectives

The educational objectives of the Petroleum Engineering (PE) program are determined to support career advancement of the graduates & as they pursue their career goals, the graduates will:

1. Be competent to handle complex petroleum engineering tasks requiring multifaceted skills.
2. Be recognized for their ability to pursue innovative solutions through creative integration of best practices.
3. Demonstrate career advancement & exhibit the habits & personal attributes to handle management & leadership roles.
4. Exhibit commitment to the wellbeing of the community & the environment in pursuant of relevant solutions.

Learning Outcomes

Upon completion of the program graduates shall be able to:

a. an ability to apply knowledge of mathematics, science, & engineering
b. an ability to design & conduct experiments, as well as to analyze & interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, & sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, & solve engineering problems
f. an understanding of professional & ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, & societal context
i. a recognition of the need for, & an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, & modern engineering tools necessary for engineering practice

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Petroleum Engineering consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 6 semesters.

Career Opportunities

Petroleum engineers attain a broad spectrum of skills sought by almost every relevant profession. Industries, enterprises, & service providers requiring petroleum engineering skills include: oil & gas production, refining & distribution, excavation, process, consulting, environmental institutions, & government. Most importantly, you can imagine something that never was & make it a reality! There is so much work to be done to guarantee the future of mankind & petroleum engineers can tap the possibilities through the spirit of innovation & entrepreneurism.

Program Overview

The Student's Study Plan is given to every student upon his/her enrollment. The PTRE curriculum consists of the following components:

I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences & Mathematics	27
General Engineering topics	15
II. PE Program-Specific Requirements	**Credits**
A. Engineering topics from outside the major	6
B. Petroleum Engineering Core	62
C. Petroleum Engineering Technical Electives	9
D. Free Engineering Electives	6
E. Final Year Project	4
F. Internship	1

I.Common Requirements

The list of the Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II.PTRE Program-Specific Requirements

A.Engineering topics from outside the major

This part of the PTRE curriculum includes 15-credits courses offered by other engineering programs. These courses are listed in the table below.

Course	**Title**	**Credits**	**Prerequisite**
MCHE 311	Mechanics of Materials	3	Pre: CVLE 210
MCHE321	Thermodynamics I	3	Pre: PHYS 282

Descriptions of this group of courses are given below.

MCHE 311 MECHANICS OF MATERIALS (3Crs.:3Lec,0Lab)

Introduction to the mechanics of deformable bodies considering linear material response. Load-stress, stress-strain, & strain-displacement relations. Tension/ compression of rods & trusses, torsion of shafts, bending in beams, bucking of columns, & pressure vessels. Analysis of combined loading. Mohr circle analysis. Stress-strain transformations. Statically indeterminate structures. Pre-req.: CVLE210.

MCHE 321 Thermodynamics I (3Crs.:3Lec,0Lab)

Introduction & basic concepts. Properties of pure substances. Energy analysis of closed systems. Mass & energy analysis of control volumes. Second law of Thermodynamics. Entropy, gas power cycle, vapor power cycle, vapor refrigeration cycle, real gas, Gas-vapor mixtures & air conditioning. Pre-req.: PHYS282

B.Petroleum Engineering Core Courses

The Petroleum Engineering core courses are listed in the table below.

Course	Title	Credits	Prerequisite
CHEM331	Organic Chemistry	3	CHEM281
GEOL201	Physical Geology	3	
GEOL202	Fundamentals of Geophysics	3	
GEOL205	Geophysical Techniques	3	GEOL202
GEOL206	Principles of petroleum geology	3	GEOL201
GEOL401	Geology of Lebanon & Levantine Region	3	GEOL206
PTRE201	Introduction to Petroleum Engineering	3	
PTRE202	Reservoir Rock Properties	3	PTRE201
PTRE206	Petroleum Drilling Systems	3	PTRE201
PTRE301	Reservoir Fluids	3	PTRE202
PTRE303	Well Logging	3	GEOL205
PTRE306	Petroleum Geo-mechanics	3	MCHE311
PTRE308	Petroleum Production Technology	3	PTRE206
PTRE405	Well Testing	3	PTRE301
PTRE410	Reservoir Characterization	3	PTRE202, PTRE303
PTRE409	Reservoir Simulation	3	PTRE301, MATH284
PTRE412	Drilling Technology	3	PTRE206, PTRE306
PTRE414	Natural Gas Production Engineering	3	MCHE321
PTRE511	Petroleum Refining Operations	3	CHEM331

PTRE513	Reservoir Engineering	3	PTRE301
PTRE512	Environment & Safety	2	PTRE306

Description of Core Courses

CHEM 331 ORGANIC CHEMISTRY (3Crs.:2Lec,2Lab)
Introduction to organic chemistry. A new mechanistic approach to the study of the chemical reactions & a survey of hydrocarbons, alcohols & ethers. Detailed study of aromatic compounds, aldehydes, ketones, carboxylic acids & their derivatives, & amines. The course also introduces students to spectroscopic identification of organic compounds. Applied experiments related to the above topics. Pre-req.: CHEM281.

GEOL 201 PHYSICAL GEOLOGY (3Crs.:2Lec,2Lab)
An introduction to the composition & structure of the earth from the atomic scale of minerals to the global scale of plate tectonics. Topics include the composition of minerals & rock, volcanism, earth structures, earthquakes, erosion & surface processes, geologic time, geologic hazards, & plate tectonics. In this course, attention will focus on the rocks, landscapes, surface erosional & depositional features, the agents that form them & scenic areas of Lebanon & Levantine region.

