Undergraduate Catalogue 2014

Faculty of

ENGINEERING (FE)

Faculty Administration

Dean	Dr. Adel El-Kordi
Assistant Dean	Dr. Yehya Temsah
Director, Tripoli Branch	Dr. Ahmed El-Lakany
Faculty Secretary	Mrs. Sereen El Hariri

History

The Faculty of Engineering (FE) at Beirut Arab University was established in recognition of the national and regional need for engineering education in 1975. The Faculty initially offered two degree programs providing opportunities for formal course of study in Electrical and 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 and the Industrial Engineering &Engineering Management Department, established in 2001. The petroleum engineering program was launched in September 2013.

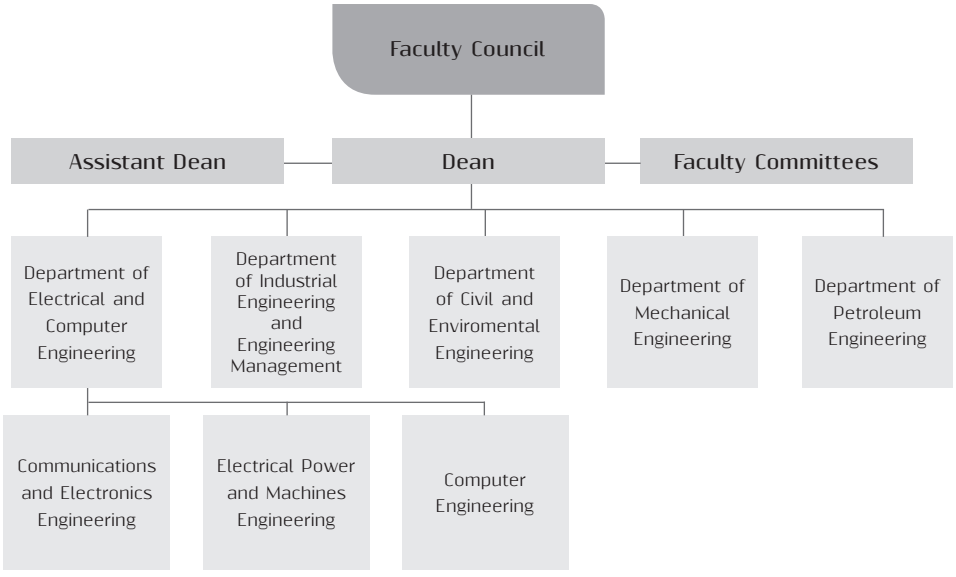
As of 1999, departments of the Faculty of Engineering have updated their curriculum to include a number of courses in humanities, with special emphasis on environmental, economic, managerial, and marketing aspects of engineering. In keeping up with the growing demands for advanced and specialized engineering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

In a collaborating effort to provide students with the opportunity to participate in practical projects that exhibit and demonstrate their skills and knowledge, the faculty established mutual incorporation and 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 and students to display the students respective work projects. The Engineering Day became an annual event to celebrate the faculty's mission of teamwork and 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 and the region. About 250 BE degrees and 20 ME and 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 and Europe, with diverse research background and 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 and 230 scientific journal titles, as well as over 15 research laboratories.

Organizational Structure

The Faculty of Engineering constitutes the following five departments: Civil and Environmental Engineering, Electrical and Computer Engineering, Industrial Engineering and Engineering Management, Mechanical Engineering, and Petroleum Engineering. The Electrical and Computer Engineering Department offers three programs: Communications and Electronics Engineering, Computer Engineering, and Electric Power and Machines 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 and the world.

Mission

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

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

- Encourage research and technical seminars that contribute to the growth of individual knowledge and prepares for continuous learning.
- Provide an excellent environment for our students that encourages interaction and 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 and Electronics Engineering
- Bachelor of Engineering in Computer Engineering
- Bachelor of Engineering in Electrical Power and Machines Engineering
- Bachelor of Engineering in Industrial Engineering
- Bachelor of Engineering in Mechanical Engineering
- Bachelor of Engineering in Petroleum 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 and logical thinking. The Petroleum Engineering exam also includes a chemistry component.**

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 and 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
INME	20	26	15	69	15	5	150
MCHE	20	26	15	75	9	5	150
PTRE	20	27	12	80	6	5	150

CVLE: Civil Engineering
COME: Communications and Electronics Engineering
COMP: Computer Engineering
POWE: Electric Power and Machines Engineering
INME: Industrial Engineering
MCHE: Mechanical Engineering
PTRE: Petroleum 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 and faculty) requirements distributed as follows:

I.A. General Education Core (11 credits)

This curricular component includes 6 courses comprising 11 credits; 3 courses (total of 5 credits) are University Requirements (UR) and 3 courses (total of 6 credits) are Faculty requirements (FR) as listed in the following table:

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

Descriptions of the University Requirement Courses and 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 and ideas in an organized manner. This is in addition to descriptive, narrative, reflective, and creative writing. Topics chosen are related to the students' culture diagram as well as current affairs. The ability of students to write academically and classify and organize ideas is stressed. Pre-req.: ENGL 001.

ENGL 300 SPEECH COMMUNICATIONS (2Crs.: 2Lec,0Lab):
Basic oral communication principles and theories; body, intonation, and stress language considerations; speaker-listener relationship; speech topic, context and audience; planning, preparing and delivering of platform speeches; showcase and spotlight ideas; group interactions; projects and formal presentations. Pre-req.: ENGL 211.

I.B. General Education Electives (9 credits)

This component encompasses 9 Credits of General Elective courses selected from the University Elective Courses listed in the introduction section of this catalogue.

II. Basic Sciences and Mathematics Courses

The Basic Sciences and 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	
ENVI 302/CVLE254	Environmental Pollution/ Environmental Science in Civil Engineering	3	
MATH 281	Linear Algebra	3	
MATH 282	Calculus	3	
MATH 283	Differential Equations	3	MATH 281, 192
MATH 284	Numerical Analysis	3	MATH 283
MATH 381	Probability and Statistics	3	MATH 282
PHYS 281	Electricity and Magnetism	3	
PHYS 282	Materials Properties and Heat	3	

Instead of the CHEM 207/CHEM405 and the ENVI 302 courses, the PTRE program requires the following two 6-credits chemistry courses instead:

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

Descriptions of the required mathematics and basic sciences courses are given below.

CHEM 281 PRINCIPLES OF CHEMISTRY I (3Crs.:3Lec,0Lab):
Introduction to the basic concepts and principles of chemistry including: Atoms, molecules, mole concept, chemical reactions and calculations, stoichiometry. Periodic table and properties of the elements, nomenclature. Theories of atomic structure, atomic spectra. Theories of chemical bonding. Covalent bonding and molecular structure: molecular geometry, VSEPR theory, valence bond theory, hybrid orbital and molecular orbital theory.

CHEM 282 PRINCIPLES OF CHEMISTRY II (3Crs.:3Lec,0Lab):
Topics discussed are the three physical states of matter (gases, liquids and solids). Properties of solutions. Chemical equilibrium. Ionic equilibria. Rates of chemical reactions. Introduction to the basic chemical thermodynamics and thermo-chemistry. Pre-req.:CHEM281.

CHEM 207 ENVIRONMENTAL CHEMISTRY (2Crs.:2Lec,0Lab):
Chemistry of ozone layer in the atmosphere; particulate matter and control of air pollution; global warming; waste management, treatment and disposal; mass-energy transfer; risk, dose response and human exposure assessment; hazard identification; risk characterization; water resources and pollutants; BOD and waste water.

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 and magnetic properties of solid state materials from a chemical perspective; fabrication techniques and modern applications.

ENVI 302 ENVIRONMENTAL POLLUTION (3Crs.:3Lec,0Lab):
Air pollution, noise pollution, radiation and electromagnetic waves, water pollution, and soil pollution: Sources, types, measurements, effects and control; impact of environmental pollution on ecosystem degradation (land, air & water) and restoration of degraded ecosystems; improvement of rural and urban ecosystems, monitoring restoration achievements, long-term strategies for handling contaminated sites and large-scale areas, capacity controlling parameters, remediation procedures.

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.

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

MATH 283 DIFFERENTIAL EQUATIONS (3Crs.:3Lec,0Lab):
First- and second-order differential equations with constant and 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 and 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 AND STATISTICS (3Crs.: 3Lec, 0Lab):
Probability space, conditional probability and independence, and probability theorems; Random variables, and density functions, joint probability; expectation, variance and covariance, moments and moment generating functions: Discrete and continuous distributions; statistical measures: mean, mode, variance, standard deviation; statistical distribution: t- distribution, chi- distribution; sampling theory; Theory of estimation, confidence intervals; probability and statistical software. Pre-req.: MATH 282.

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

PHYS 282 MATERIAL PROPERTIES AND 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 and strains, elastic energy, torsion, gravitation and gravity, satellite motion, pressure measurements, flow of ideal fluids, streamlines and equation of continuity, Bernoulli's equation and its applications, viscosity of fluids, flow in capillary tubes; Heat: heat and temperature, temperature measurements, specific heat and latent heat, heat transfer by conduction, heat convection, heat transfer by radiation and 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 and Graphics	3	
MCHE 213	Dynamics	3	

The PTRE program does not require the INME 221 – Engineering Economy course.

Descriptions of these courses are given below.

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

CVLE 210 STATICS (3Crs.: 3Lec,0Lab):
Force vectors (analytical and graphical methods), free-body diagrams; equilibrium of particles and rigid bodies in two and three dimensions; structural elements and supports; plane and space trusses; axial, shear, and moment diagrams of beams; Cable-supported structures. Friction; center of gravity and centroid; moment of inertia. Applications.

INME 221 ENGINEERING ECONOMY (3Crs.: 3Lec,0Lab):
Basics principles and techniques of economic analysis of engineering project, time value of money, cost allocation and estimation, evaluation of engineering projects and investments, depreciation, inflation, bond and 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 AND GRAPHICS (3Crs.: 2Lec,2Lab):
Constructional Geometry-constructing tangents. Plane curves and polygons. Orthographic drawing and theory of sketching shapes and surface identification. Orthographic projection of views. Sectional views and conventions. Pictorial drawing. Applications of Auto-CAD software for 2D drawings and solid modeling; project.

MCHE213 DYNAMICS (3Crs.: 3Lec,0Lab):
Dynamics of a particle, system of particles, and planar rigid bodies using Newton's law of motion. Work and energy principle, impulse and momentum principle. Free-body diagram and 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, and engineering courses chosen from outside the major. The program requirements for the bachelor degrees in the different engineering majors are given hereafter. Details and 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 :	Hisham S. Basha
Professors:	Adel El Kordi, Yehia Temsah, Hamdi Seif, Yehia Daou, Adnan Masri , Issam Gouda, Ossama Baalbaki
Associate Professors:	Youssef Atallah
Assistant Professors:	Zaher Abou Saleh, Farah Homsi, Hassan Ghanem
Part-time Lecturers:	R. Sammoura, A. Tarhini
Full-time Instructors:	Lina Jaber
Part-time Instructors:	W. Hajj, M. Mashaka, Hanadi El Khansa, Samer Ahmad, Y. Al-Rawi

Mission

The mission of the Civil and Environmental Engineering Department is dedicated to educate and graduate commendable civil engineers by providing a high-standard education delivered in a stimulating and supportive environment that expose students to a broad balanced program of theoretical and practical learning; to prepare graduates to build skills, competencies, leadership qualities, professionalism and 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 and the environment; and to instill in them a passion to continuous and lifelong learning (LLL) to surmount problems encountered in a rapidly changing and challenging world, for a better lifelong productive career.

Objectives

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

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

Learning Outcomes

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

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to identify, to formulate, and solve engineering problems.
- An ability to conduct experiments, as well as to analyze and interpret data.
- An ability to design a system, component, or process to meet desired needs.
- An ability to use the techniques, skills, and modern tools necessary for engineering practice.
- An ability to appreciate the impact of engineering solutions in a local and global context.
- An ability to function in a team environment.
- An ability to communicate effectively.
- An understanding of professional and ethical responsibility.
- An ability to engage in life-long learning.
- 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 and the Gulf region, during the last decade. Engineers have been involved primarily in large public and private development projects. The emerging reconstruction activity in Lebanon and the Gulf offers ever increasing and 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 and infrastructure sectors; this has resulted in a booming job market and 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, and 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 and consultation, contracting and supervision, or management and 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 and planning, geotechnical engineering, environmental engineering, water resources, and computer software, and in contracting firms and 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 and 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 and 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	Pre-/Co-requisites
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	Pre-/Co-requisites
CVLE 260	Engineering Surveying I	2	
CVLE 211	Mechanics of Materials	3	Pre: CVLE 210, PHYS 282
CVLE 212	Elementary Structural Analysis	3	Pre: CVLE 211
CVLE 231	Engineering Geology	2	
CVLE 254	Environmental Science in Civil Engineering	2	Pre: CHEM 207
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 254	Environmental Science in Civil Engineering	2	Pre: CHEM 207
CVLE 432	Steel Design I	3	Pre: CVLE212
CVLE 333	Soil Mechanics	3	Pre: CVLE 211, CVLE 231
CVLE 341	Hydraulics I	3	Pre: PHYS 282
CVLE 342	Hydraulics II	3	Pre: CVLE 341
CVLE 354	Environmental Engineering	2	Pre: CHEM207, (CVLE254 or ENVI302)
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 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 and graphical methods), free-body diagrams; equilibrium of particles and rigid bodies in two and three dimensions; structural elements and supports; plane and space trusses; axial, shear, and moment diagrams of beams; Cable-supported structures. Friction; center of gravity and centroid; moment of inertia. Applications.

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

CVLE 211 MECHANICS OF MATERIALS (3Crs.:3Lec,0Lab):
Center of Gravity. Moments of Inertia. Stresses, strains, and 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 and biaxial bending. Shear stresses. Combined stresses. Stress transformation and Mohr's circle. Buckling of columns. Pre-req: CVLE 210 and PHYS 282.

CVLE 212 ELEMENTARY STRUCTURAL ANALYSIS (3Crs.:3Lec,0Tut):
Types of loads, structural elements and supports. Analysis of simple, cantilever and overhanging ended beams. Axial, shear, and bending moment diagrams. Analysis of compound and inclined Beams, frames and 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 and properties of rocks; geologic processes; geologic hazards; geologic structure and engineering consequences; terrain analysis and geologic mapping; interpretation and use of geologic maps; application of geology to engineering practice; reservoirs, dam sites, and construction of tunnels.

CVLE 254 ENVIRONMENTAL SCIENCE IN CIVIL ENGINEERING (3Crs.:3Lec,0Tut):
Environmental chemistry. Water pollution: Water resources and pollutants, water quality in lakes, reservoirs, and groundwater. Air pollution: Criteria pollutants, motor vehicle emissions, indoor air quality. Global atmospheric change: Greenhouse effect, ice melting, ozone depletion, acid rain. Introduction to solid wastes: Types and source reduction, collection and transfer operations, recycling, composting, incineration, landfills. Pre-req: CHEM 207.

