FACULTY OF ENGINEERING (FE)

Graduation Requirements

To receive a Bachelor of Engineering Degree in any of the engineering programs a student must satisfactorily complete 150 credit hours with an overall minimum grade point average (GPA) of 2.0. 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 Technical Electives	Internship & FYP*	
CVLE	20	26	14	73	12	5	150
COME	20	26	12	75	12	5	150
COMP	20	26	12	75	12	5	150
POWE	20	26	16	71	12	5	150
BIME	20	26	7	80	12	5	150
INME	20	26	15	72	12	5	150
MCHE	20	26	15	72	12	5	150
PTRE	20	30	15	68	12	5	150
CHME	20	39	15	59	12	5	150
CVLE: Civil Engineering COME: Communications and Electronics Engineering COMP: Computer Engineering POWE: Electrical Power and Machines Engineering BIME: Biomedical Engineering INME: Industrial Engineering MCHE: Mechanical Engineering PTRE: Petroleum Engineering CHME: Chemical Engineering							
*FYP: Final Year Project							

Common Requirements

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

I. General Education

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

I.A. General Education Core (12 credits)

This curricular component includes 6 courses comprising 12 credits; 3 courses (total of 5 credits) are University Requirements (UR) and 4 courses (total of 7 credits) are Faculty requirements (FR) as listed in the following table:

Course	Title	Credits	Prerequisite
University Requirement			
ARAB 001	Arabic Language	2	
BLAW 001	Human Rights	1	
ENGL 001	English Language	2	
Faculty Requirement			
ENGL 211	Advanced Writing	2	ENGL 001
ENGL 300	Speech Communications	2	ENGL 211

MGMT 002	Entrepreneurship I	2	
ENGR 001	Engineering Ethics	1	Finish ≥ 90 Crs

Descriptions of the General Education core courses are given below.

ARAB 001 Arabic Language (2Crs.: 2Lec,0Lab): تقديم إطار عام للغة العربية لغير المتخصصين، وتتناول الموضوعات التالية: العربية بين لغات العالم، النظام الصوتي، النظام الصرفي، النظام النحوي والنظام الكتابي، كما تتناول العربية والتعريب، والعربية والحاسوب، ثم كيف تكتب مقالاً علمياً.

BLAW 001 Human Rights (1Cr.: 1Lec,0Lab): This course aims at introducing students to the principles of human rights and its foundations. The importance of human rights in our societies, not only from a theoretical point of view but rather more from a practical one, is highlighted. Special attention is given to certain global themes on human rights, which touch on critical topics related to our society. It also covers the following topics: Human rights, key values of human rights and other values, characteristics of human rights, history of human rights, some problematic cases, the evolution of human rights, the implementation of human rights and NGOs, human rights in Lebanon, children, citizenship, democracy, discrimination and xenophobia, education, and gender equality. Lectures are in English.

ENGL 001 English Language (2Crs.: 2Lec,0Lab): A general course that enhances the language skills and provides coverage of basic grammar, vocabulary, reading, and writing for foundation students. It deals with basic competence in reading, through exercises on getting main ideas, guessing meaning from context, understanding details, predicting and inferencing. Writing development from paragraph to composition, proceeding through writing is the focus of the course. Writing and reading build vocabulary through exercises and dictionary use and clause exercises. The latter develop grammar where the use of nouns, verbs, adjectives, and adverbs, transition

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.***

MGMT 002 Entrepreneurship I (2Crs.: 2Lec, 0Lab): An introductory course designed around the development of business plan. The course examines how to formulate business ideas, select a location, select a legal form of organization, locate financing source, assess the market, and develop a human resources management system.

ENGR 001 Engineering Ethics (1Crs.: 1Lec, 0Lab): Ethical issues in the practice of engineering, corporate responsibility; personal rights; honesty, ethical aspects of safety, risk and liability and conflicts of interest; environmental issues and sustainability; codes of ethics; emphasis on developing the capacity for independent ethical analysis of real cases. ***Pre-req.*: earned 90 crs.**

I.B. General Education Electives (8 credits)

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

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 credits for the PTRE program and 36 credits for the CHEM program) distributed as follows:

Course	Title	Credits	Prerequisite
CHEM 241	Principles of Chemistry	3	
CHEM 207/CHEM 405	Environmental Chemistry/Solid State Chemistry	2	
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 120
PHYS 282	Materials Properties and Heat	3	