GEOL 202 FUNDAMENTALS OF GEOPHYSICS (3Crs.:3Lec,0Lab)
The Planets & their characteristics, Fundamentals of gravity, Size & mass of Earth, The Earth's geoid, Rotational dynamics, Tides, Gravity anomalies, Isostasy. History of seismology, Simple elastic theory & seismic waves, Body waves, Surface waves, Free oscillations, seismometers, Earthquakes & seismicity, The velocity structure of the Earth, Seismic tomography, Seismic surveying in environmental & exploration studies, History & physics of magnetism, Magnetic properties of Earth materials, Remnant & induced magnetization, Origin of the Earth's magnetic field, The magnetosphere, Magnetic surveying, Paleomagnetism, Reversals of the Earth's magnetic field, Evidence for continental drift.

GEOL205 GEOPHYSICAL TECHNIQUES (3Crs.:2Lec,2Lab)
Introduction to geophysics; Principles of exploration seismology & field procedures; Seismic reflection: how an image of the subsurface is generated & how to interpret it. The theory, instrumentation & field procedure of the electrical resistivity techniques. How subsurface resistance structure is derived & interpreted. The theory, instrumentation & field procedure of the gravity technique. The reduction & interpretation of gravity data. The theory, instrumentation & field procedure of the magnetic techniques. The reduction & interpretation of magnetic data. Pre-req.: GEOL202.

GEOL 206 PRINCIPLES OF PETROLEUM GEOLOGY (3Crs.:2Lec,2Lab)
Geological characteristics of the Earth, sedimentary rock fill of depositional basins, fundamental principles of petroleum geology, different settings in which accumulations of conventional oil & gas are found, Fundamentals source rock, reservoir, & trap studies; well log & seismic interpretation, petroleum geochemistry, & mapping. Migration pathways & reservoir traps, procedures adopted for assessing resources & reserves. Pre-req.: GEOL201

GEOL 401 GEOLOGY OF LEBANON & LEVANTINE REGION (3Crs.:3Lec,0Lab)
The main features of Lebanon, the landscape, folds, faults, igneous features, rock types in Lebanon, fossils of Lebanon, minerals of Lebanon, Lebanon in its regional plate tectonic setting, resources of Lebanon, geologic hazards of Lebanon, the subsurface geology of Lebanon, The geology of Levantine region in regional scale. Pre-req.: GEOL206.

PTRE 201 INTRODUCTION TO PETROLEUM ENGINEERING (3Crs.:3Lec,0Lab)
Overview & history of the petroleum industry & petroleum engineering; Petroleum reserves, production & consumption statistics of the world; Structure of the petroleum industry; Composition, origin, migration & accumulation of petroleum; Oil traps. Petroleum exploration methods; Nature of oil & gas wells; Drilling History; Types of drilling rigs; Drilling equipment's; Introduction to drilling fluids; Special problems in Drilling; Cost; Data acquisition during drilling; Reservoir properties; Reservoir pressure & evaluation; properties & behaviors of reservoir fluids; Oil & gas production; The production system, Methods of oil production; Fundamentals of oil refining.

PTRE 202 RESERVOIR ROCK PROPERTIES (3Crs.:2Lec,2Lab)
Understanding the basic properties of reservoir rocks & how they relate to the storage & production of oil & gas. Important concepts such as heterogeneity, capillary pressure, relative permeability, resistivity are included as part of the course. Pre-req.:. PTRE201

PTRE 206 Petroleum Drilling Systems (3Crs.:3Lec,0Lab)
Introduction to petroleum drilling systems, including fundamental petroleum engineering concepts, quantities & unit systems, drilling rig components, drilling fluids, pressure loss calculations, casing, well cementing, & directional drilling. Pre-req: PTRE201

PTRE 301 RESERVOIR FLUIDS (3Crs.:2Lec,2Lab)
Thermodynamics behavior of naturally occurring hydrocarbon mixtures; Evaluation & correlation of physical properties of petroleum reservoir fluids, including laboratory & empirical methods. Analysis of steady ideal & viscous fluid, fluid flow systems using the continuity. Boundary layer theory is treated in terms of viscous & pressure drag, lift & its importance in heat & mass transfer. Dimensional analysis & dynamic similitude are studied to provide an understanding of flow systems analysis & modeling. Pre-req.:PTRE202

PTRE 303 WELL LOGGING (3Crs.:3Lec,0Lab)
Basic formation evaluation concepts, borehole environment, principles of resistivity, radiation, thermal & elastic wave measurements & measuring tools, applications to formation evaluation using commercial software package. Lithology plots. Saturation, irreducible saturation & permeability studies from well logs. Shale sand analysis. Complex reservoir analysis. Wire-line Formation Testing. Integration of core, log, well test & seismic data evaluation. Cementing quality monitoring. Gun perforating. Production Monitoring. Pre-req.: GEOL205

PTRE306 PETROLEUM GEOMECHANICS (3Crs.:3Lec,0Lab)
Introduction to applications of Geomechanics in oil & gas industry; stress/strain: estimation, transformation & Mohr circle representation; rock behavior under stress; rock index properties; rock mechanics lab tests; in-situ stresses & effective stresses; calculation of induced stresses around a wellbore using Kirsh's equations; mud weigh windows determination to mitigate wellbore failures; hydraulic fracturing. Pre-req.: MCHE311.