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

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

CVLE 311 STRUCTURAL ANALYSIS I(3Crs:3Lec,0Lab):
Stability and determinacy of structures. Elastic deformation (slope and deflection) of beams by double-integration method; Moment-area theorems; and Conjugate Beam Method. Strain energy theorems – Slopes and deflection of beams, frames and trusses utilizing principle of virtual work. Introduction to indeterminate structures: Compatibility conditions and 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 and frames) utilizing concept of Virtual Work. Matrix analysis of structures. Effect of temperature change and yielding of supports. Three Moment Equations and applications. Slope-deflection method for analysis of beams and rigid frames. Concept of Moment distribution methods and applications on continuous beams, and frames with and without side-sway. Influence lines of indeterminate structure - Qualitative influence lines. Computer applications. Pre-req: CVLE 311.

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

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

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

CVLE 341 HYDRAULICS I (3Crs.:2Lec,2Lab):
Properties of liquids. Hydrostatic, measurements of liquid pressures, buoyancy, principles of liquid kinematics and dynamics, continuity, energy, and momentum equations, application: steady flow, flow in pipes, velocity and discharge measurements, laminar and 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 and critical shear, design of channel cross-section, hydraulic jump, gradually varied flow, flow measurement, hydraulic models, pumps: function, types and performance curves. Main specifications of pumps, economical design of pumps and piping system, pumps in parallel and series, selection of pumps, installation, priming, and 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 and design, liners and cover systems, use of geosynthetics, vertical barriers, slope stability and settlement analyses. Groundwater pollution: contaminant transport, cone of depression, capture–zone curves, control of groundwater plumes, remediation techniques. Environmental impacts of highways and dams projects. Pre-req: CHEM 207 and either CVLE 254 or ENVI 302.

CVLE 371 STRUCTURAL MODELING (2Crs.:1Lec,2Lab):
Programming: routines of elements stiffness, overall matrix, bandwidth, solution of equations and 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 and exposure to fire resistance, floor systems: solid slabs, ribbed slabs, flat plate, and slabs, waffle slabs, and paneled beam floor slabs, design methods: Direct design method, and equivalent frame method, loads transmitted from floors to the supported beams, code requirements, detailing, and applications. Pre-req: CVLE 322 and CVLE 212.

CVLE 422 REINFORCED CONCRETE DESIGN III (3Crs.:3Lec,0Lab):
Design of framed structures, hinges, corbels and brackets, beam ledges, and shear friction, slender columns, biaxial bending, reinforced concrete stairs, water tightness, applications: ground, underground and 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 and in-situ testing. Shallow foundation: types, bearing capacity and settlement, design of isolated, combined and raft foundations. Groundwater control and dewatering. Deep foundations: bearing capacity and 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 and 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, and channel routing, groundwater: occurrence, aquifers, hydraulics of wells, surface and subsurface investigations of groundwater. Water harvesting, surface and ground water case studies. Pre-req: CVLE 342.

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

CVLE 463 TRANSPORTATION PLANNING AND 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 and facilities, transport and 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 and horizontal Alignment, transition curves, super-elevation, and intersections, highway materials: mineral aggregates and bituminous materials, structural design of rigid and 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	Pre-/Co-requisites
CVLE 510	Non-Destructive Concrete Testing	3	Pre: CVLE 321
CVLE 511	Photogrammetry and 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 and Site Improvement	3	Pre: CVLE 333
CVLE 529	Feasibility Study and 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 and Drainage Engineering	3	Pre: CVLE 441
CVLE 538	Hydraulic Structures	3	Pre: CVLE 342 and CVLE 432
CVLE 539	Hydraulic and Hydrologic Modeling	3	Pre: CVLE 441
CVLE 542	Water and Wastewater Treatment	3	Pre: CVLE 342 and CVLE 432
CVLE 543	Water and Wastewater Network	3	Pre: CVLE 342 and 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 and maintenance. Analysis of fresh concrete. Accelerated testing methods. Analysis of hardened concrete. Core drilling and testing. Partially destructive

testing. Non-destructive testing. Load testing. Assessment of reinforcement condition. Standards, Specifications and Code of Practice of existing documents relevant to preceding items and discussion of their relevance. Pre-req: CVLE 321.

CVLE 514 ADVANCED STRUCTURAL ANALYSIS (3Crs.:3Lec,0Lab):
Force and Displacement Methods for analysis of indeterminate structures. Flexibility and Stiffness matrix method for analysis of indeterminate trusses, beams, and frames. Grid beams and structures on elastic supports. Influence lines of indeterminate structure utilizing concepts of virtual work and moment distribution methods – Qualitative and 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, and uniqueness theorems, combined mechanisms, beams, multistory, multiply and gable frames, computer implementation. Pre-req: CVLE 312.

CVLE 517 EARTHQUAKE ENGINEERING (3Crs.:3Lec,0Lab):
Earthquake causes and measures, earthquake faults and waves, plate tectonics, structural dynamics of single and 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 and Macro–composite, Engineering applications of fibers, Design of Composite sections, Nonlinear analysis, Fracture Mechanics: crack initiation and 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 and shear walls of walls and deep beams as pier and 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 and bearings. Design of Truss Bridges and Arched Bridges. Specifications and Detailing. Pre-req: CVLE 424.

CVLE 522 REINFORCED CONCRETE BRIDGES (3Crs.:3Lec,0Lab):
Introduction, types of bridges, and loads, slab type hollow-type bridges, box-type bridges, girder type bridges, bearing pads, code requirements, detailing applications. Pre-req: CVLE 422.

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 and 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 and their properties, losses of prestress, elastic behavior and stress distribution under different load stages, analysis and design of homogeneous sections, care of simply supported members. Pre-req: CVLE 421.

Elective Courses - Geotechnical Sequence

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

CVLE 527 RETAINING STRUCTURES (3Crs.:3Lec,0Lab):
Lateral earth pressures: at rest, active and passive states, limit equilibrium methods and theory of elasticity, seismic conditions, hydrostatic and seepage pressures. Retaining walls: design of gravity, cantilever, and basement walls. Sheet-piles:

cantilever and anchored bulkheads, free- and fixed-earth support methods, moment reduction, anchorage design. Braced cuts: pressure envelopes, design of sheeting, wale beams and struts, stability against bottom heave or piping. Shoring systems: types, control of groundwater, construction stages, anchors prestressing and testing, ground settlement around excavations. Code requirements, computer applications. Pre-req: CVLE 432.

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

Elective Courses - Environmental & Water Resources Sequence

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

CVLE 538 HYDRAULIC STRUCTURES (3Crs.:3Lec,0Lab):
Hydraulic and 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 and CVLE 432.

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

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

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

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

Elective Courses - Transportation Sequence

CVLE 511 PHOTOGRAMMETRY AND GEODESY (3Crs.:3Lec,0Lab):
Principles of photography, types of photographs, aerial cameras, vertical photographs: scale, ground coordinates, relief displacement, project planning: end and side lap-flying height, ground coverage, and 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 and resection: with angles and 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 and geometric design, topographic site surveys and mapping, civil engineering and construction surveys, layout of industrial plants, building, pipelines and manufacturing machinery, horizontal curves ,circular curve layout by different methods, special circular curve problems, compound and 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 and Deceleration, Braking and Stopping distances), Design of Railway tracks (Subgrade, Ballast Section, Sleepers, Rails, fastenings and rail joints, Stresses in Track Components), Track alignment (Cant - Transition Curves - Longitudinal and 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 and wagons yards), Control of Train Movement and Signaling (types of Signaling systems- Mechanical and Electrical signaling systems- automatic block sections- green wave). Pre-req: CVLE 463.

CVLE 531 HARBOR ENGINEERING (3Crs.:3Lec,0Lab):

Theory of Waves, wave refraction and diffraction, wave forces on vertical walls, Port Planning, water and land areas, breakwaters, temporary and fixed breakwaters, submerged and ruble mound breakwaters, wall breakwaters composite breakwaters, gravity quay walls, plain concrete blocks Quay walls, cantilever and anchored sheet piles, Marine platforms supported by group piles. Pre-req: CVLE 432.

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

Highway and Airports pavement design (flexible and rigid pavements), Stress Analysis in flexible and rigid pavements, pavement response under traffic load, failure of flexible and rigid pavements, highways pavement maintenance and rehabilitation (methods, programs, management), types and design, Hot mix Asphalt Concrete: Materials, Design Methods and 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 and airport access, Airport Capacity and 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 AND MARKETING (3Crs.:3Lec,0Lab):
Economics: cost nature and concepts, cost definition, material, labor cost, factory overhead, direct cost, indirect cost, variable cost, fixed cost, semi-variable semi-fixed cost, differential and increment cost, and opportunity cost, cost measurement and 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 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, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and 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 and Environmental Engineering(150 Credits)

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

Second Semester (17 Credits)			Crs.	Pre-/co-requisites
MCHE	213	Dynamics	3	
MATH	282	Calculus	3	
CVLE	260	Engineering Surveying I	2	
PHYS	281	Electricity and Magnetism	3	
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	
INME	221	Engineering Economy	3	
CVLE	211	Mechanics of Materials	3	Pre: CVLE 210, PHYS 282
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
CVLE	254	Environmental Science[1]	3	Pre: CHEM 207
MATH	284	Numerical Analysis	3	Pre: MATH 283
CVLE	270	Civil Engineering Drawings and Detailing	2	Pre: MCHE 201
ENGL	300	Speech Communications	2	Pre: ENGL 211
BLAW	001	Human Rights	1	
		Elective (General)	3	

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 and Statistics	3	Pre: MATH 282

Sixth Semester (15 Credits)			Crs.	Pre-/co-requisites
CVLE	354	Environmental Engineering	2	Pre: CHEM207, CVLE254 (or (ENVI302
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 and Management	3	
CVLE	499	Internship (Approved Experience / Independent Study)	1	
		Technical Elective	3	See Footnote [3]
		Technical Elective	3	See Footnote [3]
CVLE	501	Final Year Project I	1	See Footnote [3]
		Free Engineering Elective[2]	3	

Tenth Semester (10 Credits)			Crs.	Pre-/co-requisites
		Technical Elective	3	See Footnote [3]
CVLE	502	Final Year Project II	3	Pre: CVLE 501
		Free Engineering Elective[2]	4	

1 ENVI 302 Environmental Pollution may be taken instead

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

3 Must have completed 120 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 and concepts of structures to emphasize an intuitive comprehension of the fundamental principles of structural behavior including loading, shear and bending moments. Calculation of internal forces in simple structures such as cantilevers, simples beams, and 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 and angles, using the tape, level, compass, transit and theodlit. Computation of areas and traverses, lines and grades. Introduction to construction surveys, and an introduction to GPS measurement.

CVLE 301 CONCRETE AND STEEL STRUCTURES (2Crs.:1Lec,2Lab):
Combined course addressing two technical fields:

- Review of concrete and steel structure systems. Reinforced concrete fundamentals, reviewing basics of reinforced concrete behavior and introducing methods of design used in current engineering practice. Basic mechanics of structural concrete introduced in examining bending, shear, and axial forces. Topic areas including beams, slab systems, columns, foundations, retaining walls, and an introduction to pre-stressed concrete.
- Review of statics and strengths of materials, review of tension, compression and bending steel members. Design of trusses, columns, and beams structural elements.

CVLE 303 SOIL MECHANICS & FOUNDATIONS, AND TESTING & PROPERTIES OF MATERIALS (2Crs.:1Lec,2Lab):
Combined course addressing two technical fields:

- Introduction to soil mechanics: Soil formation and 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, and pile caps.
- Introduction to testing and properties of materials: strength characteristics of building materials and material assemblies; stresses and strains; rigidity and deformation; temperature effects; torsion effects; combined loading of elements and systems

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Academic Staff

Chairperson : Ziad Osman

Professors: Onsy Abdel Alim, Soubhi Abou Chahine, Hamed Nassar, Ali Haidar

Assistant Professors: Mohamed Moselhy; Ahmed Mordi, Mohamed Tarnini, Rola Kassem, Hamza Issa, Nabil Abdel Karim, Wassim Itani, Hiba Abdallah, Youmni Ziadeh, Chadi Nohra

A. Communications and Electronics Engineering Program

Mission

The educational mission of Communications & Electronics Engineering (CEE) Program is to deliver high quality undergraduate education which combines balanced theoretical and 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, and 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 and maintain communication systems in tune with community needs and environmental concerns
- Be able to develop and integrate new technologies as they emerge
- Engage in a technical/managerial role in diverse teams
- Pursue entrepreneurial initiatives and launch startup companies
- Communicate effectively and use resources skillfully in projects development

Learning Outcomes

Upon completion of the program, graduates shall be able to:

- Ability to apply mathematics, physics, and basic engineering science in solving problems.
- Understand the basic theory of electrical and electronic devices and systems.
- Ability to analyze, design and implement electronic circuits and communications systems.
- Understand the theory and applications of fields and waves.
- Ability to analyze, design and implement RF transmission systems and circuits.
- Ability to process electric signals for the use of design and interface of embedded and microprocessor-based systems.
- Ability to use relevant modern tools of instrumentation and information technology.
- Recognize and respond to the need for lifelong and self-learning for a successful everlasting career.

- Ability to work in teams and to communicate ideas verbally, in writing, and graphically.
- Understanding of professional and ethical responsibilities.
- Ability to identify, formulate, and solve engineering problems while considering the impact of the suggested solutions on society as a whole.
- A knowledge of contemporary issues.

Degree Requirements

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

Career opportunities

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

II.CEE Program-Specific Requirements

A. Engineering topics from outside the major

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

Course	Title	Credits	Pre-/Co-requisites
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: PHYS281
POWE 214	Electric and Electronic Measurements	3	Pre: POWE 271

Descriptions of this group of courses are given below:

COMP 210 PROGRAMMING II (3Crs.:2Lec,2Lab):
Pointers. Recursion. Character strings. Structures, union, and bit manipulation. File operations, sequential and 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 and node voltage analysis methods, transformation methods, DC network theorems, capacitors and inductors, phasors and AC steady state circuit analysis, series and parallel resonance, power in AC circuits, balanced and unbalanced three-phase circuits.Pre-req: PHYS 281.