Instead of the CHEM 207/CHEM405 and the CHEM 241 courses, the PTRE program requires the following three 9-credits chemistry courses instead:

- CHEM 281: Principles of Chemistry I (3 Credits)
- CHEM 282: Principles of Chemistry II (3 Credits)
- CHEM 331: Organic Chemistry (3 Credits)

Instead of the CHEM 207/CHEM405 and the CHEM 241 courses, the CHME program requires the following six 18-credits chemistry courses instead:

- CHEM 248: Physical Chemistry I (3 Credits)
- CHEM 281: Principles of Chemistry I (3 Credits)
- CHEM 282: Principles of Chemistry II (3 Credits)
- CHEM 331: Organic Chemistry (3 Credits)
- CHEM 345: Inorganic Chemistry (3 Credits)
- CHEM 358: Surface and Colloid Chemistry (3 Credits)

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

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

CHEM 248 Physical Chemistry I (3Crs.:3Lec): The course covers principles and applications of the first and second laws of thermodynamics. Third Law of Thermodynamics, entropy and free energy changes in chemical reactions, Thermodynamic of solutions. Phase equilibria in heterogenous systems. Phase rule and its application in one, two and three component systems. Pre-req.: CHEM 282.

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 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.***

CHEM 345 – Inorganic Chemistry I (3Crs.:3Lec,0Lab): Brönsted and Lewis acid and base. Chemistry of main group elements. Basic concepts of coordination compounds: nomenclature, bonding, structure, stability, magnetic properties, stereochemistry. Crystal and ligand field theories. ***Pre-req.: CHEM 282.***

CHEM 358 Surface and Colloid Chemistry (3Crs.:3Lec): Basic terms in surface and colloid chemistry, the kinetic properties of disperse systems, interfacial phenomena, the optical and electrical properties of colloids, the preparation and stability of colloids, properties of gels, emulsion, foams and aerosol. ***Pre-req.: CHEM248***

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.

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): Electric charges and Coulomb's Law; Electric field and potential of various charge distributions; electric dipoles; Gauss's Law in electricity; Capacitance and Dielectrics; Electric conduction current; Resistance and Temperature; Magnetic field of a solenoid; Gauss's Law in Magnetism; Electromotive force; Electromagnetic induction; Faraday's law; Self induction and inductance. ***Pre- req.: PHYS 120***

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 ECE programs) 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	

*Not included in the curriculum of ECE programs, replaced by INME 423 Project Planning and Management (3 credits)

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.

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.

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.

MCHE 201 Engineering Drawing and Graphics (3Crs.: 1Lec,4Lab): 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.

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 ELECTRICAL & COMPUTER ENGINEERING

Chairperson	*Ziad Osman*
Professors	*Soubhi Abou Chahine, Ali Haidar*,
Associate Professors	*Hamza Issa, Mohamad Tarnini, Wassim Itani, Chadi Nohra*
Assistant Professors	*Rola Kassem, Nabil Abdel Karim, Hiba Abdallah, Khaled Chahine, Hilal El Misilmani, Ahmad El Hajj, Youmni Ziadeh, Bilal Youssef, Abdul Rahman El Falou*

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:

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

Learning Outcomes

Upon completion of the program graduates shall have:

a. An ability to apply knowledge of mathematics, science, and engineering
b. An ability to design and conduct experiments, as well as to analyze and interpret data
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. An ability to function on multi-disciplinary teams
e. An ability to identify, formulate, and solve engineering problems
f. An understanding of professional and ethical responsibility
g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. A recognition of the need for, and an ability to engage in life-long learning
j. A knowledge of contemporary issues
k. 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 Communications and Electronics Engineering consists of 150 credit-hours of course work + ICDL, where the standard duration of study is 10 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	12
II. CEE Program-Specific Requirements	**Credits**
A. Engineering topics from outside the program	21
B. CEE Core	54
C. CEE Technical Electives	12
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 catalog.

II. CEE Program-Specific Requirements

A. Engineering Topics from outside the major

This part of the CEE curriculum includes 21-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
COMP 225	Digital Systems I	3	
COMP 226	Digital Systems II	3	COMP 225
COMP 328	CPU Design	3	COMP 226
COMP 426	Microprocessor Interfacing	3	COMP 328
POWE 212	Electric Circuits I	3	
POWE 271	Electromagnetic Fundamentals	3	Pre: PHYS 281

Descriptions of this group of courses are given below:

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

COMP 225 DIGITAL SYSTEMS I (3Crs.: 2Lec, 2Lab): 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). Several laboratory experiments will be based on the simple logic gates.