PTRE308 PETROLEUM PRODUCTION TECHNOLOGY (3Crs.:3Lec,0Lab)
Overview of oil & gas production facilities with an emphasis on offshore situations. Engineering design & operation of wells, pipelines, & oil & gas processing equipment. Health, safety & environmental aspects of production operations. Well completion design, well flow performance concepts, tubing design & selection, well intervention & workover techniques, completion fluids, perforating, completion equipment, production logging, artificial lift, sand stabilization & exclusion, production optimization, well flow performance evaluation, stimulation, new technology, surface production facilities & operation. Pre-req.: PTRE206

PTRE405 WELL TESTING (3Crs.:3Lec,0Lab)
Analysis of well performance under varied reservoir conditions including evaluation of university, pseudo-state & unsteady state flow, well testing methods used to determine well & reservoir parameters; applications to conventional & unconventional wells producing gas and/or liquids; fundamentals of preparing & operating well test equipment to monitor, measure & gather samples for evaluating well performance. Pre-req.:PTRE301

PTRE410 RESERVOIR CHARACTERIZATION (3Crs.:2Lec,2Lab)
Definition of petroleum reservoir heterogeneity using conventional methods & possible improvements to these methods. Reservoir rock properties & their spatial variations; estimation of reserves; introduction to theory & application of geostatistics to reservoir characterization; presentation of fundamental geostatistical concepts including: variogram analysis, estimation variance, kriging & stochastic simulations. Impact of geologic structure on oil recovery methods. Review of basic statistical concepts & methods. Reservoir rock & fluid property evaluation by statistical methods. Scale-up & simulator data Preparation. Emerging methods in petroleum reservoir characterization..Pre-req.: PTRE202, PTRE303.

PTRE 409 RESERVOIR SIMULATION (3Crs.:2Lec,2Lab)
Solution of production & reservoir engineering problems using state-of-the-art commercial reservoir simulation software, using data commonly available in industry. Emphasis on reservoir description, reservoir model design & calibration, production forecasting & optimization, economic analysis & decision making under uncertainty. Pre-req.: PTRE301, MATH284.

PTRE 412 DRILLING TECHNOLOGY (3Crs.:2Lec,2Lab)
Rotary Drilling Technique; Basic Rig systems & Rig components & their functions; Drilling Fluid Technology; Properties & testing; Types & additives; Drilling hydraulics; Drilling cost analysis & control; Formation pressure (types of formation pressures; Formation pressure prediction; Fracture gradient Prediction; Casing & primary cementing equipment; Hole conditions; Volume calculations & rate of Circulation; Squeeze cementing; Plug cementing; Measurement while drilling; Well control; Hole problems & stuck pipes; Fishing tools; Objects lost in the hole; Fishing methods; Drilling risks; Kicks & blow outs; Coring; Directional, horizontal & multilateral drilling. Pre-req.: PTRE306, PTRE206

PTRE 414 NATURAL GAS PRODUCTION ENGINEERING (3Crs.:3Lec,0Lab)
Vapor-liquid equilibrium, natural gas flow in wellbores & pipelines, networks, gas well unloading & solutions, metering, compressor design, special topics. Pre-req.:MCHE321.

PTRE 511 PETROLEUM REFINING OPERATIONS (3Crs.:3Lec,0Lab)
Students study oil refining & associated downstream processing technologies, operations & economics; process safety & operations integrity; & methods for the optimal design of process systems; the program combines petroleum refining (technologies, operations & economics) & systems engineering (modeling & simulation, optimization, & process design & integration); in addition, it provides opportunities for students to learn about the general economics of the energy sector, oil exploration & production, as well as renewable energy systems; furthermore, study of the various aspects of petroleum refining are augmented by unique work assignments at a virtual oil refining & chemical company. Pre-req.: CHEM331

PTRE 513 RESERVOIR ENGINEERING (3Crs.:3Lec,0Lab)
Determination of reserves; material balance methods; aquifer models; fractional flow & frontal advance; displacement, pattern & vertical sweep efficiencies in waterfloods; enhanced oil recovery processes; design of optimal recovery processes; introduction & performance analysis of unconventional reservoirs. Pre-req.:PTRE301.

PTRE 512 ENVIRONMENT & SAFTY (2Crs.:2Lec,0Lab)
Environmental technology, Environmental Control Technology for Oilfield Processes, Environmental Control of Drilling Fluids & Produced Water, Oilfield Waste Disposal Control, Drilling & Production Discharges in the Marine Environment, Decommissioning of Offshore Oil & Gas Installations, Tanker Design: Recent Developments from an Environmental Perspective, Pipeline Technology, Environmental Management &

Technology in Oil Refineries, Distribution, Marketing & Use of Petroleum Fuels, Lubricants, & Climate Change Scenarios. Pre-req.: PTRE306

C.Petroleum Engineering Technical Electives

The PTRE curriculum includes two 3-creidt hour courses as technical electives. The courses are chosen from the courses listed in the table below with their descriptions given thereafter.