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

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

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

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

B. Communications and Electronics Engineering Program Core

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

Course	Title	Credits	Pre-/Co-requisites
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 and Systems	3	
COME 361	Modern Physics	2	
COME 372	Propagation and Antennas I	4	Pre: POWE 271
COME 382	Communication Theory and Systems I	4	Pre: COME 381

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

COME 384	Digital Signal Processing	3	Pre: COME 381
COME 332	Microprocessor Fundamentals	4	Pre: COMP 221
COME 471	Propagation and Antennas II	2	Pre: COME 372
COME471L	Propagation and Antennas Lab	1	Co: COME 471
COME 481	Communication Theory and Systems II	2	Pre: COME 382
COME 481L	Communication Lab	1	Co: COME 481
COME 431	Microprocessor Interfacing and 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

Description of Core Courses

COME 212 NETWORK ANALYSIS (2Crs.:2Lec,0Lab):
Transient analysis, Laplace transform and its application to circuit analysis, two-port networks, frequency selective passive and 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) and 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 and FET amplifiers: Types, circuit models, frequency response, differential and multistage amplifiers, large signal analysis and power amplifiers, operational amplifiers: Characteristics, applications, imperfections, feedback amplifiers, sinusoidal oscillators and 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 and asynchronous sequential networks, programmable logic devices: PLA, PAL, CPLD, FPGA, applications in design and implementation of combinational and sequential circuits, sequential circuits for arithmetic operations. Memory elements, adders, and 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 and stack organization, design of a simple hardwired processor, instruction sets and instruction formats, machine and assembly language programming, assembler functions and design, micro - programmed CPU, comparison between RISC and 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 AND ANTENNAS I (4Crs.:4Lec,0Lab):
Review of Maxwell's equations. Plane wave. Material media. Polarization. Pointing vector. Reflection and transmission. Normal and oblique incidence. Propagation of electromagnetic waves in the atmosphere. High frequency transmission lines. Matching techniques. Smith chart. Rectangular and 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 AND SYSTEMS (3Crs.:3Lec,0Lab):
Classification of continuous and discrete - time signals and systems. Fourier transform. Linear and time - invariant (LTI) systems: Impulse response, step response, transfer function. Band - pass signals: Hilbert transform, pre - envelope, complex envelope. Convolution and correlation functions. Energy and power spectral densities. Transmission of continuous random signals through LTI systems. Introduction to sampling theorem and reconstruction of signals. Application of taped delay line filters.

COME 382 COMMUNICATION THEORY AND SYSTEMS I (4Crs.:4Lec,0Lab):
Introduction to communication systems. Linear modulation techniques: AM, DSB, SSB, VSB. AM transmission and super heterodyne receivers. Exponential modulation techniques: FM, NBFM, PM. Analog pulse modulation. Noise effects on linear and exponential modulation techniques. Study of several analog systems which may include: AM and 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 and systems, LSI and causal systems, Z-Transform. Difference equations, IIR and FIR systems. Discrete time and frequency representation of systems. Discrete Fourier Transform (DFT). Digital filters design techniques, Chebychev and Butterworth. Computation of DFT and FFT. Pre-req: COME 381.

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

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

COME 471L PROPAGATION AND 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, and frequency. Microwave passive components using waveguide technology: T-junction, attenuators, isolators, circulators, couplers. Microstrip components: Power dividers, hybrid couplers. Microwave semiconductor devices: Microwaves Filters, Introduction to: Bipolar transistor, MESFET, GUNN diode and avalanche - transit - time devices. Pre-req: COME 372.

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

COME 481 COMMUNICATION THEORY AND 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 and 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 and digital FAX. Pre-req.: COME 382.

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

COME 573 L 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, and 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 and wireless transmission, multiplexing techniques, packet switching. Data link control. Local Area Networks (LANs): Logical link control, medium access control. Fast and Gigabit Ethernet, Internetworking Devices, Unicast Routing Protocols, Wireless LANs. Pre-req.: COME 481.

COME 588 WIRELESS COMMUNICATION (2Crs.:2Lec,0Lab):
RF spectrum, Spread Spectrum Transmission, Wireless Multiplexing and 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 and 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	Pre-/Co-requisites
COME 421	Digital Integrated Circuits	2	Pre: COME 221
COME 461	Solid State Electronics	2	Pre: COME 361
COME 522	Radio Frequency Communication Circuits	2	Pre: COME 222 COME 471
COME 531	Embedded Systems	2	Pre: COME 431
COME 533	VLSI Design	2	Pre: COME 232
COME 562	Semiconductor Devices	2	Pre: COME 361
COME 585	Information Theory and Coding	2	Pre: COME 481
COME 572	Optical Communications	2	Pre: POWE 271
COME 582	Cellular Communication	2	Pre: COME 481

Description of Technical Elective Courses

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

COME 461 SOLID STATE ELECTRONICS (2Crs.:2Lec,0Lab):
Principles of quantum mechanics: state functions and 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 and synthesizers. Use of computer aided design tools for RF design and simulation. Pre-req.: COME 222 and 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 and BiCMOS technology. MOS and BiCMOS circuit design processes: MOS layers, Stick diagrams, design rules and layout. Basic VLSI circuit concepts: layer sheet resistance, layer area capacitance, delay unit, propagation delays, wiring capacitances. Structured design of combinational and sequential logic circuits. VLSI testability. Use of computer aided design tools for VLSI design and simulation. Pre-req.: COME 232.

COME 562 SEMICONDUCTOR DEVICES (2Crs.:2Lec,0Lab):
Carrier transport phenomena in semiconductors. Operation principles and device modeling of p-n junctions, metal-semiconductor contacts, bipolar and MOS transistors, and related devices. Silicon device fabrication technology: crystal growth, oxidation, diffusion, lithography, contacts and 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 and receivers. Lasers. Optical amplifiers. Long haul and multi-channel systems. Pre-req.: POWE 271.

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

COME 585 INFORMATION THEORY AND CODING (2Crs.:2Lec,0Lab):
Information and 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.

Elective University Requirement Course

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

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 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 and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and 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 and Electronics 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 and Magnetism	3	
MCHE	201	Engineering Drawing and Graphics	3	
BLAW	001	Human Rights	1	
ENGL	001	English Language	2	

Second Semester (18 Credits)			Crs.	Pre-/co-requisites
COMP	210	Programming II	3	Pre: COMP 208
MATH	281	Linear Algebra	3	
PHYS	282	Material Properties and Heat	3	
MCHE	213	Dynamics	3	
POWE	210	Fundamentals of Electric Circuits	3	Pre: PHYS 281
		(Elective General)	3	

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	
POWE	271	Electromagnetic Fundamentals	3	Pre: PHYS281
ARAB	001	Arabic Language	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 and Electronic Measurements	3	Pre: POWE 271

Fifth Semester (15 Credits)			Crs.	Pre-/co-requisites
COME	381	Signals and Systems	3	
COME	361	Modern Physics	2	
MATH	381	Probability and Statistics	3	Pre: MATH 282
CHEM	405	Solid State Chemistry	2	
ENGL	300	Speech Communications	2	Pre: ENGL211
		Elective (General)	3	

Sixth Semester (18 Credits)			Crs.	Pre-/co-requisites
COME	372	Propagation and Antennas I	4	Pre: POWE 271
COME	382	Communication Theory and 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	

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

Seventh Semester (14 Credits)			Crs.	Pre-/co-requisites
COME	471	Propagation and Antennas II	2	Pre: COME 372
COME	471L	Propagation and Antennas Lab	1	Co: COME 471
COME	481	Communication Theory and Systems II	2	Pre: COME 382
COME	481L	Communication Lab	1	Co: COME 481
COME	431	Microprocessor Interfacing and Applications	2	Pre: COME 232
		Elective (General)	2	
		Technical Elective	2	
		Free Engineering Elective	2	

Eighth Semester (12 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	

Ninth Semester (11 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	
ENVI	302	Environmental Pollution	3	
		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. These courses are described below.

COME 212 NETWORK ANALYSIS (2Crs.:2Lec,0Lab):
Transient analysis, Laplace transform and its application to circuit analysis, two-port networks, frequency selective passive and 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) and 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 and stack organization, design of a simple hardwired processor, instruction sets and instruction formats, machine and assembly language programming, assembler functions and design, micro - programmed CPU, comparison between RISC and CISC processors, introduction to memory organization. I/O operations. Pre-req.:COMP 221. This course is equivalent to COMP 322.

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

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

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

B. Computer Engineering Program

Mission

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

Objectives

The Computer Engineering Program is designed such that its students upon graduation will:

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

Learning Outcomes

A comprehensive set of Intended Learning Outcomes has been derived from the above Program Objectives. These outcomes comprise the knowledge, skills, and attitudes our students are expected to possess by the time they graduate so the objectives can be achieved. Specifically, by the end of the program, the student should be able to:

- Apply relevant mathematical and scientific knowledge.
- Apply core computer engineering and informatics technical knowledge.
- Employ standard experimental techniques to generate and analyze data as well as use state-of-the-art hardware and software to solve computer engineering problems.
- Engage in the creative design process through the integration and application of diverse technical knowledge and expertise to meet customer needs and address social issues.
- Communicate effectively both through oral presentations and the written word.
- Interact professionally with others in the workplace, to engage effectively in teamwork, and to function productively on multidisciplinary group projects.
- Explain an engineer's responsibilities to employers, society, and their fellow engineers as well as recognize potential and actual ethical problems.
- Explain the symbiotic relationship between engineering and society – specifically, how engineering artifacts are shaped by human values.

- Engage in life-long learning, continually exploiting gained skills in refining and updating one's knowledge base.

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, and medical. Specific jobs include the functions of designing, installing, modifying, maintaining, repairing, and overhauling computer systems, digital control subsystems, logic circuits, and microprocessor-based interfaces. Furthermore, the graduates are able to analyze, design, test, and evaluate network systems, including local area networks (LAN), wide area networks (WAN), Internet, intranet, sensor networks, and other data communications systems. Additionally, they can develop, create, and modify general security schemes, including cryptography, intrusion detection and prevention, counter attacks for phishing, snooping, sniffing, and viruses, as well as computer applications software or specialized utility programs at large. Also, they are capable of doing research, design, development, and testing of operating systems-level software, compilers, and network distribution. Moreover, they have the competencies to design, develop, administer large-scale database systems and set standards for operations, programming, and security. Finally, they can supervise the manufacturing and installation of computer or computer-related equipment and 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 and Mathematics	**26**
General Engineering topics	**15**
II.CE Program-Specific Requirements	**Credits**
A. Engineering topics from outside the program	**6**
B. CE Core	**63**
C. Technical Electives	**9**
D. Free Engineering Electives	**6**
E. Final Year Project	**4**
F. Practical Training/Independent Study	**1**

I. Common Requirements

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

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 table below.

Course	Title	Credits	Pre-/Co-requisites
POWE 210	Fundamentals of Electric Circuits	3	Pre: PHYS281
COME 221	Electronic Circuits I	3	Pre:POWE210

Descriptions of this group of courses are given below.

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

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) and field effect transistors (FET): types, physical structures, basic configurations, characteristic curves, circuit models, biasing circuits, small-signal amplifiers. Pre-req.: POWE 210.

B. Computer Engineering Program Core

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

Course	Title	Credits	Pre-/Co-requisites
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	Co: COMP 222

COMP 231	Discrete Structures	4	Pre: MATH 282
COMP 232	Data Structures	4	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 232
COMP 344	Data Base Systems	4	Pre: COMP 311, COMP 232
COMP 361**	Control Systems for Computer Engineers	3	Pre: MATH 283
COMP 421	Computer Organization and Architecture	3	Pre: COMP 324
COMP 431	Queuing and Modeling	3	Pre: MATH 381
COMP 443	Operating Systems	3	Pre: COMP 311, COMP 324
COMP 448	Compilers	3	Pre: COMP 311, COMP 324
COMP 453	Transmission and Processing of Digital Signals	3	Pre: COMP 231
COMP 458	Computer Networks	3	Pre: COMP 453
COMP 462	Artificial Intelligence	3	Pre: COMP 231
COMP 541	Software Development	3	Pre: COMP 311
COMP 552	Computer Network Development	3	Pre: COMP 458

Description of Core Courses

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

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

COMP 221 DIGITAL SYSTEMS I (2Crs.:2Lec,0Lab):
Number systems and coding, Binary systems. Conversion from decimal to other

* These courses are equivalent to COME 232 and COME 232L.

** This course is equivalent to POWE 341.

bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions and circuits designs (HA, FA, and ALU). Combinational functions and circuits design (decoder, encoder, multiplexer and de-multiplexer). Sequential circuits definitions and designs (Latches, RS-FF, D-FF, JK-FF, T-FF). Simple buffer registers. Counters.

COMP 222 DIGITAL SYSTEMS II (2Crs.:2Lec,0Lab):
Latches and flip-flops. Synchronous and Asynchronous sequential systems. Registers and Counters. Control and Data path units. Serial data transfer for multiple register. Types of RAM and ROM. Cache concept. ALU functions and circuits (addition, subtraction, increment, decrement, transfer, AND, OR, XOR, NOT, etc.). Binary multiplier. BCD functions and circuits. Flags. Control unit. None binary logic. Logical fault tolerant. Pre-req.: COMP 221.This course is equivalent to COME232.

COMP 222L DIGITAL SYSTEMS II LAB (1Cr.:0Lec,2Lab):
The content of this lab is directly related to the courses COMP 221, COMP 222. Co-req.: COMP 222. This course is equivalent to COME232L.

COMP 231 DISCRETE STRUCTURES (4Crs.:4Lec,0Lab):
Logic and predicates. Mathematical induction. Sets and Power sets. Functions and Relations. Partial and total orders. Sequences. Counting. Multinomial theorems. Inclusion/exclusion principle. Recurrence relations and generating functions. Hardness of problems. Tress and Graphs. Groups, Rings and Fields. Lattices. Pre-req.: MATH 282.

COMP 232 DATA STRUCTURES (4Crs.:3Lec,2Lab):
Complexity measures and 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 and objects. Inheritance. Polymorphism. Information hiding and abstract data types. Overloading. Generic functions and 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, and control buses, with reference to standard implementations. Single and multi-core processors. Machine and assembly languages of a standard microprocessor are used to illustrate the design and its interface with upper layers such as operating systems, control drivers, and compilers.Pre-req.: COMP 222.

COMP 333 COMPUTER ALGORITHMS (3Crs.: 2Lec,2Lab):
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 and polynomials. Number theoretic algorithms. Reductions between problems. Theory of NP completeness. Examples of NP complete problems. Some approximation algorithms. Pre-req.: COMP 231 and COMP 232.

COMP 344 DATABASE SYSTEMS(4Crs.:3Lec, 2Lab):
Components of database systems: DBMS functions. Database architecture and data integrity. Data modeling: conceptual models, relational data model, conceptual schema, relational schema, relational algebra and relational calculus. Database query languages: SQL functional dependency, decomposition, normal forms. Higher normal forms. Transaction processing: Transactions; Failure and recovery systems; Physical database design: Storage and file structure; Indexed files; Hashed files; Signature files; B-trees. Query processing. Query optimization. Pre-req.: COMP 311 and COMP 232.

COMP 361 CONTROL SYSTEMS FOR COMPUTER ENGINEERS (3Crs.:2Lec, 2Lab):
Types of control systems. Advantages and limitations of using digital processors in control systems. System representation: transfer function, block diagram, signal-flow-graph. Time domain analysis: steady state and transient analysis. Frequency domain analysis. Writing programs for solving problems in control systems. Pre-req.: MATH 283.This course is equivalent to POWE 341.

COMP 421 COMPUTER ORGANIZATION AND ARCHITECTURE (3Crs.:2Lec,2Lab):
Organization vs Architecture. Fundamentals of computer design, Von-Neuman machine. Computer evolution and performance. Computer function and interconnection. Memory systems (Internal, external and cache). Input/Output modules. Instruction Sets: Characteristics, functions, addressing modes and formats. RISC & CISC. Assembly and machine languages. Processor implementation techniques. Pipelining. Performance enhancements. Pre-req.: COMP 324.