COMP 226 DIGITAL SYSTEMS II (3Crs.: 2Lec, 2Lab): 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. Several laboratory experiments and projects will be based on the simple logic gates to design micro-digital systems. Pre-req.: COMP 225.

COMP 328 CPU DESIGN (3Crs.:2Lec, 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. Several laboratory experiments will be based on microcontrollers. ***Pre-requisite.: COMP 226***.

COMP 426 MICROPROCESSOR INTERFACING (3 Crs.: 2Lec,2Lab): Topics include assembly language programming, microprocessor software applications, PPI and interfacing techniques: I/O port design and handshaking protocols; I/O programming, I/O interface design, Direct Memory Access, data communications, interrupt control systems; parallel and serial interfaces; timers. Several laboratory experiments will be based on microprocessors and/or microcontrollers. ***Pre-requisite: COMP 328***.

POWE 212 ELECTRIC CIRCUITS I (3 Crs.: 3Lec, 0Lab): Circuit variables: voltage, current, power, and energy. Circuit elements: resistors, inductors, capacitors, voltage sources, and current sources. Circuit reduction techniques: series and parallel resistors and delta-to-wye transformation. Ohm's law. Kirchhoff's laws. DC and AC circuit analysis techniques: node-voltage and mesh-current methods, source transformations, Thévenin and Norton equivalent circuits, and maximum power transfer. Self and mutual inductances. AC steady-state power calculations. Balanced three-phase circuits.

POWE 271 ELECTROMAGNETIC FUNDAMENTALS (3 Crs.: 3Lec,0Lab): Three-dimensional orthogonal coordinate systems: Cartesian, Cylindrical and Spherical. Vector Analysis: Gradient, Divergence and Curl of fields, Divergence theorem, Stokes's theorem. Fundamental Postulates of Electrostatics in free space, Coulomb's Law in space, Gauss's Law in space. Material Media: Conductors and Dielectrics, Polarization, Electric Flux Density. Boundary Conditions. Capacitors and Electrostatic Energy. Poisson's Equation, Laplace's Equation, Method of Images, Boundary Value Problems, Steady Electric Currents: conduction and convection currents, equation of continuity, boundary conditions for current density. Resistance and Power calculations. Fundamental Postulates of Magnetostatics in free space, Biot-Savart law in space, Ampere's Law in space. Magnetic materials: Magnetization, Inductance and Magnetostatic Energy. Magnetic circuit analysis. Introduction to Magnetic Forces and Torques. Time varying fields: Faraday's Law for Electromagnetic Induction (stationary circuit in a time-varying magnetic field, Transformers, moving circuit in steady and time- varying magnetic fields), Maxwell's Equations, Electromagnetic boundary conditions***. Pre-requisite.: 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
ENGR 002	Introduction to Engineering	2	
ENGR 003	Engineering Project Management	3	Pre: ENGL 300
COME 214	Electric Circuits II	3	Pre: POWE 212
COME 212L	Electric Circuits Lab	1	Co: COME 214
COME 221	Electronic Circuits I	3	Pre: POWE 212
COME 222	Electronic Circuits II	3	Pre: COME 221
COME 222L	Electronic Circuits Lab	1	Co: COME 222
COME 372	Propagation and Antennas I	4	Pre: POWE 271
COME 381	Signals and Systems	3	
COME 380	Communication Theory and Systems I	3	Pre: COME 381, MATH 381
COME 384	Digital Signal Processing	3	Pre: COME 381, MATH 284
COME 411	Instrumentation	3	Pre: COME 222
COME 473	Propagation and Antennas II	3	Pre: COME 372
COME 473L	Propagation and Antennas Lab	1	Co: COME 473
COME 472	Microwave Engineering	3	Pre: COME 372
COME 485	Communication Theory and Systems II	3	Pre: COME 380
COME 485L	Communication Lab	1	Co: COME 485
COME 500	Research Methodology	2	Pre: ENGR 003
COME 576	Optical Communications	3	Pre: POWE 271
COME 573L	Microwave Lab	1	Pre: COME 472
COME 580	Communication Networks	3	Pre: COME 485
COME 580L	Communication Networks Lab	1	Co: COME 580
COME 588	Wireless Communications	3	Pre: COME 485
COME 588L	Wireless Communications Lab	1	Co: COME 588