Elective Courses			
Course	**Title**	**Credits**	**Prerequisite**
GEOL314	Marine Geology	3	GEOL201
GEOL316	Carbonate Sedimentology	3	GEOL201
GEOL318	Petroleum Geology of Middle East	3	GEOL401, GEOL205
CMPS322	Digital Image Processing for Petroleum Engineering	3	COMP208
PTRE413	Natural Gas Reservoir Engineering	3	PTRE301
PTRE415	Fire Control Engineering	3	
PTRE417	Hydrocarbon Phase Behavior	3	MCHE321
PTRE419	Petroleum Economy, Risk & Management	3	MATH381
PTRE 503	Crude Oil Processing	3	CHEM331
PTRE506	Process Instrumentation & Control	3	POWE210, MATH284
GEOL203	Sedimentary Rocks	3	GEOL202
GEOL504	Seismic (3D) Stratigraphy & Interpretation	3	GEOL205
GEOL506	Structural Geology & Tectonics	3	PTRE303
GEOL507	Seismic Exploration	3	GEOL202
GEOL508	Fundamentals of Seismic Acquisition, Processing & Interpretation	3	GEOL507
GEOL509	Basin Evolution & Hydrocarbon Resources	3	GEOL206

Description of Technical Elective Courses

GEOL 314 MARINE GEOLOGY (3Crs.:3Lec,0Lab)

Introduction to marine geology, a brief review of the formation of the ocean basins is presented, followed by a detailed study of the ocean margins. Sedimentary processes operating in the fluvial, estuarine, near shore & continental-shelf regions will be discussed, as well as sea-level history. Pre-req.: GEOL201.

GEOL 316 CARBONATE SEDIMENTOLOGY (3Crs.:3Lec,0Lab)
Discussion of the origins, classification, & criteria of recognition of carbonate accumulations from different depositional environments. Pre-req.: GEOL201.

GEOL 318 PETROLEUM GEOLOGY OF MIDDLE EAST (3Crs.:3Lec,0Lab)
Provides an integrated tectonic, stratigraphic, paleogeographic, & structural framework for the region to evaluate known & frontier petroleum areas. Pre-req.: GEOL401, GEOL205.

CMPS 322 DIGITAL IMAGE PROCESSING FOR PETROLEUM ENGINEERING (3Crs.:2Lec,2Lab)
Introduction; image sensing & acquisition; some basic gray level transformations for oil slick image enhancement; image contrast enhancement using histogram processing for oil slick; image smoothing using spatial filters; image sharpening using Spatial filters; point, line & edge detection for oil slick; optimal global & adaptive thresholdings for oil slick Image Segmentation. Pre-req.: COMP208

PTRE 415 FIRE CONTROL ENGINEERING (3Crs.:3Lec,0Lab)
Aspects involved in the control from fire, explosion, & other related hazards. Protective considerations & building design & construction. Fire & explosive protection organization including fire detection & control.

PTRE413 NATURAL GAS RESERVOIR ENGINEERING (3Crs.:3Lec,0Lab)
Phase behavior of natural gas, estimation of gas reserves, production decline curves, testing of fractured & unfractured gas wells, aspects of production from gas condensate reservoirs. Pre-req.: PTRE301

PTRE 417 HYDROCARBON PHASE BEHAVIOR (3Crs.:3Lec,0Lab)
Thermodynamics fundamentals, petroleum reservoir fluids, cubic equations of state, C7+ characterization & lumping, viscosity measurements, sampling, pressure/temperature (P/T) flash calculations, prediction of transport properties, pressure-volume-temperature (PVT) experiments, regression to experimental PVT data, evaluation of PVT reports & field experience. Pre-req.: MCHE321.

PTRE 419 PETROLEUM ECONOMY, RISK & MANAGEMENT (3Crs.:3Lec,0Lab):
This unit aims to teach the student about the economics & risk management of petroleum asset development, supply & demand economics, profit maximization, depreciation & all aspects of oil field project management required to fully understand the risk involved in exploration, production, capital cost & expenditure on assets. Pre-req.: MATH381.

PTRE 503 CRUDE OIL PROCESSING (3Crs.:3Lec,0Lab)
Introduction to crude oil processing, Two phase separators, Three phase separators, Emulsion Treatment & Dehydration, Desalting of Crude Oil, Stabilization & sweetening, Storage tanks, Produced Water Treatment, Choosing a Line Size & Wall Thickness, Organizing the project, Flow Assurance, Flow in wells &pipes. Pre-req.: CHEM331.

PTRE 506 PROCESS INSTRUMENTATION & CONTROL (3Crs.:2Lec,2Lab)
Control loop hardware.; Mathematical modeling of chemical processes for control purposes.; Dynamic behavior of processes.; Development of dynamic models from experimental data for control purposes; Introduction to strain gauges; Basic components of control systems.; Design of single-loop control systems.; Controller tuning techniques.; Introduction to frequency domain methods.; Experimental rigs on process control. Block diagrams. Transient behavior of closed-loop control systems. Stability analysis. Controller tuning. Controller design: direct synthesis & frequency response methods. General comments on other types of controllers. Pre-req.: POWE210, MATH284

GEOL 203 SEDIMENTARY ROCKS (3Crs.:3Lec,0Lab)
Provides a general introduction to sedimentary rocks, sedimentary processes, & the depositional environments in which these rocks form. The course covers classification & knowledge of sedimentary rocks, sedimentary processes & environments, & the relationship of sedimentary rocks & plate tectonics. Laboratories focus on the identification of sedimentary rocks & structures in hand specimen. Pre-req.: GEOL202.