COMP 431 QUEUING AND MODELING (3Crs.:2Lec,2Lab):
Random variables, Performance measures. Markov processes. Birth/death processes. Solving Markov models. Continuous and 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 448 COMPILERS (3Crs.:2Lec,2Lab):
Introduction to language translation. Language translation phases. Generators.

Lexical analysis: Regular expressions; NFA; DFA. Syntactic analysis: Formal definition of grammars; BNF and EBNF; bottom-up vs. top-down parsing; Tabular vs. recursive-descent parsers; Error handling; Models of execution control. Declaration, modularity, and storage management: Code generation. Optimization: Machine-independent optimization; Data-flow analysis; Loop optimizations; Machine-dependent optimization. Pre-req.: COMP 311 and COMP 324.

COMP 443 OPERATING SYSTEMS (3Crs.:2Lec,2Lab) :
Overview, functionalities and characteristics of OS, CPU states, I/O channels, memory hierarchy, process, operations on processes, UNIX process control and management, PCB, signals, forks and pipes, Interrupt processing, operating system organization, OS kernel, Job and 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 and management, storage allocation, Virtual memory concepts, paging and segmentation, address mapping, File organization. Pre-req.: COMP 311 and COMP 324.

COMP 453 TRANSMISSION AND PROCESSING OF DIGITAL SIGNALS (3Crs.:2Lec,2Lab):
Sampling and discrete time signals. The z-transform. Quantization. Histograms. Recursive and non- recursive digital filters. Frequency response and 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 and 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 and sliding-window protocols. Data-link protocols: HDLC, BSC, PPP. The MAC sublayer. Local area networks: Ethernet, token ring and FDDI, wireless LANs. Circuit switching versus packet switching. Routing algorithms. Pre-req.: COMP 453.

COMP 462 ARTIFICIAL INTELLIGENCE (3Crs.:2Lec,2Lab):
Fundamental issues. Rule-based systems, logic programming, Search and constraint satisfaction. Knowledge representation and reasoning. Search: algorithms. Knowledge representation and reasoning: temporal and spatial reasoning, uncertainty, knowledge representation for diagnosis. Machine learning and neural networks. Pre-req.: COMP 231.

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

COMP 552 COMPUTER NETWORK DEVELOPMENT (3Crs.:1Lec,4Lab):
Covers current technology in computer software. Topics will vary every year. Pre-req.: COMP 458

C. Computer Engineering Program Technical Elective

The CE curriculum includes 9 credits as technical electives. The courses are chosen from the courses listed in the table below.

Course	Title	Credits	Pre-/Co-requisites
COMP 438	Performance Evaluation	3	Pre: MATH 283
COMP 442	Software Engineering	3	Pre: COMP 344
COMP 464	Operations Research for Computer Engineering	3	Pre: COMP 231
COMP 512	Web Programming	3	Pre: COMP 211
COMP 521	Microprocessor-based Systems	3	Pre: COMP 324
COMP 531	Cryptography and Information Security	3	Pre: COMP 333
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 553	Network Interconnections	3	Pre: COMP 458
COMP 556	Sensor Networks	3	Pre: COMP 458
COMP 561	Digital Control	3	Pre: COMP 361
POWE 214	Electric and Electronic Measurements	3	Pre: POWE 210
MCHE 461	Applied Robotics	3	Pre: MCHE 213 and (MCHE 302 or COME 431 or COMP 324)

Description of Technical Elective Courses

COMP 438 ERFORMANCE EVALUATION (3Crs.:3Lec,0Lab):
Work load performance indices. Single and multiple job processing models. Scheduling policies. Paging techniques. Network protocols. Routing policies. Pre-req.: MATH 283.

COMP 442 SOFTWARE ENGINEERING (3Crs.:3Lec,0Tut):
Concepts of software development. Life-cycle of software. Requirements and specification. Data model. Process model. Design and coding. Verification, validation and testing. Management of software projects. Software evolution. Pre-req.: COMP 344.

COMP 464 OPERATIONS RESEARCH FOR COMPUTER ENGINEERS (3Crs.:3Lec,0Tut):
Linear programming: Graphical solution; Simplex method; Duality and sensitivity analysis; Polynomial-time solutions. Decision making and game theory. Network flows. Optimization techniques. Non-linear programming. Transportation. Project management PERT/CPM. Pre-req.: COMP 231.

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 521 MICROPROCESSOR-BASED SYSTEMS (3Crs.:2Lec,2Lab):
Interfacing microprocessors to memory and I/O devices. Supporting chips: buffers, decoders, system clock generator. Interfacing techniques: serial, parallel, timer, ADC, DAC. Interrupts and interrupt controller. DMA. I/O ports. Memory shadows and expending. Hardware software co-design. Computer applications. Pre-req.: COMP 324.

COMP 531 CRYPTOGRAPHY AND 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.

COMP 532 INFORMATION THEORY AND CODING (3Crs.:3Lec,0Lab):
Zero-memory and 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 and MATH 381.

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

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

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

COMP 553 NETWORK INTERCONNECTIONS (3Crs.:2Lec,2Lab):
Bridges. Routers. Brouters. Tunnels. Nodes and links failures. Robust networks. Pre-req.: COMP 458.

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 and describing-function analysis. State-space representations. Linear state-space equations and their solutions. Computing the fundamental matrix. Properties of the state-space models: stability, controllability, observability. Pole placement and observers principles. Digital systems: advantages and disadvantages of using a digital processor. Sampling and reconstruction. Analysis of discrete-time systems. Design of digital controllers. Pre-req.: COMP 361.

POWE 214 ELECTRIC AND ELECTRONIC MEASURMENTS (3Crs.:2Lec,2Lab):
Introduction to instrumentation and measurements (Errors, precision, accuracy, measurement statistics, etc.), Analog instrumentation (Permanent magnet moving coil PMMC, Moving Iron MI, Electrodynamometer), bridges (AC, DC), Oscilloscopes (functions and controls, voltage, time, and 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, and applications; mechanisms and drives; forward and inverse kinematics; trajectory planning; dynamics and control; actuators and drive electronics; sensors and interface; mobile robots and navigation; intelligence; collaborative learning; team project. Pre-req.:MCHE 213 and either MCHE 302 or COME 431 or COMP 324.

University Requirement Electives

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

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

D. Free Engineering Elective

The CE program includes 6 credits taken as free Engineering electives. The courses may be chosen from any engineering major by the student in consultation with his/her advisor.

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 and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and 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 Computer Engineering (150 Credits)

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

Second Semester (16 Credits)			Crs.	Pre-/co-requisites
COMP	210	Programming II	3	Pre: COMP 208
MATH	281	Linear Algebra	3	
MCHE	213	Dynamics	3	
PHYS	282	Materials Properties and Heat	3	
ENGL	211	Advanced Writing	2	Pre:ENGL001
ARAB	001	Arabic Language	2	

Third Semester (16 Credits)			Crs.	Pre-/co-requisites
COMP	221	Digital Systems I	2	
COMP	231	Discrete Structures	4	Pre: MATH 282
MATH	283	Math Differential Equations	3	Pre: MATH 281,MATH 282
COMP	211	Introductory Web Programming	3	Pre: COMP 208
CHEM	405	Solid State Chemistry	2	
		Elective (General)	2	

Fourth Semester (15 Credits)			Crs.	Pre-/co-requisites
COMP	232	Data Structures	4	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	22L	Digital Systems II LAB	1	Co: COMP 222
ENGL	300	Speech Communication	2	Pre:ENGL211

*These courses are equivalent to COME232 and COME233L.

Fifth Semester (15 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, COMP 232
BLAW	001	Human Rights	1	
		Elective (General)	2	

Sixth Semester (16 Credits)			Crs.	Pre-/co-requisites
MGMT	002	Entrepreneurship	2	
COMP	344	Data Base Systems	4	Pre: COMP 311 and COMP 232
MATH	381	Probability and Statistics	3	Pre: MATH 282
COMP	324	CPU Design	4	Pre: COMP 222
		Elective (General)	3	

Seventh Semester (14 Credits)			Crs.	Pre-/co-requisites
COMP	421	Computer Organization and Architecture	3	Pre: COMP 324
COMP	431	Queuing and Modeling	3	Pre: MATH 381
COMP	443	Operating Systems	3	Pre: COMP 311 and COMP 324
COMP	453	Transmission and Processing of Digital Signals	3	Pre: COMP 231
		Elective (General)	2	

Eighth Semester (15 Credits)			Crs.	Pre-/co-requisites
COMP	448	Compilers	3	Pre: COMP 311 and COMP 324
COMP	458	Computer Networks	3	Pre: COMP 453
COMP	462	Artificial Intelligence	3	Pre: COMP 231
ENVI	302	Environment Pollution	3	
		Technical Elective I[1]	3	

*This course is equivalent to POWE341.

Ninth Semester (14 Credits)			Crs.	Pre-/co-requisites
COMP	541	Software Development	3	Pre: COMP 311
COMP	501	Final Year Project I	1	
INME	221	Engineer Economy	3	
COMP	499	Internship (Approved Experience / Independent Study)	1	
		Technical Elective II[2]	3	
		Free Engineering Elective	3	

Tenth Semester (12 Credits)			Crs.	Pre-/co-requisites
COMP	552	Computer Network Development	3	Pre: COMP 458
COMP	502	Final Year Project II	3	Pre: COMP 501
		Technical Elective III[3]	3	
		Free Engineering Elective	3	

1 Technical Elective I is chosen from the following list:

MCHE 461 Applied Robotics
POWE 214 Electric and Electronic measurements
COMP 442 Software Engineering
COMP 464 Operations Research for Computer Engineering
COMP 438 Performance Evaluation

2 Technical Elective II is chosen from the following list:

COMP 521 Microprocessor-based Systems
COMP 531 Cryptography and Information Security
COMP 533 Computer Graphics
COMP 553 Network Interconnections
COMP 561 Digital Control

3 Technical Elective III is chosen from the following list

COMP 532 Information Theory & Coding
COMP 534 Pattern Recognition
COMP 535 Digital Image Processing
COMP 556 Sensor Networks
COMP 512 Web Programming

Courses offered for other majors

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

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

COMP 210 PROGRAMMING II (3Crs.:2Lec,2Lab):
Pointers. Recursion. Character strings. Structures, union, and bit manipulation. File operations, sequential and 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,0Tut):
Number systems and coding, Binary systems. Conversion from decimal to other bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions and circuits designs (HA, FA, and ALU). Combinational functions and circuits design (decoder, encoder, multiplexer and de-multiplexer). Sequential circuits definitions and designs (Latches, RS-FF, D-FF, JK-FF, T-FF). Simple buffer registers. Counters.

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

C.Electrical Power and Machines Program

Mission

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

Objectives

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

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

Learning Outcomes

Upon completion of the program, graduates shall be able to:

- Ability to apply Mathematics, Physics, Engineering Sciences in solving electrical problems;
- Understand the basic theories of electrical and electronic circuits;
- Understand the basics of Communication Theory, Electrical Instruments and its application in Power Systems;
- Ability to analyze, design and implement electrical and electronic circuits in electrical power, machines, and control systems;
- Be able to apply the theory and applications of magnetic and static fields.
- Ability to analyze, design, implement, formulate, and operate advanced electrical power systems, advanced electrical machine drive systems, advanced control, and automation systems;
- Apply professional and ethical responsibilities;
- Efficient use of the techniques, skills, and tools of modern engineering in the practice use of the practice of power and machine engineering;
- Ability to apply the pre-learned tools in any advanced projects and works as a team;
- Recognition of the need of and ability to engage in Lifelong learning, the new practices, principles, and techniques of the Electrical Power and Machines; And
- Ability to communicate ideas effectively in Graphical, Oral, and Written Media.

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 and electronic equipment and machinery. Electric motors, controls of machinery, lights and wiring in building complexes, vehicles, aircrafts, power generations, control and 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 and 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 and charts. Testing equipment and machinery, solving operations problems, estimating time and cost of electrical and 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:

Program Requirements	
I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences and 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 and their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalogue.

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.

Courses		crs.	Pro/Co-requisites
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 and Applications	2	Pre: COME 232

Descriptions of this group of courses are given below:

COMP 221 DIGITAL SYSTEMS I (2Crs.:2Lec,0Lab):
Number systems and coding, Binary systems. Conversion from decimal to other bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions and circuits designs (HA, FA, and ALU). Combinational functions and circuits design (decoder, encoder, multiplexer and de-multiplexer). Sequential circuits definitions and 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) and 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 and FET amplifiers: Types, circuit models, frequency response, differential and multistage amplifiers, large signal analysis and power amplifiers, operational amplifiers: Characteristics, applications, imperfections, feedback amplifiers, sinusoidal oscillators and multivibrators. Pre-req.: COME 221.

COME 212 NETWORK ANALYSIS (2Crs.:2Lec,0Lab):
Transient analysis, Laplace transform and its application to circuit analysis, two-port networks, frequency selective passive and 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 and asynchronous sequential networks, programmable logic devices: PLA, PAL, CPLD, FPGA, applications in design and implementation of combinational and sequential circuits, sequential circuits for arithmetic operations. Memory elements, adders, and 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 AND APPLICATIONS (2Cr.:1Lec,2Lab):
Microprocessor chips and LSI technology. Architecture and instruction set of a 16 bit microprocessor. Supporting chips: Buffers, decoders, system clock generator. Interfacing 16 bit microprocessor to memory and I/O devices. Interfacing techniques: Serial, parallel, timers. Direct memory access and DMA controllers. System development and design tools (hardware and software).Pre-req.: COME 232.

B. Electric Power and Machine Engineering Core

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

Courses		Crs.	Pre/Co-requisites
POWE 210	Fundamental of Electric Circuits	3	Pre: PHYS 281
POWE 271	Electro-Magnetics	3	Pre: PHYS 281
POWE 214	Electrical and Electronic Measurements	3	Pre: POWE 271
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 and node voltage analysis methods, source transformation, DC network theorems, capacitors and inductors, phasors and AC steady state circuit analysis, series and parallel resonance, power in AC circuits, Fourier series technique applied to circuit analysis, balanced and unbalanced three-phase circuits. Pre-req.: PHYS 281.

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

POWE 271 ELECTROMAGNETIC (3Crs.:3Lec,0Lab):
Vector calculus, electrostatics: Coulomb's law, Gauss's law, divergence theorem, energy and potential, conductors and dielectrics, electric dipole and polarization, capacitances, magnetostatics: Biot-Savart law, Ampere's law, Stoke's theorem, magnetic materials, magnetic dipole and 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, and electrical performance, reactive power compensation and voltage control of transmission lines, underground power cables. Pre-req.: POWE 210 and POWE 271.