Description of Core Courses

ENGR 002 INTRODUCTION TO ENGINEERING (2 Crs.: 2Lec, 0Lab): Introduction the student to the engineering profession in general and the learning objectives that new students should attain, as aligned with the ABET requirements. Covering the basics of the engineering profession and engineering ethics. Introduction to the different engineering majors and to the learning objectives as specified by ABET. Insight into different engineering courses that are not technical in nature (e.g., engineering economy). Engineering design tasks that allow the student to start thinking as engineers: problem definition, specification of constraints, investigation of different solution alternatives, implementation of best solution, writing technical reports. Fundamental tools and numerical software used in engineering. The tools and software covered could be

COME 214 ELECTRIC CIRCUITS II (3 Crs.: 3Lec, 0Lab): Transient analysis, Laplace transform and its application to circuit analysis, two-port networks, frequency selective passive and active circuits. ***Pre-requisite: POWE 212.***

COME 212L ELECTRIC CIRCUITS LAB (1 Cr.: 0Lec, 2Lab): The content of this lab is directly related to the courses POWE 212, COME 214. ***Co-requisite.: COME 214***.

COME 221 ELECTRONIC CIRCUITS I (3 Crs.: 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-requisite.: POWE 212***.

COME 222 ELECTRONIC CIRCUITS II (3 Crs.: 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-requisite: 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-requisite: COME 222***.

COME 372 ANTENNAS & PROPAGATION I (4 Crs.: 4Lec, 0Lab): Review of Maxwell's equations. Plane waves in material media. Polarization of waves. Poynting vector. Reflection and transmission of waves. Normal and oblique incidence. Propagation of electromagnetic waves in the atmosphere. High frequency transmission lines. Smith chart. Matching techniques. Rectangular and cylindrical waveguides. Antennas: propagation mechanism. Antennas parameters and radiation potentials. Linear antennas (elementary dipole, short dipole, linear dipole), antenna arrays***. Pre-requisite.: POWE 271***.

COME 381 SIGNALS AND SYSTEMS (3 Crs.: 3Lec, 0Lab): Signals and systems properties and classifications. Continuous and Discrete Linear Time-Invariant systems. Analytical and graphical convolution. Fourier series and Fourier Transform. Hilbert transform, pre-envelope, complex envelope. Frequency spectra, energy and power spectra. Frequency response and transfer function, impulse response and step response. Filter design. Butterworth and Chebyshev filters.

COME 380 COMMUNICATION THEORY AND SYSTEMS I (3 Crs.: 3Lec, 0Lab): Transmission and reception of analog signals (AM, FM, PM). Performance of analog modulation schemes in the presence of noise. Building block of a digital transmission system and the differences with analog transmission. Digital communication concepts: analog to digital conversion, pulse coded modulation, transmission and reception of digital signals; pulse shaping and digital modulation. ***Pre-requisite.: COME 381, MATH381.***

COME 384 DIGITAL SIGNAL PROCESSING (3 Crs.: 2Lec, 2Lab): Sampling, Quantization and SQNR. Signal Reconstruction and anti-aliasing filter. Discrete time signals. Difference equations and impulse responses. BIBO stability. Digital convolution. Discrete Fourier Transform and Fast Fourier Transform. Z- transform. Digital filter frequency response and transfer function. Z-plane stability. Realization of digital filters. Methods of FIR and IIR filter designs. Digital Butterworth and Chebyshev filter designs***. Pre-requisite: COME 381, MATH 284***

COME 411 INSTRUMENTATION (3 Crs. : 2 lec, 2 lab) : Different types of transducers and their applications. Instruments used in measuring electrical quantities. Display instruments. Signal generators. Digital to analog and analog to digital conversion. Data acquisition systems components, hardware and software. ***Pre-requisite: COME 221***.

COME 473 ANTENNAS & PROPAGATION II (3 Crs.: 3Lec,0Lab): Coaxial transmission lines, Microstrip transmission lines. Cavity resonators. Special Antennas: Loop antenna, Traveling wave antenna. Helical antenna. Yagi antenna, Aperture principles. Microwave antennas: Horn, parabolic and microstrip antennas. Introduction to radar systems. Introduction to line of sight radio links. Introduction to satellite systems. ***Pre- requisite: COME372***.

COME 473L PROPAGATION AND ANTENNAS LAB (1 Cr.: 0Lec, 2Lab): The contents of this lab are directly related to the courses COME 372, COME 473. ***Co-requisite: COME 473***.