GEOL 504 SEISMIC STRATIGRAPHY & INTERPRETATION (3D SEISMIC) (3Crs.:3Lec,0Lab)
The stratigraphic significance of seismic reflectors –Identification of depositional sequences – Age determination of depositional sequences – Recognition & analysis of the seismic facies present in terms of reflector geometry, continuity & amplitude & mapping their distribution- Interpretations of relative changes of sea-levels. Hands-on exercises provide practice in: identifying examples of reflection terminations (onlap, downlap, toplap), identifying depositional sequence boundaries on seismic sections on the basis of reflector terminations, determining the age of seismic sequences, identifying different seismic facies on seismic sections, & constructing chronostratigraphic summary chart from suitable seismic sections or geological cross-sections. Pre-req.: GEOL205.

GEOL 506 STRUCTURE GEOLOGY & TECTONICS (3Crs.:3Lec,0Lab)
Fundamental concepts, principles & methods in global tectonics & structural geology. The course covers global plate tectonics & analytical methods in plate kinematics, including an understanding of tectonic motions on a sphere. The structure & geodynamics of the mantle are examined in relation to the driving forces of plate tectonics, & to the principles of isostasy. Gravity measurements & modeling are used to examine uplift & erosion. The structural geology part of the covers aspects of stress, strain, rock failure, rock deformation, rheology, & the origin & significance of commonly observed brittle & ductile structures in rocks. Pre-req.: PTRE303.

GEOL 507 SEISMIC EXPLORATION (3Crs.:3Lec,0Lab)
Principles of the seismic method; exploration objectives & requirements of seismic data acquisition; the seismic pulse – its generation & transmission; partition of seismic energy at an interface; seismic energy reflection, refraction, attenuation, & travel time – distance functions; reflection time corrections; field testing & procedures

with emphasis on multiple coverage & design of source & receiver arrays for signal enhancement; well velocity survey; the synthetic seismogram & the convolution model. Pre-req.: GEOL202.

GEOL 508 FUNDAMENTAL OF SEISMIC ACQUISITION, PROCESSING & INTERPRETATION (3Crs.:2Lec,2Lab)

Fundamentals; Introduction to Seismic exploration; Overview of non-seismic geophysical techniques; Wave Propagation; Reflection Principles & Resolution; Signal Analysis; Migration Principles Acquisition; Principles of data acquisition; 3D Survey Design • QA/QC Processing; Principles & Processing Flows. Prestack Analysis & Signal Corrections; Velocity/ Normal Move out Analysis; Static Corrections; Migration & Imaging Interpretation; Trap Definition; Structural Mapping; Stratigraphic Interpretation; Amplitude Interpretation. Pre-req.: GEOL507.

GEOL 509 BASIN EVOLUTION & HYDROCARBON RESOURCES (3Crs.:3Lec,0Lab)

Origin of sedimentary basins; structural styles of basins & their expression in seismic data; lateral variations of sedimentary facies in differing basin settings; models of external controls on depositional & seismic architectures; an introduction to sequence stratigraphy; burial histories & the derivation of tectonic subsidence/uplift histories from stratigraphic data; an overview of the petroleum play system; the petroleum charge system; reservoir, top seal & trap; quantifying risk in hydrocarbon exploration; petroleum geology Middle East. Pre-req.:GEOL206.

D.Free Engineering Elective

The PTRE program does not include a Free Engineering Elective component.

E.Final Year Project

PTRE 501 FINAL YEAR PROJECT I (1Cr) / PTRE 502 FINAL YEAR PROJECT II (3Crs)

After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester & ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, & give a presentation on a significant, relevant, & comprehensive engineering problem. The FYP is intended to stimulate student creativity & critical thinking, & build skills in formulating, designing, developing, building, communicating, & managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.

Refer to the Final Year Project Policy for more details.

F.Internship (Approved Experience/ Independent Study)

PTRE 499 INTERNSHIP (1Cr)

This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.

Refer to the department policy for further details.

Study Plan

Bachelor of Engineering in Petroleum Engineering (150 Credits)

First Semester (18 Credits)			Crs.	Pre-co/requisites
COMP	208	Programming I	3	
MATH	281	Linear Algebra	3	MATH112
CVLE	210	Statics	3	
PHYS	281	Electricity & Magnetism	3	PHYS120
MCHE	201	Engineering Drawing & Graphics	3	
ENGL	001	English Language	2	
BLAW	001	Human Rights	1	

Second Semester (17 Credits)			Crs.	Pre-co/requisites
MATH	282	Calculus	3	MATH111
MCHE	213	Dynamics	3	
PHYS	282	Material Properties & Heat	3	
GEOL	202	Fundamentals of Geophysics	3	
CHEM	281	Principles of Chemistry I	3	CHEM110
ARAB	001	Arabic Language	2	

Third Semester (17 Credits)			Crs.	Pre-co/requisites
MATH	283	Differential Equations	3	MATH281 + MATH282
CHEM	282	Principles of Chemistry II	3	CHEM281
PTRE	201	Introduction to Petroleum Engineering	3	
GEOL	205	Geophysical Techniques	3	GEOL202
GEOL	201	Physical Geology	3	
ENGL	211	Advanced Writing	2	ENGL001

Fourth Semester (17 Credits)			Crs.	Pre-co/requisites
MATH	284	Numerical Analysis & Techniques	3	MATH283
MCHE	311	Mechanics of Materials	3	CVLE210
PTRE	202	Reservoir Rock Properties	3	PTRE201
GEOL	206	Principles of Petroleum Geology	3	GEOL201
PTRE	206	Petroleum Drilling Systems	3	PTRE201
ENGL	300	Communications Skills	2	ENGL211