POWE 322 ELECTRIC POWER II (3Crs.:2Lec,2Lab):
Physical interpretation of transmission line equations, mechanical analysis and design of overhead transmission lines, line insulators, corona discharge and 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 and co-energy, single phase transformers: construction, theory of operation, equivalent circuit, power flow, regulation and testing, auto transformer, three phase transformers: connections, special connections of transformers, DC Machines: construction, theory of operation, induced voltage and developed torque, armature reaction, commutation, equivalent circuits, generator and motor (types and characteristics). Pre-req.: POWE 210 and 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 and frequency, power computation for AC sources, power computation for non-sinusoidal periodic waveform, Fourier analysis and total harmonic distortion, power losses, Rectifying circuits: single-phase and three-phase, uncontrolled, half controlled and fully controlled rectifiers for R and RL loads. Effect of source impedance and 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 and mechanical diagrams, parallel operation, three-phase induction motors: Construction, theory of operation, equivalent circuit, power flow, regulation starting and 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 and lab to simulate and 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 and Z bus formulation technique, symmetrical fault analysis, unbalanced fault analysis, instrument transformers for protection purposes, protection fundamentals, relay and switchgear characteristics, over-current relays. Pre-req.: POWE 321.

POWE 422 POWER SYSTEM CAD (2Crs.:1Lec,2Lab):
Standard software: simulation and 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 and extra high voltage line protection, carrier schemes, for high voltage and 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 and applications, economic operation of power systems, load forecasting, reliability and generation planning, power system security: assessment and analysis of the effect of disturbing loads connected to the power system, power system stability, and voltage stability. Pre-req.: POWE 322.

POWE 431 POWER ELECTRONICS II (3Crs.:2Lec,2Lab):
Three-phase and single phase AC voltage controllers for R and RL loads, effect of impedance, type of three phase connections (delta or star), introduction to induction motor speed control and static VAR control,. DC to DC Converters: linear voltage regulation, design consideration for buck, boost and cuk converters, modes of operation, effect of ripples, single, two and four quadrants operation. Switched capacitor converter. Single phase and three phase inverters: the full bridge converter, square wave inverter, total harmonic distortion and Fourier analysis, amplitude and harmonic control, Multilevel inverter, PWM for bipolar and unipolar switching, Voltage control through pulse amplitude and 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 and the root locus, design of lag, lead, and lag-lead compensators. PID controllers and design of feedback control systems using frequency response, state variable representation, state-space approach, transition matrix, controllability and observability, design of state variable control systems. MATLAB / SIMULINK is used in class assignment and lab to simulate and 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 and 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 and insulation coordination, electrical transients in power systems, principles of system grounding and applications to industrial plants, protective grounding systems, breakdown mechanisms in solids, liquids and dielectrics, high voltage generation, measurements and testing techniques. Co-req.: POWE 424 and POWE 426.

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

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

C. Electric Power and Machine Engineering Technical Elective

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

Courses		crs.	Pro/Co-requisites
POWE 428	Electrical Design In Commercial and Industrial Buildings	2	Pre: POWE322
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 and Operation	2	Pre: POWE441 & POWE426
POWE 536	Solid-State Drives	2	Pre: POWE431

Description of Technical Elective Courses

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

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

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

POWE 524 POWER SYSTEM CONTROL AND OPERATION (2Crs.:2Lec,0Lab):
Control problems in interconnected power systems, modelling power system components and 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 and control. Pre-req.: POWE 441 and POWE 426.

POWE 533 SPECIALIZED MODES OF MACHINE OPERATION (2Crs.:2Lec,0Lab):
Induction machine modes of operation: generation, plugging and braking, unbalanced operation. Induction regulator: single and three-phase, Selsyns and Synchros, Single phase induction motors: construction, theory of operation, types and 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 and 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 and lab to simulate and 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 and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and 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 and Machines (150 Credits)

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

Second Semester (18 Credits)		Crs.	Pre-/co-requisites
MATH 281	Linear Algebra	3	
MCHE 213	Dynamics	3	
PHYS 282	Properties of Materials, Mechanics, and Heat	3	
POWE 210	Fundamentals of Electric Circuits	3	Pre: PHYS 281
ENGL 211	Advanced Writing	2	Pre:ENGL001
ARAB 001	Arabic Language	2	
	Elective (General)	2	

Third Semester (18 Credits)		Crs.	Pre-/co-requisites
MATH 283	Differential Equations	3	Pre: MATH 281,MATH 282
CHEM 405	Solid State Chemistry	2	
COMP 221	Digital Systems I	2	
COME 221	Electronic Circuits I	3	Pre: POWE 210
INME 221	Engineering Economy	3	
ENGL 300	Speech Communication	2	Pre: ENGL 211
POWE 271	Electromagnetics	3	Pre: PHYS 281

Fourth Semester (16 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 and Electronic Measurements	3	Pre: POWE 271
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
COME232L	Logic Circuit Lab	1	Co: COME 232
MATH 284	Numerical Analysis	3	Pre: MATH 283

Fifth Semester (17 Credits)		Crs.	Pre-/co-requisites
COME 431	Microprocessor Interfacing and 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 and Statistics	3	Pre: MATH 282
	Elective (General)	3	

Sixth Semester (14 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
	Free Engineering Elective	3	
	Elective (General)	2	

Seventh Semester (15 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
MGMT 001	Entrepreneurship I	2	
	Free Engineering Elective	3	

*This course is equivalent to COMP 361.

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
ENVI 302	Environmental Pollution	3	
	Technical Elective	2	
	Elective (General)	2	

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 (10 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
	Technical Elective	2	

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 and node voltage analysis methods, source transformation, DC network theorems, capacitors and inductors, phasors and AC steady state circuit analysis, series and 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 and digital electronic circuits; semiconductors and the PN Junction; diode circuits and applications; rectification – half- and full-wave; bipolar junction transistors, IGBT, and MOSFET operation and circuits; motor drives; operational amplifiers; applications. Pre-req.: POWE 210.

POWE 238L CIRCUITS AND ELECTRONICS LAB (1Cr.:0Lec,2Lab):

Passive electronic components; laboratory instruments; voltage-divider and bridge circuits; RC filters and lead-lag networks; LEDs; Zener regulator; diode rectifier circuits; BJT, IGBT, and MOSFET applications; op-amp circuits; filters and oscillators. Pre-req.: POWE 210; Co-req.: POWE 238.

POWE 333 ELECTRIC MACHINES AND DRIVES (3Crs.:3Lec,0Lab):

Single-Phase and 3-phase Transformers; Power Transmission and Distribution; DC Machines, Motors; Synchronous Generators; Poly-Phase Induction Motors. Pre-req.: POWE 210.

DEPARTMENT OF INDUSTRIAL ENGINEERING AND ENGINEERING MANAGEMENT

Academic Staff

Chairperson	Hadi Abou Chakra
Assistant Professors	Akram Tannir, Ramzi Fayad
Part-time Lecturers	Rola Sammoura, Ali Ghandour
Part-time Instructors	Abdel kader Elsaiidi, Mohammad Hammoud

Mission

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

Objectives

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

- Graduates will be able to identify and implement effective solutions to real problems by applying contemporary industrial engineering tools and cutting-edge technology in production, quality, safety, supply chain, optimization, economic, manufacturing, service and information systems.
- Graduates will be able to formulate problems accurately, generate alternative solutions, evaluate those alternatives, and present the best solutions to clients or decision makers in a fashion that facilitates decision-making processes.
- Graduates will be able to assume leadership roles with strong communication skills and will be able to work competently and ethically alone and as team members.

Learning Outcomes

Upon completion of the program graduates shall be able to:

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

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

Degree Requirements

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

Career Opportunities

Industrial engineering differs from other branches of engineering in essentially two ways. First, it applies to all types of industrial, commercial, and 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, and 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, and food processing. Students develop skills in mathematics, the sciences, communications, and 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 and 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, and government.

Program Overview

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

Program Requirements	
I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences and 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 and their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalogue.

II. IE Program-Specific Requirements

A. Industrial Engineering Core Courses

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

Courses		crs.	Pre/Co-requisites
INME202	Engineering Management	2	
INME211	Engineering Materials and Technology	3	
INME212	Metal Shaping	3	Pre: INME211
INME214	Manufacturing Processes	3	Pre: INME211
INME222	Operations Research	3	Pre: MATH282
INME312	Computer Aided Design and Manufacturing	3	Pre: INME331 and MATH284
INME321	Management Information Systems	3	Pre: INME222
INME322	Organization Design	3	
INME324	Production and Operation Management	3	Pre: INME222
INME331	Engineering Design	3	Pre: INME212 and INME214
INME332	Industrial Measurements and Inspection	3	Pre: INME214
INME333	Facility Planning and Design	3	
INME341	Engineering Safety	2	
INME421	Reliability	3	Pre: MATH381
INME422	Engineering Logistics and Supply Chain	3	Pre: INME324
INME423	Project Planning and Management	3	
INME431	System Modeling and Simulation	3	Pre: INME324
INME432	Failure Analysis	3	Pre: INME331
INME433	Maintenance Planning and Technology	3	Pre: INME332
INME434	Statistical Quality and Process Control	3	Pre: MATH381
INME442	Ergonomics	2	
INME521	Total Quality Management and Six Sigma	3	Pre: INME421
INME522	Management of Global Operations	3	
INME531	Production Systems and Automations	3	Pre: INME333

Description of Core Courses

INME 202 ENGINEERING MANAGEMENT (2Crs.:2Lec,0Lab):
The function of engineering management (planning, organizing, leading and controlling), engineers as managers and leaders, ethics in engineering management.

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

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

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

INME 221 ENGINEERING ECONOMY (3Crs.:3Lec,0Lab):
Basics principles and techniques of economic analysis of engineering project, time value of money, cost allocation and estimation, evaluation of engineering projects and investments, depreciation, inflation, bond and 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 and sensitivity analysis), goal programming, transportation, assignment, and deterministic dynamic programming, Queuing theory, dynamic programming, markov decision process, Waiting line and queuing theory, Deterministic and Probabilistic Inventory Model, software applications and demonstrations. Pre-req.: MATH 282.

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

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

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

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

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

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

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

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

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

INME 422 ENGINEERING LOGISTICS AND SUPPLY CHAIN (3Crs.:3Lec,0Lab):
Introduction to supply chain management, supply chain integration, strategic partnering, decision support systems, information technology, customer value and 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 AND MANAGEMENT (3Crs.:3Lec,0Tut):
Principles of project planning, project identification, time frame, project objectives, network construction (activity on arrows, activity on nodes), CPM and PERT applications, cost estimation, earned value analysis, project quality management, crashing of schedules, resource allocation and leveling, computer-based project management.

INME 431 SYSTEM MODELING AND SIMULATION (3Crs.:2Lec,2Lab):
Principles of simulation, Systems concepts, modeling, design and analysis of network flows for material and information, modeling of discrete and continuous systems, advanced system modeling, case studies with verification and 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 and Irwin's theory, crack initiation, crack propagation and 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 AND TECHNOLOGY (3Crs.:3Lec,0Lab):
Maintenance strategy, maintenance organization, maintenance systems, condition based maintenance, maintenance awareness in design, cost of maintenance team, effectiveness, and case studies. Pre-req.: INME 332.

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

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

INME 521 TOTAL QUALITY MANAGEMENT AND SIX SIGMA (3Crs.:3Lec,0Lab):
Analytical and management tools necessary to solve manufacturing quality problems and 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 and quality function deployment. Pre-req.: INME 421.

INME 522 MANAGEMENT OF GLOBAL OPERATIONS (3Crs.:3Lec,0Lab):
Introduction to international operations and 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, and 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.

Courses		crs.	Pre/Co-requisites
INME414	Industrial Scheduling	3	Pre: INME324
INME416	Industrial Packaging	3	Pre: INME214, INME331
INME418	Plastic Engineering	3	Pre: INME214
INME512	Intermediate Stochastic Operation Research	3	Pre: INME222
INME514	Business Process Re-engineering	3	Pre: MATH381
INME516	Advanced Manufacturing Processes	3	Pre: INME214
INME518	Strategic Manufacturing Planning	3	Pre: INME214/333
INME535	Advanced Engineering Statistics	3	Pre: MATH381
INME537	Analysis of variance and Design of Experiments	3	Pre: MATH381
INME539	Reverse Engineering and Prototyping	3	Pre: INME331

Description of Technical Elective Courses

INME 414 INDUSTRIAL SCHEDULING (3Crs.:3Lec,0Lab):
basic scheduling models for single machine, parallel machines, flow shops and flexible flow shops, applications in production and services will be used throughout and algorithms will be explained from theoretical and 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 and containers. Pre-req.: INME331

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

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

INME 514 BUSINESS PROCESS RE-ENGINEERING (3Crs.: 3Lec,0Lab):
Topics include business Process diagnosis, design, and 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 and processes, including metallic/nonmetallic materials and their fabrication, non-materials, rapid prototyping, and materials' testing. Pre-req.: INME214.

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

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

INME 537 ANALYSIS OF VARIANCE AND 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 and related designs, latin square design. Pre-req.: MATH381.

INME 539 REVERSE ENGINEERING AND PROTOTYPING (3Crs.:3Lec,0Lab):
Concept, techniques, analysis and applications of engineering design, fundamentals of design and design principles, conceptual design, importance of sketching, use of computer aided drafting and computer aided design packages, reverse engineering principles, design projects and 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, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and 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 and Engineering Management (150 Credits)

First Semester (16 Credits)		Crs.	Pre-/co-requisites
COMP 208	Programming I	3	
MATH 282	Calculus	3	
PHYS 281	Electricity and Magnetism	3	
CVLE 210	Statics	3	
MCHE 201	Engineering Graphics and Visualization	3	
BLAW 001	Human Rights	1	

Second Semester (15 Credits)		Crs.	Pre-/co-requisites
MATH 281	Linear Algebra	3	
PHYS 282	Materials properties and Heat	3	
MCHE 213	Dynamics	3	
INME 202	Engineering Management	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	
ENGL 211	Advanced Writing	2	
ARAB 001	Arabic Language	2	
INME 221	Engineering Economy	3	
INME 211	Engineering Materials and Technology	3	
	Elective (General)	1	

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 and Statistics	3	
ENVI 302	Environmental Pollution	3	
INME 331	Engineering Design	3	Pre: INME 212 INME 214
INME 333	Facility Planning and 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 and Manufacturing	3	Pre: INME 331 MATH 284
INME 324	Production and Operation Management	3	Co: INME 222
INME 332	Industrial Measurements and Inspection	3	Pre: INME 214
	Elective (General)	2	

Seventh Semester (14 Credits)		Crs.	Pre-/co-requisites
INME 431	System Modeling and Simulation	3	Pre: INME 324
INME 433	Maintenance Planning and Technology	3	Pre: INME 332
INME 421	Reliability	3	Pre: MATH 381
INME 423	Project Planning and Management	3	
	Elective (General)	2	

Eighth Semester (14 Credits)		Crs.	Pre-/co-requisites
INME 432	Failure Analysis	3	Pre: INME 331
INME 422	Engineering Logistics and Supply Chain	3	Pre: INME 324
INME 434	Statistical Quality and Process Control	3	Pre: MATH 381
INME 442	Ergonomics	2	
	Technical Elective[1]	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 and Automations	3	Pre: INME 333
INME 521	Total Quality Management and Six Sigma	3	Pre: INME 421
	Technical Elective[2]	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[2]	3	
	Free Engineering Elective	4	

1Student may choose one of the following courses: INME414, INME416, or INME418.
2Student may choose one of the following courses: INME512, INME514, INME516, INME518, INME534, INME537, or INME539.

DEPARTMENT OF MECHANICAL ENGINEERING

Academic Staff

Chairperson	Ali Hammoud
Associate Professors	Ahmed Abdel-Naby, Mohamad Khamis
Assistant professors	Ossama Mokhaimar, Mohamed Darwish, Hassan Assoum, Mohamad Ali
Part-time Lectures	Souheil Matar, Semaan Amine, Mohammad Kanaan, Amer Keblawi, Bilal Taher, Ziad Naga

Mission

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

Objectives

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

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

Learning Outcomes

Upon completion of the program graduates shall be able to:

- Apply knowledge of mathematics, science, and engineering
- Build an experimental setup, conduct experiment, analyze and interpret data, and take appropriate action as needed.
- Identify, formulate, and solve mechanical engineering problems in thermal and mechanical systems using real world engineering tools
- Apply the techniques, skills, and modern engineering tools necessary for engineering practice.
- Exhibit higher-order thinking and sound reasoning in dealing with complex engineering problems
- Demonstrate knowledge of the entrepreneurial process and related tools
- Recognize the need for, and an ability to engage in life-long learning
- Function on multidisciplinary and multicultural teams.
- Use information and communication technologies to effectively communicate ideas and present

technical information to constituents in oral and written forms.
- Demonstrate commitment to upholding established professional and ethical norms.
- Design a system, component, or process to meet desired needs and satisfy realistic constraints.
- Recognize the global, economic, environmental, and social context and the associated implications of engineering solutions.

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

Program Requirements	
I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences and Mathematics	26
General Engineering topics	15
II. IE 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 and their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalogue.

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.

Courses		crs.	Pre/Co-requisites
INME 211	Engineering Materials and 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 and Electronics Lab	3	Co: POWE 238
POWE 333	Electric Machines and Drives	1	Pre: POWE 210

Descriptions of this group of courses are given below.

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

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

POWE 238 CIRCUITS AND ELECTRONICS LAB (1Cr.:0Lec,2Lab):
Passive electronic components; laboratory instruments; voltage-divider and bridge circuits; RC filters and lead-lag networks; LEDs; Zener regulator; diode rectifier circuits; BJT, IGBT, and MOSFET applications; op-amp circuits; filters and 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 and node voltage analysis methods, transformation methods, DC network theorems, capacitors and inductors, phasors and AC steady state circuit analysis, series and parallel resonance, power in AC circuits, balanced and unbalanced three-phase circuits. Pre-req.: PHYS 281.

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

POWE333 ELECTRIC MACHINES AND DRIVES (3Crs.:3Lec,0Lab):
Single-Phase and 3-phase Transformers; Power Transmission and Distribution; DC Machines, Motors; Synchronous Generators; Poly-Phase Induction Motors. Pre-req.: POWE 210.

B. Mechanical Engineering Core

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

Courses		crs.	Pro/Co-requisites
MCHE 201	Engineering Drawing and 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 and Instrumentation	3	Pre: POWE 238
MCHE 302L	Measurement and 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 and Analysis	3	Pre: MCHE 213, POWE 210
MCHE 414	Applied Mechatronics	3	Pre: MCHE 302, POWE 333
MCHE 421	Heat Transfer	3	Pre: MATH 284, MCHE 321
MCHE 422	Refrigeration and 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 AND GRAPHICS (3Crs.:2Lec,2Lab):
Constructional Geometry-constructing tangents. Plane curves and polygons. Orthographic drawing and theory of sketching shapes and surface identification. Orthographic projection of views. Sectional views and conventions. Pictorial drawing. Applications of Auto-CAD for 2D drawings and solid modeling; project.

MCHE 204 FOUNDATION OF MECHANICAL ENGINEERING (3Crs.:3Lec,0Lab):
Students teams develop and complete a community related project. Examples of contemporary engineering systems are presented and major engineering principles are introduced. Class discussions are organized to support the completion of the projects by introducing topics such as design process, machine elements, electronics, visualization and communication. Issues of teamwork, ethics, creativity, report writing, and fundamental principles are emphasized. Pre-req.: Completed first term.

MCHE 213 DYNAMICS (3Crs.:3Lec,0Tut):
Dynamics of a particle, system of particles, and planar of rigid bodies using Newton's law of motion,work and energy principle, and impulse and momentum principle. Free-body diagram and concept of equilibrium. Inertia properties of rigid bodies.

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

MCHE 302 MEASUREMENT AND INSTRUMENTATION (3Cr.:3Lec,0Lab):
Elements of a measurement system. Classification of sensors, sensor characteristics, sensor types. Statistical analysis of data, curve fitting, and uncertainty analysis. Physical principles. Interfacing concepts - amplification, filtering, impedance buffering, etc. Computer-aided data acquisition, manipulation, transmission, and recording. Team project to formulate and develop a measurement system. Pre-req.: POWE 238.

MCHE 302L MEASUREMENT AND INSTRUMENTATION LAB (1Cr.:0Lec,2Lab):
Introduction to LABVIEW. Experiments to measure various physical quantities. Data acquisition and analysis using NI-ELVIS platform. Typical laboratory experiments involve building signal conditioning circuits for thermocouples, thermistors, photodiodes, strain gauges, accelerometers, etc. 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, and strain-displacement relations. Tension/compression of rods and trusses, torsion of shafts, bending in beams, bucking of columns, and 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 and tools for the design of machine elements. Failure theories. Design for strength under static and fatigue loading. Design for rigidity. Design of shafts. Design of non-permanent joints (fasteners and keys) and power screws. Design of permanent joints: rivets, welds and adhesive joints. Design of mechanical springs. Computer aided applications. Project. Pre-req.: MCHE 311.

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

MCHE 321 THERMODYNAMICS I (3Crs.:3Lec,0Lab):
Introduction and basic concepts. Properties of pure substances. Energy analysis of closed systems. Mass and energy analysis of control volumes. Second law of Thermodynamics. Entropy, gas power cycle, vapor power cycle, vapor refrigeration cycle, real gas, Gas–vapor mixtures and air-conditioning. Pre-req.: PHYS 282.

MCHE 322 THERMODYNAMICS II (3Crs.:3Lec,0Lab):
Reheat and regenerative steam power generation plants. Thermal energy conversion into mechanical. Steam flow through nozzles and forces exerted on different types of turbine blades. Gas turbine (Regeneration, inter-cooling, and reheat cycles) and reciprocating engines. Thermodynamic analyses of power plants. Computer applications. Pre-req.: MCHE 321.

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

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

MCHE 411 MECHANICAL DESIGN II (3Crs.:3Lec,0Lab):
Design of friction elements: Clutches and brakes. Design of couplings Design of wire ropes. Design of gear drives for strength using AGMA standards for spur, helical, bevel and worm gearing. Selection of rolling bearings. Lubrication and design of journal bearings. Design of belt and chain drives. Introduction to optimization. Computer-aided applications. Team project to formulate, design and build a mechanical system for a useful purpose. Pre-req.: MCHE312.

MCHE 412 DYNAMIC SYSTEMS – MODELING AND ANALYSIS (3Crs.:3Lec,0Lab):
Introduction to dynamic modeling of mechanical, electrical, thermal, fluid, magnetic, and mixed discipline systems. Linear graph and bond-graph methods. Linear and non-linear systems. Time- and frequency-response analysis. Nonlinear systems. Introduction to dynamic systems design and control. Simulation using MATLAB and SIMULINK and LabVIEW. Team project to model and simulate a dynamic system. Pre-req.: MCHE 213 and POWE 210.

MCHE 414 APPLIED MECHATRONICS (3Crs.:2Lec,2Lab):
Introduction to designing mechatronic systems and embedded technology platforms for real-time control. Programming of the PIC MCU. Serial and Wireless communications. Programmable timers. A/D and D/A conversion. Hardware/software development tools. Team project to develop and commission an MCU controlled mechatronic system. Pre-req.: MCHE 302 and POWE 333.

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

MCHE 422 REFRIGERATION AND AIR CONDITIONING (3Crs.:3Lec,0Lab):
Introduction to refrigeration methods: Air refrigeration, steam jet, thermoelectric, absorption, vapor compression system, psychometric processes and cycles, cooling and heating loads, duct design, air conditioning systems, noise criteria, metering devices, compressors, evaporators, condensers, cooling towers. Pre-req.: MCHE 421.

MCHE 429 THERMO-FLUIDS LAB (2Crs.:0Lec,4Lab):
Experiments relevant to thermodynamics, heat transfer, thermal processes, fluid systems and hydraulic machines. Measurement of thermal conductivity, convective heat transfer coefficients, and 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 and combined flow. Major and minor loss in pipes, pipes in series and 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 and block diagrams. Time-domain analyses and the root-locus method. Frequency-domain methods. State space methods. Stability and sensitivity analysis. Design of PID controllers and dynamic compensators. Control experiments that includes: DC Motor, HVAC system, and inverted pendulum. Applications using Matlab, Simulink and LabVIEW. Team project to model and control of a dynamic system. Pre-req.: MCHE 412.

MCHE 521 THERMAL POWER STATIONS (3Crs.:3Lec,0Lab):
Systems and cycles used in electrical power generation. Overview of plants operating on fossil fuel, nuclear energy and solar energy. The main emphasis is on gas turbine, steam turbine, (CCGT) - combined cycle plants and traditional steam-generation plants burning fossil fuel such as natural gas or oil. Nuclear power generation and the steam generation systems, heat recovery systems, the condenser systems, pumps and other auxiliaries operations. Pre-req.: MCHE 421.

MCHE 531 PUMP TECHNOLOGY (3Crs.:3Lec,0Lab):
Piping system calculations. Pump classifications. Centrifugal pump construction. Pump performance curves, operating points, discharge regulation, similarity, speed variation, and cavitation. Pumps in series and parallel. Multi-stage pumps, axial flow pumps, Kaplan pumps. Pump applications and introduction to pump station design and cavitation in pumps. Project - 1: design and construction of two pumps connected in series and parallel. Projects- 2: design and construction of variable speed pump in a closed or open system. Pre-req.: MEHE 332.

MCHE 532 FLUID SYSTEM DESIGN (3Crs.:3Lec,0Lab):
Design, selection, operation and maintenance of pumps. Viscosity effect on pump performance air entraining vortex effect. Priming of pumps. Design of pump stations. Design, selection, operation, and maintenance of fans, compressors, and blowers and theory and application of each type. Project - 1involve the design and application of a ventilation system in building car parking. Projects-2 relates to hot water pipes distribution in a heating system, and chiller pipes sizing and system in HVAC applications. Pre-req.: MEHE 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.

Courses		crs.	Pre/Co-requisites
MCHE 461	Applied Robotics	3	Pre: MCHE 213 and either MCHE 302 or COME 431
MCHE 512	Engineering Vibrations	3	Pre: MCHE 412
MCHE 513	Finite Element Analysis – Theory and Applications	3	Pre: 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 and 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 and 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 and Applications	3	Pre: MCHE 331
MCHE 538	Compressed Air Technology	3	Pre: MCHE 331
MCHE 539	Gas Dynamics	3	Pre: MCHE 321 and MCHE 331
MCHE 561	Robotic Control and Intelligent Systems	3	Pre: MCHE 461
MCHE 562	Sensors and 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 and INME 221
MCHE 571	Refrigeration and HVAC Applications	3	Pre: MCHE 422
MCHE 572	Water Desalination Technologies	3	Pre: MCHE 421
MCHE 573	Operation and management of Thermal Power Stations	3	Pre: MCHE 521
MCHE 581	Computational Fluid Dynamics	3	Pre: MCHE 332 and MCHE 421

Description of Technical Elective Courses

MCHE 461 APPLIED ROBOTICS (3Crs.:2Lec,2Lab):
Robot architecture, subsystems, and applications; mechanisms and drives; forward and inverse kinematics; trajectory planning; dynamics and control; actuators and drive electronics; sensors and interface; mobile robots and navigation; intelligence; collaborative learning; team project. Pre-req.: MCHE 213 and either MCHE 302 or COME431.

MCHE512 ENGINEERING VIBRATIONS (3Crs.:3Lec,0Lab):
Introduction to vibration and the free response, forced response of un-damped and 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 AND APPLICATIONS (3Crs.:3Lec,0Lab):
Introduction to the theoretical basis of finite element method and its application in solving engineering problems. Topics covered include: Overview of the finite element solution; basic finite elements; modeling considerations; static, modal and dynamic analysis of structures and 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, and state-based design; instruction list and structured text programming; Interface of sensors, actuators, and 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, and mobility analysis, synthesis of single- and 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 and synthesis. Project. Pre-req.: MCHE 317.

MCHE 518 PRODUCT DESIGN AND DEVELOPMENT (3Crs.:3Lec,0Lab):
Modern tools and methods involving product design and development process. Product planning; Idea generation; concept generation; concept selection; functional analysis; engineering design process for systems and components; economic and 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 and classifications of shell and 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, and modeling of various thermal systems are covered in the course. Computer programs and software applications for rating, design and simulation are integrated into the assignment and course project report. Pre-req.: MCHE 421.

MCHE 525 RENEWABLE ENERGY TECHNOLOGIES (3Crs.:3Lec,0Lab):
The course provides students with the fundamentals, design tools, and state-of-the-art alternative energy technologies. Emphasis is given to solar energy fundamentals, design and performance evaluation of solar collectors, passive and active applications of solar energy, thermal and electric energy storage. Other alternative energy technologies such as wind, hydro, geothermal, ocean thermal energy conversion are introduced. The economics of alternative energy and their potential in the Arab region is highlighted. Pre-req.: MCHE 321.

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

MCHE 527 GAS TURBINES TECHNOLOGY (3Crs.:3Lec,0Lab):
Gas Turbine engine and component performance; Gas Turbine thermodynamic cycles; Combustors fuels and emissions; Gas Turbine applications and implications to the user; Gas Turbine Control system, Gas turbine maintenance strategies, reliability and availability; Gas turbine procurement, condition monitoring, usage and retention. Pre-req.: MCHE 322.

MCHE 533 HYDRAULIC MACHINERY AND STATIONS (3Crs.:3Lec,0Lab):
Hydraulic turbines, Pelton wheel, Francis, propeller and Kaplan turbines, construction, design factors, discharge regulation and part load performance, model testing, cavitations and 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 and series, three pipe reservoirs , Pipe Network single- and two-phase flow for incompressible flow in pipelines, Water Hammer, pipes, fittings, valves, accessories, standards, pipeline installation, operation, monitoring and maintenance. Pre-req.: MCHE 332.

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

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

MCHE 538 COMPRESSED AIR TECHNOLOGY (3Crs.:3Lec,0Lab):
Compressed air system definition and its applications in industry, System components: Compressors, Air reservoirs, Pipes, Air treatment devices: dryers, filters. System leakage resources & Control. Maintenance and 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 and cooling, normal and oblique shock waves, applications and analysis in aero jet engines and components. Pre-req.: MCHE 321 and MCHE 331.