Fifth Semester (18 Credits)			Crs.	Pre-co/requisites
MATH	381	Probability & Statistics	3	MATH282
MCHE	321	Thermodynamics	3	PHYS282
PTRE	301	Reservoir Fluids	3	PTRE202
PTRE	303	Well Logging	3	GEOL205
MGMT	002	Entrepreneurship	2	
		Elective (General)	2	
		Elective (General)	2	

Sixth Semester (17 Credits)			Crs.	Pre-co/requisites
PTRE	308	Petroleum Production Technology	3	PTRE206
INME	221	Engineering Economy	3	
PTRE	306	Petroleum Geomechanics	3	MCHE311
CHEM	331	Organic Chemistry	3	CHEM281
		Elective (General)	2	
		Elective (General)	2	
		Elective (General)	1	

Seventh Semester (12 Credits)			Crs.	Pre-co/requisites
PTRE	405	Well Testing	3	PTRE301
PTRE	409	Reservoir Simulation	3	PTRE301 + MATH284
GEOL	401	Geology of Lebanon & Levantine Region	3	GEOL206
		Free Elective	3	

Eighth Semester (12 Credits)			Crs.	Pre-co/requisites
PTRE	410	Reservoir Characterization	3	PTRE202 + PTRE303
PTRE	412	Drilling Technology	3	PTRE206 + PTRE306
PTRE	414	Natural Gas Production	3	MCHE321
		Free Elective	3	

Ninth Semester (11 Credits)			Crs.	Pre-co/requisites
PTRE	499	Internship (Approved Experience / Independent Study)	1	
PTRE	501	Final Year Project 1	1	
PTRE	511	Petroleum Refining Operations	3	CHEM331
PTRE	513	Reservoir Engineering	3	PTRE301
		Technical Elective	3	

Tenth Semester (11 Credits)			Crs.	Pre-co/requisites
PTRE	502	Final Year Project 2	3	PTRE501
PTRE	512	Environment & Safety	2	PTRE306
		Technical Elective	3	
		Technical Elective	3	

DEPARTMENT OF CHEMICAL & PETROLEUM ENGINEERING

Chemical Engineering Program

Mission

The Chemical & Petroleum Engineering Department is devoted to educating exemplary chemical engineers by instituting best learning practices that drives knowledge, build skills & competencies, & inspire the learner to define a purpose, develop a passion to forever learn, cultivate a sense of responsibility toward the profession, society & the environment, & attain the ability to confront challenges, & in so doing contribute to the advancement of the community, immediate & beyond.

Objectives

The educational objectives of the Petroleum Engineering (ChE) program are determined to support career advancement of the graduates & as they pursue their career goals. Chemical Engineering program objectives are:

1. Provide Students with the education & training in the field of chemical engineering through the study of chemical manufacturing or industrial processes by transforming raw materials into consuming products through the design, construction & management of factories
2. Supply the student with basic Chemical Engineering knowledge necessary for industrial pratices.
3. Meet the growing needs to face future difficulties in the Lebanese & Middle East Chemical industries

Learning Outcomes

Upon completion of the program graduates shall be able to:

a. an ability to apply knowledge of mathematics, science, & engineering
b. an ability to design & conduct experiments, as well as to analyze & interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturability, & sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, & solve engineering problems
f. an understanding of professional & ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, & societal context
i. a recognition of the need for, & an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, & modern engineering tools necessary for engineering practice

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Chemical Engineering consists of 150 credit-hours of course work + ICDL or its equivalent, where the standard duration of study is 10 semesters.

Career Opportunities

Chemical engineers bridge sciences & manufacturing by applying the principles of science & engineering, to solve problems involving modification of raw materials into required products in a variety of industries including: oil & gas; pharmaceuticals; energy; water treatment; food & drink; plastics; & toiletries.

Program Overview

The Student's Study Plan is given to every student upon his/her enrollment. The CHME curriculum consists of the following components:

I. Common Requirements	**Credits**
A. General Education Requirements	20
B. Basic Sciences & Mathematics	36
C. General Engineering topics	15
II. ChE Program-Specific Requirements	**Credits**
A. Chemical Engineering Major Core Courses	59
B. Chemical Engineering Major Technical Courses	9
C. Free Engineering Electives	6
D. Internship	1
E. Final Year Project	4

I.Common Requirements
The list of the Common Requirement courses & their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog.

II.CHE Program-Specific Requirements
A.Chemical Engineering Core Courses
The Petroleum Engineering core courses are listed in the table below.

Course	Title	Credits	Prerequisite
CHEM358	Surface & Colloid Chemistry	3	
CHME 202	Introduction to Chemical Engineering	3	
CHME301	Separation Processes	3	MCHE322
CHME302	Chemical Engineering Reaction + lab	3	MCHE322+CHEM246

CHME304	Membrane Science	3	CHME301
CHME403	Process Control + lab	4	CHME301
CHME405	Reactor Design	3	CHME302
CHME407	Mass transfer	3	MCHE331
CHME402	Unit Operation + lab	4	CHME302
CHME404	Transport Phenomena	3	MCHE332
CHME406	Catalytic Processes	3	CHEM345
CHME408	Chemical Process Design	3	CHME304 + MCHE 421+ CHME407
CHME503	Biomass Engineering	3	CHME403 + CHME408
CHME507	Process Optimization	3	MCHE332
MCHE321	Thermodynamics I	3	PHYS 282
MCHE 322	Thermodynamics II	3	MCHE321
MCHE 331	Fluid Mechanics I	3	PHYS282
MCHE 332	Fluid Mechanics II	3	MCHE331
MCHE 421	Heat Transfer	3	MATH284 + MCHE321

Description of Core Courses

CHEM 358 SURFACE & COLLOID CHEMISTRY (3Crs.:3Lec)
Basic terms in surface & colloid chemistry, the kinetic properties of disperse systems, interfacial phenomena, the optical & electrical properties of colloids, the preparation & stability of colloids, properties of gels, emulsion, foams & aerosol.