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

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

MCHE 563 APPLIED ENGINEERING OPTIMIZATION (3Crs.:3Lec,0Lab):
Problem definition, objective functions and constraint; local vs. global optimization methods; deterministic vs. stochastic methods; linear and non-linear programming methods; gradient-based methods; combinatorial optimization techniques: Genetic algorithm, simulated annealing, tabu search, and 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, and systems - engines, fuel systems, ignition systems, cooling, lubrication, power boosting, transmission, steering, braking, suspension and damping, starting and 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 and achieve targets, prepare budgets, find capital by effectively communicating the idea to those who can finance it, hire the right mix of marketing and technical talent, know the market by engaging in real time market research, and focus on the customer; team project. Pre-req.: MGMT 002 and INME 221.

MECE 571 REFRIGERATION AND HVAC APPLICATIONS (3Crs.:2Lec,2Lab):
Refrigeration cycles, Multi-stage compression cycles, compressor types and selection, metering device selection, cooling coil design, Air handling unit design, condensing unit design, refrigerant piping design, chilled and hot water piping design, control devices, refrigeration system troubleshooting cold stores, computer software. Pre-req.: MCHE 422.

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

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

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

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.

Courses		crs.	Pro/Co-requisites
MCHE 461	Applied Robotics	3	Pre: MCHE 213 and either MCHE 302 or COME 431
MCHE 512	Engineering Vibrations	3	Pre: MCHE 412
MCHE 513	Finite Element Analysis – Theory and 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 and 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 and 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 and Applications	3	Pre: MCHE 331
MCHE 538	Compressed Air Technology	3	Pre: MCHE 331
MCHE 539	Gas Dynamics	3	Pre: MCHE 321 and MCHE 331
MCHE 561	Robotic Control and Intelligent Systems	3	Pre: MCHE 461
MCHE 562	Sensors and 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 and INME 221
MCHE 571	Refrigeration and HVAC Applications	3	Pre: MCHE 422
MCHE 572	Water Desalination Technologies	3	MCHE 421
MCHE 573	Operation and management of Thermal Power Stations	3	Pre: MCHE 521
MCHE 581	Computational Fluid Dynamics	3	Pre: MCHE 332 and MCHE 421

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 and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and 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 (15 Credits)		Crs.	Pre-/co-requisites
COMP 208	Programming I	3	
MATH 281	Linear Algebra	3	
CHEM 405	Solid State Chemistry	2	
PHYS 282	Material Properties and Heat	3	
MCHE 201	Engineering Graphics and Visualization	3	
	Elective (General)	1	

Second Semester (15 Credits)		Crs.	Pre-/co-requisites
MCHE 204	Foundation of Mechanical Engineering	3	
MATH 282	Calculus	3	
CVLE 210	Statics	3	
PHYS 281	Electricity and Magnetism	3	
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 and Technology	3	
MATH 283	Differential Equations	3	Pre: MATH 281, MATH 282
MCHE 213	Dynamics	3	
ENGL 211	Advanced Writing	2	Pre: ENGL 001
ARAB 001	Arabic Language	2	

Fourth Semester (14 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 and Electronics Lab	1	Co: POWE 238
ENGL 300	Speech Communications	2	Pre: ENGL 211

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
MATH 381	Probability and Statistics	3	Pre: MATH 282
	Elective (General)	1	

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 and Instrumentation	3	Pre: POWE 238
MCHE 302L	Measurement and Instrumentation Lab	1	Co: MCHE 302
MCHE 312	Machine Design I	3	Pre: MCHE 311
	Elective (General)	2	

Seventh Semester (16 Credits)		Crs.	Pre-/co-requisites
MCHE 421	Heat Transfer	3	Pre: MATH 284 and MCHE 321
MCHE 411	Machine Design II	3	Pre: MCHE 312
POWE 333	Electric Machines and Drives	3	Pre: POWE 210
MGMT 002	Entrepreneurship I	2	
MCHE 429	Thermo-fluids Lab	2	Pre: MCHE 332, Co: MCHE 421
	Elective (General)	3	

Eighth Semester (17 Credits)		Crs.	Pre-/co-requisites
MCHE 412	Dynamic Systems - Modeling and Analysis	3	Pre: POWE 210, MCHE 213
MCHE 422	Refrigeration and Air Conditioning	3	Pre: MCHE 421
MCHE 414	Applied Mechatronics	3	Pre: MCHE 302, POWE 333
INME 221	Engineering Economics	3	
ENVI 302	Environmental Pollution	3	
	Elective (General)	2	

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 and thermal insulation; ventilation and air conditioning; sound insulation; elevators and escalators, and fire fighting.

MCHE 301 HVAC AND SANITATION FOR ARCHITECTS (2Crs.:1Lec,2Lab):
This course addresses two technical fields, HVAC and Sanitation. HVAC: Introduction to air conditioning and mechanical installations in buildings and indoor spaces, general consideration, various heating and cooling systems, ventilation and air conditioning of various types, Installations and control of systems. Sanitation: Sanitary engineering issues, dampness: Sources and methods of insulation, water supply treatment and distribution, sanitary fixtures, installation and connections, treatment of soiled water, rainwater drainage and storm sewers.

MCHE 407 THERMAL AND HYDRO POWER STATIONS (3Crs.:3Lec,0Lab):
Thermal Power Stations: Introduction to power generation; modern power plant layouts; gas fired, combined cycle, nuclear, and renewable energy; thermodynamic principles including Carnot cycle, Rankine cycle, Brayton cycle, and combined cycles; combustion processes, steam generations and boiler systems; steam turbines systems; gas turbine systems, combined cycle power plants and cogeneration; condensers and cooling technologies. Fluid Mechanics and Hydraulics Applications: Introduction to fluid mechanics and application fields, fluid Properties; fluid statics: pressure measurements and forces on submerged surfaces; fluid flow kinematics: velocity, acceleration, flow field types and applications; fluid dynamics: mass and energy conservation, continuity, Bernoulli's equation, fluid flow measurements, flow through pipes; fluid mechanics and hydraulic applications: pumps, turbines and fluid system design (water supply and fire fighting system).

DEPARTMENT OF PETROLEUM ENGINEERING

Academic Staff

Chairperson	Dr. Hadi Abou Chakra (Acting)
Full-time Instructors	Kamel Bou Hamdan

Mission

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

Objectives

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

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

Learning Outcomes

Upon completion of the program graduates shall be able to:

- Apply knowledge of mathematics, science, and engineering.
- Build an experimental setup, conduct experiment, analyze and interpret data, and take appropriate action as needed.
- Identify, formulate, and solve petroleum engineering problems using real world engineering tools.
- Apply the techniques, skills, and modern engineering tools necessary for engineering practice.
- Exhibit higher-order thinking and sound reasoning in dealing with complex engineering problems.
- Demonstrate knowledge of the entrepreneurial process and related tools.
- Recognize the need for, and an ability to engage in life-long learning.
- Function on multidisciplinary and multicultural teams.
- Use information and communication technologies to effectively communicate ideas and present technical information to constituents in oral and written forms.
- Demonstrate commitment to upholding established professional and ethical norms.

- Design a system, component, or process to meet desired needs and satisfy realistic constraints.
- Recognize the global, economic, environmental, and social context and the associated implications of engineering solutions.

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, and service providers requiring petroleum engineering skills include: oil and gas production, refining and distribution, excavation, process, consulting, environmental institutions, and government. Most importantly, you can imagine something that never was and make it a reality! There is so much work to be done to guarantee the future of mankind and petroleum engineers can tap the possibilities through the spirit of innovation and 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:

Program Requirements	
I. Common Requirements	**Credits**
General Education Requirements	20
Basic Sciences and Mathematics	27
General Engineering topics	12
II. PE Program-Specific Requirements	**Credits**
A. Engineering topics from outside the major	6
B. Petrolum Engineering Core	74
C. Petrolum Engineering Technical Electives	6
D. Free Engineering Electives	0
E. Final Year Project	4
F. Internship	1

I. Common Requirements

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

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.

Courses		Crs.	Pre/Co-requisites
POWE 210	Electric Circuits	3	Pre: PHYS 281
MCHE 311	Mechanics of Materials	3	Pre: CVLE 210

Descriptions of this group of courses are given below.

POWE 210 FUNDAMENTAL OF ELECTRIC CIRCUITS (3Crs.:3Lec,0Lab):
DC circuit analysis: reduction methods, mesh current and node voltage analysis methods, transformation methods, DC network theorems, capacitors and inductors, phasors and AC steady state circuit analysis, series and parallel resonance, power in AC circuits, balanced and unbalanced three-phase circuits. Pre-req.: PHYS281.

MCHE 311 MECHANICS OF MATERIALS (3Crs.:3Lec,0Lab):
Introduction to the mechanics of deformable bodies considering linear material response. Load-stress, stress-strain, and strain-displacement relations. Tension/compression of rods and trusses, torsion of shafts, bending in beams, bucking of columns, and pressure vessels. Analysis of combined loading. Mohr circle analysis. Stress-strain transformations. Statically indeterminate structures. Pre-req.: CVLE210.

B. Petroleum Engineering Core Courses

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

Courses		Crs.	Pre/Co-requisites
CHEM331	Organic Geochemistry	3	Pre: CHEM281
GEOL203	Physical Geology	3	
GEOL204	Fundamentals of Geophysics	3	Pre: GEOL203
PTRE201	Introduction to Petroleum Engineering	3	

GEOL203	Sedimentary Rocks	3	Pre: GEOL204
PTRE202	Reservoir Rock Properties	3	Pre: GEOL203
PTRE204	Principles of petroleum geology	3	Pre: GEOL203
GEOL204	Geophysical Techniques	3	Pre: GEOL204
PTRE301	Reservoir Fluids	3	
PTRE303	Well Logging	3	Pre: GEOL204
PTRE302	Seismic (3D) Stratigraphy and Interpretation	3	Pre: GEOL203
PTRE304	Structural Geology and Tectonics	3	Pre: PTRE303
PTRE401	Reservoir Characterization	3	Pre: PTRE202
GEOL403	Seismic Exploration	3	Pre: GEOL204
GEOL401	Geology of Lebanon and Levantine region	3	Pre: GEOL203
PTRE402	Petroleum Geomechanics	3	Pre: MCHE311
PTRE404	Reservoir Simulation	3	Pre: PTRE301
PTRE406	Fundamentals of Seismic Acquisition, Processing & Interpretation	3	Pre: PTRE302
PTRE503	Crude Oil Processing	3	Pre: PTRE401
PTRE505	Basin Evolution and hydrocarbon Resources	3	Pre: CHEM331
PTRE507	Environment and Safety	2	
PTRE509	Drilling Technology	3	Pre: PTRE303
PTRE504	Petroleum Production Technology	3	Pre: PTRE401
PTRE506	Process Instrumentation and Control	3	
PTRE508	Petroleum Refining Operations	3	Pre: PTRE401

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 and a survey of hydrocarbons, alcohols and ethers. Detailed study of aromatic compounds, aldehydes, ketones, carboxylic acids and their derivatives, and 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 and structure of the earth from the atomic scale of minerals to the global scale of plate tectonics. Topics include the composition of minerals and rock, volcanism, earth structures, earthquakes, erosion and surface processes, geologic time, geologic hazards, and plate tectonics. In this course, attention will focus on the rocks, landscapes, surface erosional and depositional features, the agents that form them and scenic areas of Lebanon and Levantine region.

GEOL 204 FUNDAMENTALS OF GEOPHYSICS (3Crs.:2Lec,2Lab):
The Planets and their characteristics, Fundamentals of gravity, Size and mass of Earth, The Earth's geoid, Rotational dynamics, Tides, Gravity anomalies, Isostasy. History of seismology, Simple elastic theory and seismic waves, Body waves, Surface waves, Free oscillations, seismometers, Earthquakes and seismicity, The velocity structure of the Earth, Seismic tomography, Seismic surveying in environmental and exploration studies, History and physics of magnetism, Magnetic properties of Earth materials, Remnant and 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. Pre-req.: GEOL203.

GEOL 201 SEDIMENTARY ROCKS (3Crs.:2Lec,2Lab):
Provides a general introduction to sedimentary rocks, sedimentary processes, and the depositional environments in which these rocks form. The course covers classification and knowledge of sedimentary rocks, sedimentary processes and environments, and the relationship of sedimentary rocks and plate tectonics. Laboratories focus on the identification of sedimentary rocks and structures in hand specimen. Pre-req.: GEOL204.

GEOL 204 GEOPHYSICAL TECHNIQUES (3Crs.:2Lec,2Lab):
Introduction to geophysics; Principles of exploration seismology and field procedures; Seismic reflection: how an image of the subsurface is generated and how to interpret it. The theory, instrumentation and field procedure of the electrical resistivity techniques. How subsurface resistance structure is derived and interpreted. The theory, instrumentation and field procedure of the gravity technique. The reduction and interpretation of gravity data. The theory, instrumentation and field procedure of the magnetic techniques. The reduction and interpretation of magnetic data. Pre-req.: GEOL204.

GEOL 401 GEOLOGY OF LEBANON AND 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.: GEOL203.

PTRE 201 INTRODUCTION TO PETROLEUM ENGINEERING (3Crs.:3Lec,0Lab):
Overview and history of the petroleum industry and petroleum engineering; Petroleum reserves, production and consumption statistics of the world; Structure of the petroleum industry; Composition, origin, migration and accumulation of petroleum; Oil traps. Petroleum exploration methods; Nature of oil and 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 and evaluation; properties and behaviors of reservoir fluids; Oil and 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 and how they relate to the storage and production of oil and gas. Important concepts such as heterogeneity, capillary pressure, relative permeability, resistivity are included as part of the course. The course is complemented by relevant lab experiments where the students get hands on experience on measuring some of the single and multiphase flow properties of reservoir rocks. Pre-req.: GEOL203.

PTRE 204 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 and gas are found, Fundamentals source rock, reservoir, and trap studies; well log and seismic interpretation, petroleum geochemistry, and mapping. migration pathways and reservoir traps, procedures adopted for assessing resources and reserves. Pre-req.: GEOL203

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

PTRE 302 SEISMIC STRATIGRAPHY AND INTERPRETATION (3D SEISMIC) (3Crs.:3Lec,0Lab):
The stratigraphic significance of seismic reflectors -Identification of depositional sequences - Age determination of depositional sequences - Recognition and analysis of the seismic facies present in terms of reflector geometry, continuity and amplitude and 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, and constructing chronostratigraphic summary chart from suitable seismic sections or geological cross-sections. Pre-req.: GEOL203.

PTRE 303 WELL LOGGING (3Crs.:3Lec,0Lab):
Basic formation evaluation concepts, borehole environment, principles of resistivity, radiation, thermal and elastic wave measurements and measuring tools, applications to formation evaluation using commercial software package. Lithology plots. Saturation, irreducible saturation and permeability studies from well logs. Shale sand analysis. Complex reservoir analysis. Wire-line Formation Testing. Integration of core, log, well test and seismic data evaluation. Cementing quality monitoring. Gun perforating. Production Monitoring. Pre-req.: GEOL204.

PTRE 304 STRUCTURE GEOLOGY & TECTONICS (3Crs.:3Lec,0Lab):
Fundamental concepts, principles and methods in global tectonics and structural geology. The course covers global plate tectonics and analytical methods in plate kinematics, including an understanding of tectonic motions on a sphere. The structure and geodynamics of the mantle are examined in relation to the driving forces of plate tectonics, and to the principles of isostasy. Gravity measurements and modeling are used to examine uplift and erosion. The structural geology part of the covers aspects of stress, strain, rock failure, rock deformation, rheology, and the origin and significance of commonly observed brittle and ductile structures in rocks. Pre-req.: PTRE303.

PTRE 401 RESERVOIR CHARACTERIZATION (3Crs.:2Lec,2Lab):
Definition of petroleum reservoir heterogeneity using conventional methods and possible improvements to these methods. Reservoir rock properties and their spatial variations; estimation of reserves; introduction to theory and application of geostatistics to reservoir characterization; presentation of fundamental geostatistical concepts including: variogram analysis, estimation variance, kriging and stochastic simulations. Impact of geologic structure on oil recovery methods. Review of basic statistical concepts and methods. Reservoir rock and fluid property evaluation by statistical methods. Scale-up and simulator data Preparation. Emerging methods in petroleum reservoir characterization..Pre-req.: PTRE202.

PTRE 402 PETROLEUM GEOMECHANICS (3Crs.:3Lec,0Lab):
Introduction to applications of Geomechanics in oil and gas industry; stress/strain: estimation, transformation and Mohr circle representation; rock behavior under stress; rock index properties; rock mechanics lab tests; in-situ stresses and 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.

PTRE 403 SEISMIC EXPLORATION (3Crs.:2Lec,2Lab):
Principles of the seismic method; exploration objectives and requirements of seismic data acquisition; the seismic pulse - its generation and transmission; partition of seismic energy at an interface; seismic energy reflection, refraction, attenuation, and travel time - distance functions; reflection time corrections; field testing and procedures with emphasis on multiple coverage and design of source and receiver arrays for signal enhancement; well velocity survey; the synthetic seismogram and the convolution model. Pre-req.: GEOL204.

PTRE 404 RESERVOIR SIMULATION (3Crs.:2Lec,2Lab):
Solution of production and 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 and calibration, production forecasting and optimization, economic analysis and decision making under uncertainty. Pre-req.: PTRE301.

PTRE 406 FUNDAMENTAL OF SEISMIC ACQUISITION, PROCESSING AND INTERPRETATION (3Crs.:2Lec,2Lab):
Fundamentals; Introduction to Seismic exploration; Overview of non-seismic geophysical techniques; Wave Propagation; Reflection Principles and Resolution; Signal Analysis; Migration Principles Acquisition; Principles of data acquisition; 3D Survey Design • QA/QC Processing; Principles and Processing Flows. Prestack Analysis and Signal Corrections; Velocity/ Normal Move out Analysis; Static Corrections; Migration and Imaging Interpretation; Trap Definition; Structural Mapping; Stratigraphic Interpretation; Amplitude Interpretation. Pre-req.: PTRE302.

PTRE 503 CRUDE OIL PROCESSING (3Crs.:2Lec,2Lab):
Introduction to crude oil processing, Two phase separators, Three phase separators, Emulsion Treatment and Dehydration, Desalting of Crude Oil, Stabilization and sweetening, Storage tanks, Produced Water Treatment, Choosing a Line Size and Wall Thickness, Organizing the project, Flow Assurance, Flow in wells &pipes. Pre-req.: PTRE401.

PTRE 504 PETROLEUM PRODUCTION TECHNOLOGY (3Crs.:3Lec,0Lab):
Overview of oil and gas production facilities with an emphasis on offshore situations. Engineering design and operation of wells, pipelines, and oil and gas processing equipment. Health, safety and environmental aspects of production operations. Well completion design, well flow performance concepts, tubing design and selection, well intervention and workover techniques, completion fluids, perforating, completion equipment, production logging, artificial lift, sand stabilization and exclusion, production optimization, well flow performance evaluation, stimulation, new technology, surface production facilities and operation. For tuition pattern details and contact hours please contact the Department of Petroleum Engineering. Pre-req.: PTRE401.

PTRE 505 BASIN EVOLUTION AND HYDROCARBON RESOURCES (3Crs.:2Lec,2Lab):
Origin of sedimentary basins; structural styles of basins and their expression in seismic data; lateral variations of sedimentary facies in differing basin settings; models of external controls on depositional and seismic architectures; an introduction to sequence stratigraphy; burial histories and the derivation of tectonic subsidence/ uplift histories from stratigraphic data; an overview of the petroleum play system; the petroleum charge system; reservoir, top seal and trap; quantifying risk in hydrocarbon exploration; petroleum geology Middle East. Pre-req.:CHEM331.

PTRE 506 PROCESS INSTRUMENTATION AND 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 and frequency response methods. General comments on other types of controllers.

PTRE 507 ENVIRONMENT AND SAFTY (2Crs.:2Lec,0Lab):
Environmental technology, Environmental Control Technology for Oilfield Processes, Environmental Control of Drilling Fluids and Produced Water, Oilfield Waste Disposal Control, Drilling and Production Discharges in the Marine Environment, Decommissioning of Offshore Oil and Gas Installations, Tanker Design: Recent Developments from an Environmental Perspective, Pipeline Technology, Environmental Management and Technology in Oil Refineries, Distribution, Marketing and Use of Petroleum Fuels, Lubricants, and Climate Change Scenarios.

PTRE 508 PETROLEUM REFINING OPERATIONS (3Crs.:3Lec,0Lab):
Students study oil refining and associated downstream processing technologies, operations and economics; process safety and operations integrity; and methods for the optimal design of process systems; the program combines petroleum refining (technologies, operations and economics) and systems engineering (modeling and simulation, optimization, and process design and integration); in addition, it provides opportunities for students to learn about the general economics of the energy sector, oil exploration and 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 and chemical company. Pre-req.: PTRE401.

PTRE 509 DRILLING TECHNOLOGY (3Crs.:3Lec,0Lab):
Rotary Drilling Technique; Basic Rig systems and Rig components and their functions; Drilling Fluid Technology; Properties and testing; Types and additives; Drilling hydraulics; Drilling cost analysis and control; Formation pressure (types of formation pressures; Formation pressure prediction; Fracture gradient Prediction; Casing and primary cementing equipment; Hole conditions; Volume calculations and rate of Circulation; Squeeze cementing; Plug cementing; Measurement while drilling; Well control; Hole problems and stuck pipes; Fishing tools; Objects lost in the hole; Fishing methods; Drilling risks; Kicks and blow outs; Coring; Directional, horizontal and multilateral drilling. Pre-req.:PTRE303.

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.

Courses		Crs.	Pro/Co-requisites
CHEM421	Oilfield Chemistry and Corrosion	3	Pre: CHEM282
CHEM423	Water Chemistry	3	Pre: CHEM282; PTER201
CHEM440	Petrochemical Industry	3	Pre: CHEM331
GEOL314	Marine Geology	3	Pre: GEOL203
GEOL316	Carbonate Sedimentology	3	Pre: GEOL203
GEOL318	Petroleum Geology of Middle East	3	Pre: GEOL204, GEOL401
PTRE413	Natural Gas Reservoir Engineering	3	
PTRE415	Fire Control Engineering	3	
PTRE417	Hydrocarbon Phase Behavior	3	Pre: CHEM331
PTRE419	Petroleum Economy, Risk and Management	3	
PTRE421	Natural Gas Production Engineering	3	
CMPS322	Digital Image Processing for Petroleum Engineering	3	Pre: COMP208

Description of Technical Elective Courses

CHEM 421 OILFIELD CHEMISTRY AND CORROSION (3Crs.:2Lec,2Lab):
Fundamentals of oilfield chemistry including corrosion chemistry, water injection chemicals; Thermodynamics of electrochemical corrosion: Pourbaix and Evans diagrams, electrochemical reactions, polarisation and corrosion rate calculation and measurement; Corrosion tests and standards; Classification of corrosion: General corrosion, localised corrosion, MIC, FAC, SCC, CO2 and H2S corrosion; Introduction to coating and corrosion protection; Pipeline materials and corrosion resistant alloys. Applied experiments related to the above topics. Pre-req.: CHEM282.

CHEM 423 WATER CHEMISTRY (3Crs.:2Lec,2Lab):
Importance, applications & basics of hydrogeochemistry; Chemical speciation & controls on mineral solubility; Controls on the chemistry of natural waters; Physical chemistry of gases in ground waters; Dating ground waters; Stable isotopes in natural waters; Stable isotopic geothermometry; Stable isotopes & water-rock interaction; Surface adsorption reactions; Kinetics applied to mineral-fluid reactions. Applied experiments related to the above topics.Pre-req.:CHEM282; PTER201.

CHEM 440 PETROCHEMICAL INDUSTRY (3Crs.:2Lec,2Lab):
Petrochemical industry, chemical process technology. Chemistry and industrial applications of petrochemicals including ethylene production by steam cracking, ethylene derivatives, propylene derivatives, butadiene and butenes, benzene, toluene and xylene production and derivatives, steam reforming and related processes. Applied experiments related to the above topics.Pre-req.:CHEM331.

GEOL 314 MARINE GEOLOGY (3Crs.:2Lec,2Lab):
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 and continental-shelf regions will be discussed, as well as sea-level history. Pre-req.: GEOL203.

GEOL 316 CARBONATE SEDIMENTOLOGY (3Crs.:2Lec,2Lab):
Discussion of the origins, classification, and criteria of recognition of carbonate accumulations from different depositional environments.Pre-req.: GEOL203.

GEOL 318 PETROLEUM GEOLOGY OF MIDDLE EAST (3Crs.:3Lec,0Lab):
Provides an integrated tectonic, stratigraphic, paleogeographic, and structural framework for the region to evaluate known and frontier petroleum areas. Pre-req.: GEOL204, GEOL401.

PTRE 413 NATURAL GAS RESERVOIR ENGINEERING (3Crs.:3Lec,0Lab):
Phase behavior of natural gas, estimation of gas reserves, production decline curves, testing of fractured and unfractured gas wells, aspects of production from gas condensate reservoirs.

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

PTRE 417 HYDROCARBON PHASE BEHAVIOR (3Crs.:3Lec,0Lab):
Thermodynamics fundamentals, petroleum reservoir fluids, cubic equations of state, C7+ characterization and 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 and field experience. Pre-req.: CHEM331.

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

PTRE 421 NATURAL GAS PRODUCTION ENGINEERING (3Crs.:3Lec,0Lab):
Vapor-liquid equilibrium, natural gas flow in wellbores and pipelines, networks, gas well unloading and solutions, metering, compressor design, special topics.

CMPS 322 DIGITAL IMAGE PROCESSING FOR PETROLEUM ENGINEERING (3Crs.:2Lec,2Lab):
Introduction; image sensing and 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 and edge detection for oil slick; optimal global and adaptive thresholdings for oil slick Image Segmentation. Pre-req.: COMP208

D. Free Engineering Elective

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

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 and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and 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 Petroleum Engineering (150 Credits)

First Semester (18 Credits)		Crs.	Pre-/co-requisites
COMP208	Programming I	3	
MATH281	Linear Algebra	3	
CVLE210	Statics	3	
PHYS281	Electricity & Magnetism	3	
MCHE210	Engineering Drawing and Graphics	3	
GEOL203	Physical Geology	3	

Second Semester (17 Credits)		Crs.	Pre-/co-requisites
MATH282	Calculus	3	
MCHE213	Dynamics	3	Pre: CVLE210
PHYS282	Material Properties and Heat	3	
GEOL204	Fundamentals of Geophysics	3	Pre: GEOL203
CHEM281	Principles of Chemistry I	3	
ENGL001	English Language	2	

Third Semester (16 Credits)		Crs.	Pre-/co-requisites
MATH283	Differential Equations	3	Pre: MATH281 + MATH282
CHEM282	Principles of Chemistry II	3	Pre: CHEM281
PTRE201	Introduction to Petroleum Engineering	3	
GEOL203	Sedimentary Rocks	3	Pre: GEOL204
ENGL211	Advanced Writing	2	Pre: ENGL001
	(Elective (General	2	

Fourth Semester (17 Credits)		Crs.	Pre-/co-requisites
MATH284	Numerical Analysis and Techniques	3	Pre: MATH283
POWE210	Electric Circuits	3	Pre: PHYS281
PTRE202	Reservoir Rock Properties	3	Pre: GEOL203
PTRE204	Principles of petroleum geology	3	Pre: GEOL203
GEOL204	Geophysical Techniques	3	Pre: GEOL204
ENGL300	Communications Skills	2	Pre: ENGL211

Fifth Semester (14 Credits)		Crs.	Pre-/co-requisites
MATH381	Probability & Statistics	3	Pre: MATH282
CHEM331	Organic Chemistry	3	Pre: CHEM281
PTRE301	Reservoir Fluids	3	
PTRE303	Well Logging	3	Pre: GEOL204
MGMT002	Entrepreneurship	2	

Sixth Semester (15 Credits)		Crs.	Pre-/co-requisites
MCHE311	Mechanics of Materials	3	Pre: CVLE210
PTRE302	Seismic (3D) Stratigraphy and Interpretation	3	Pre: GEOL203
PTRE304	Structural Geology and Tectonics	3	Pre: PTRE303
	Technical Elective	3	
ARAB001	Arab Language	2	
BLAW 001	Human Rights	1	

Seventh Semester (14 Credits)		Crs.	Pre-/co-requisites
PTRE401	Reservoir Characterization	3	Pre: PTRE202
PTRE403	Seismic Exploration	3	Pre: GEOL204
GEOL401	Geology of Lebanon and Levantine region	3	Pre: GEOL203
	Technical Elective	3	
	Elective (General)	2	

Eighth Semester (12 Credits)		Crs.	Pre-/co-requisites
PTRE402	Petroleum Geomechanics	3	Pre: MECH311
PTRE404	Reservoir Simulation	3	Pre: PTRE301
PTRE406	Fundamentals of Seismic Acquisition, Processing & Interpretation	3	Pre: PTRE302
	(Elective (General	2	
	Elective (General)	1	

Ninth Semester (13 Credits)		Crs.	Pre-/co-requisites
PTRE499	Internship (Approved Experience / Independent Study)	1	
PTRE501	Final Year Project	1	
PTRE503	Crude Oil Processing	3	Pre: PTRE401
PTRE505	Basin Evolution and hydrocarbon Resources	3	Pre: CHEM331
PTRE507	Environment and Safety	2	
PTRE509	Drilling Technology	3	Pre: PTRE303

Tenth Semester (15 Credits)		Crs.	Pre-/co-requisites
PTRE502	Final Year Project	3	
PTRE504	Petroleum Production Technology	3	Pre: PTRE401
PTRE506	Process Instrumentation and Control	3	
PTRE508	Petroleum Refining Operations	3	Pre: PTRE401
	Elective (General)	2	