CHME 202 INTRODUCTION TO CHEMICAL ENGINEERING (3Crs:3Lec)
Overview of chemical engineering & its applications. Overall staged separations. Concepts of rate processes. Energy & mass transport. Material & energy balances. Kinetics of chemical reactions.

CHME301 SEPARATION PROCESSES (3Crs.:3Lec,0Lab)
Concepts on the thermodynamics, mechanisms, processes & design of equilibrium separation processes such as adsorption, ion exchange, membrane separations, chromatography & crystallization.

CHME302 CHEMICAL ENGINEERING REACTION (3Crs.2Lec,2Lab)
Principles of reaction engineering. Stoichiometry applications in combination with a rate. Continuous stirred-tank. Plug-flow, Different types of chemical reactors. Continuous-operation & batch-operation reactors. Heterogeneous reactors, catalytic systems & fluidized beds.

CHME304 MEMBRANE SCIENCE (3Crs.:3Lec)
Membrane processes used for engineering materials & systems. Knowledge in a membrane technology area from medicine to wastewater engineering.

CHME402 UNIT OPERATION (3Crs.2Lec, 2Lab)
Principles of unit operations with emphasis on distillation, absorption, extraction, & fluid-solid systems. Principles of heat exchanger design, multi-component fractionation, absorption, stripping & extraction. Property prediction of multi-component fluids.

CHME403 PROCESS CONTROL (3Crs.3Lec,2Lab)
Key concepts in automatic control & instrumentation of process plants. Commonly used sensing, transmission & final control elements in piping & Instrumentation Diagrams. First order, second order, & integrating systems including dead time are treated with basic controller algorithms.

CHME404 TRANSPORT PHENOMENA (3Crs.:3Lec,0Lab)
Fundamental theory of momentum, mass & energy transport in porous media. Emphasis on interrelationship of incompressible & compressible fluid flow. Piping system design, filtration, packed beds, diffusive & convective transport mechanisms. Applications of steady-state balances & equations of change to fluid drag,

CHME405 REACTOR DESIGN (3Crs.3Lec,0Lab)
Basic principles of chemical reaction engineering. Principles of catalysis. Reaction engineering principles in modern technologies. Analysis of kinetic data. Basic (Ideal) reactor description modeling & design. Isothermal & non-isothermal reactor design.

CHME407 MASS TRANSFER (3Crs:3Lec,0Lab)
Diffusion, convective & interfacial mass transfer, & its application to continuous contact operation. Gas-liquid absorption & stripping, liquid-liquid extraction, & humidification. Design of equilibrium-stage separation processes including distillation,

CHME405 REACTOR DESIGN (3Crs.:3Lec,0Lab)
Design of ideal reactors & deviations from ideality. Multiple chemical reactions, steady state & unsteady-state operation, Interpretation of rate data & development of performance equations for single & multiple reactor systems. Optimization of reactors, collection & analysis of rate law data & bioreactors.

CHME406 CATALYTIC PROCESSES (3Crs.3Lec,0Lab)
Fundamentals of catalytic science; catalyst properties, preparation & characterization. Industrial catalytic processes: Hydrogen Production & Synthesis Gas Reactions (Fischer-Tropsch Synthesis), Hydrogenation & dehydrogenation of organic compounds, Oxidation of organic & inorganic compounds. Catalytic reactor design & catalyst deactivation.

CHME408 CHEMICAL PROCESS DESIGN (3Crs.:3Lec,0Lab)

Implementation of real engineering projects & comparing alternatives. Basic concepts & methodology for making rational decisions. Design of plants & processes representative of the chemical & related process industries. Transfer knowledge of a flow sheet into a suitable form for simulation & design.

CHME503 BIOMASS ENGINEERING (3Crs.:3Lec,0Lab)

Fundamental principles & practical applications of biomass-to renewable energy processes. Biodiesel production from plant oils. Thermo-conversion of biomass & waste materials for renewable energy production. Bioethanol production from starch & lingo cellulosic materials. Anaerobic digestion of agricultural & industrial wastes for biogas & hydrogen production.

CHME507 PROCESS OPTIMIZATION (3Crs.3Lec,0Lab)

Process flowschemes. Modifying equipment internals. Upgrading process. Technical solutions to reduce energy consumption. Various methods & techniques to optimize processing energy efficiency in process plants

B.Chemical Engineering Technical Electives

The CHME curriculum includes two 3-credit hour courses as technical electives. The courses are chosen from the courses listed in the table below with their descriptions given thereafter.

Elective courses			
Course	**Title**	**Credits**	**Prerequisite**
PTRE511	Petroleum Refining Operations	3	CHEM331
PTRE419	Petroleum Economics & Management	3	MATH381.
PTRE503	Crude Oil Processing	3	CHEM331
CHEM355	Petro-chemistry	3	
CHME511	Polymer Engineering	3	
CHME512	Chemical Product design	3	
CHME513	Water & Waste Management	3	
CHME514	Air-Pollution Problems & Control	3	

Description of Technical Elective Courses

CHEM 355 PETROCHEMISTRY (3Crs.:3 Lec)

A study of the chemicals obtained directly & indirectly from petroleum, including their chemistry & their industrial production & applications.

CHME511 POLYMER ENGINEERING (3Crs.:3Lec,0Lab)

This course provides a good understanding of the synthesis of polymers & their commercial applications. Important properties that these materials possess, including their molecular, physical, chemical, thermal, mechanical, & electrical properties

are reviewed. The forming techniques for plastics (compression molding, injection molding…) & the different parameters leading to the degradation of polymers will also be covered.

CHME512 CHEMICAL PRODUCT DESIGN (3Crs.:3Lec,0Lab)
This course covers the application of the design process to products based on chemical technology. It covers the entire design process from initial identification of product needs, to the generation & selection of product ideas, & culminates in the manufacture of a new product.

CHME513 WATER & WASTE MANAGEMENT (3Crs.:3Lec,0Lab)
Quality & treatment methods of water & wastewater; testing for physical, chemical, & biological parameters.

CHME514 AIR-POLLUTION PROBLEMS & CONTROL (3Crs.:3Lec,0Lab)
Advanced concepts on air-pollutant identification & control technology; estimation of pollutant transport, dispersion, & conversion; design of control units using computer simulation applications.

C.Free Engineering Elective
The CHME program includes 6-credit hour courses taken as Free Engineering Elective. The student in consultation with his/her advisor may choose the course from any engineering major in the university.

D.Internship (Approved Experience/ Independent Study)
CHME 499 INTERNSHIP (1Cr) This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned.

E.Final Year Project
CHME 501 FINAL YEAR PROJECT I (1Cr) / CHME 502 FINAL YEAR PROJECT II (3Crs)
After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester & ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, & give a presentation on a significant, relevant, & comprehensive engineering problem. The FYP is intended to stimulate student creativity & critical thinking, & build skills in formulating, designing, developing, building, communicating, & managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world.

Chemical Engineering Program Study Plan (150 Credits)

Year I, Semester 1 (17 Credits)			
Course	**Title**	**Crs**	**Pre/Co-requisites**
COMP208	Programming I	3	
MATH281	Linear Algebra	3	
CVLE210	Statics	3	
PHYS281	Electricity & Magnetism	3	
MCHE210	Engineering Drawing & Graphics	3	
ARAB001	Arabic Language	2	

Year 1, Semester 2 (17 Credits)			
Course	**Title**	**Crs**	**Pre/Co-requisites**
MATH282	Calculus	3	
MCHE213	Dynamics	3	CVLE210
PHYS282	Material Properties & Heat	3	
CHME 202	Introduction to Chemical Engineering	3	
CHEM281	Principles of Chemistry I	3	
ENGL001	English Language	2	

Year 2, Semester 3 (15 Credits)			
Course	**Tile**	**Crs**	
MATH283	Differential Equations	3	MATH281 + MATH282
CHEM282	Principles of Chemistry II	3	CHEM281
CHEM331	Organic Chemistry	3	CHEM281
MCHE321	Thermodynamics I	3	PHYS282
	General Elective	1	
ENGL211	Advanced Writing	2	ENGL001

Year 2, Semester 4 (15 Credits)			
Course	**Title**	**Crs**	
MATH284	Numerical Analysis & Techniques	3	MATH283
CHEM246	Physical Chemistry I	3	Pre: CHEM282
MCHE 322	Thermodynamics II	3	Pre: MCHE321
	General Elective	2	
	General Elective	2	
ENGL300	Communications Skills	2	ENGL211

Year 3, Semester 5 (14 Credits)			
Course	**Title**	**Crs**	**Pre/Co-requisites**
MATH381	Probability & Statistics	3	MATH282
CHME301	Separation Processes	3	MCHE322
MCHE 331	Fluid Mechanics I	3	PHYS282
BLAW001	Human Rights	1	
	General Elective	2	
MGMT002	Entrepreneurship	2	

Year 3, Semester 6 (14 Credits)			
Course	**Title**	**Crs**	
INME221	Engineering Economy	3	
CHME302	Chemical Engineering Reaction + lab	3	MCHE322+CHEM246
CHME304	Membrane Science	3	CHME301
MCHE 332	Fluid Mechanics II	3	Pre: MCHE331
	General Elective	2	
ENGL001	English Language	2	

Year 4, Semester 8 (16 Credits)			
Course	**Title**	**Crs**	
CHME402	Unit Operation + lab	4	CHME302
CHME404	Transport Phenomena	3	MCHE332
CHME406	Catalytic Processes	3	CHEM345
CHME408	Chemical Process Design	3	CHME304 + MCHE 421+ CHME407
	Free Elective	3	
	Free Elective	3	

Year 4, Semester 7 (16 Credits)			
Course	**Tile**	**Crs**	
CHME499	Internship (Approved Experience / Independent Study)	1	
CHME501	Final Year Project	1	
CHME503	Biomass Engineering	3	CHME403 + CHME408
CHEM358	Surface & Colloid Chemistry	3	
CHME507	Process Optimization	3	MCHE332
	Technical Elective	3	

Year 5, Semester 10 (12 Credits)			
Course	**Title**	**Crs**	
CHME502	Final Year Project	3	
	Technical Elective	3	
	Technical Elective	3	
	Free Elective	3	