COME 472 MICROWAVE ENGINEERING (3 Crs.: 3Lec,0Lab): Scattering parameters. Microwave instrumentations: Reflection coefficient measurements, transmission coefficient measurements, S-parameters measurements, power measurements, dielectric constant measurements, and frequency measurements. Microwave passive components design: T-junction, attenuators, isolators, circulators, couplers, filters. Microstrip components: Power dividers, hybrid couplers, coupled transmission lines, filters. ***Pre- requisite: COME372***.

COME 485 COMMUNICATION THEORY AND SYSTEMS II (3 Crs.: 3Lec, 0Lab): Data transmission through information theoretic concepts: entropy and its use in the design of source coding algorithms, mutual information and its use in the definition of channel capacity, channel coding. Spectral and power efficiency of digital modulation schemes and their performance in the presence of noise. Advanced Intersymbol interference mitigation techniques (e.g., equalizers). ***Pre-requisite: COME 380.***

COME 485L COMMUNICATION LAB (1 Cr.: 0Lec, 2Lab): The contents of this lab are directly related to the courses COME 380, COME 485. ***Co-requisite: COME 485***.

COME 499 INTERNSHIP (1Cr): This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned. *Refer to the department policy for further details*.

COME 500 RESEARCH METHODOLOGY (2 Crs.: 2Lec, 0Lab): Why to Conduct Scientific Research, stepping in: Research Methodology, formulating a research problem, conceptualizing a research design, constructing an instrument for data collection, selecting samples, writing a research proposal, collecting data, processing & displaying data, writing a research report. Conducting Scientific Research at the faculty of Engineering. ***Pre-requisite: ENGL 003***

COME 501 FINAL YEAR PROJECT I (1Cr) / COME 502 FINAL YEAR PROJECT II (3Crs): After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester 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. ***Pre/Co-requisite: COME 500***. *Refer to the Final Year Project Policy for more details.*

COME 576 OPTICAL COMMUNICATIONS (3 Crs.: 3Lec, 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-requisite: POWE 271***.

COME 573L MICROWAVE LAB (1 Cr.: 0Lec, 2Lab): The contents of this lab are directly related to the courses COME 472. ***Pre-requisite: COME 472***.

COME 580 COMMUNICATION NETWORKS (3 Crs.: 3Lec, 0Lab): Networking topologies and architecture. TCP/IP protocol stack: application layer, transport layer, network layer, data link layer, physical layer. Network security. Implementation of networking concepts in current communication technologies.
Introduction to emerging topics in communication networks.

COME 580L COMMUNICATION NETWORKS LAB (1 Cr.: 0Lec, 2Lab): This lab covers topics discussed in COME 580. ***Co-requisite: COME 580***.

COME 588 WIRELESS COMMUNICATIONS (3 Crs.: 3Lec, 0Lab): Fundamental theoretical concepts in wireless communication systems. Characterization and modeling of the wireless channel, Performance of digital communication schemes over wireless fading channels, spread spectrum techniques, diversity techniques, orthogonal frequency division multiplexing (OFDM). multiple-input multiple output (MIMO). Introduction to emerging topics in wireless communications. ***Pre-requisite: COME 485.***

COME 588L WIRELESS COMMUNICATIONS LAB (1 Cr.: 0Lec, 2Lab): This lab covers topics discussed in COME 588. ***Co-requisite: COME 588***.

C. Communications and Electronics Engineering Program Technical Electives

The CEE curriculum includes 12-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 423	Digital Integrated Circuits	3	COME 221
COME 470	Acoustics	3	COME 372
COME 478	Microwave Transmission Networks	3	COME 485
COME 528	Radio Frequency Communication Circuits	3	COME 222, COME 473
COME 520	Advanced Antenna Design	3	COME 473
COME 535	Embedded Systems	3	COMP 426
COME 537	VLSI Design	3	COME 221
COME 564	Semiconductor Devices	3	
COME 576	Millimeter Wave Integrated Circuit (MMIC) Design	3	COME 472
COME 589	Cellular Communications	3	COME 485

Description of Technical Elective Courses

COME 423 DIGITAL INTEGRATED CIRCUITS (3 Crs.: 3Lec, 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-requisite: COME 221***.

COME 470 ACOUSTICS (3 Crs.: 3Lec, 0Lab): Fundamentals of sound. Acoustic wave equation. Sound levels and Decibel. Perception of sound. Loudness. Reverberation. Control of interfering noise. Absorption of sound. Reflection, diffraction, and refraction of sound. Acoustics design of enclosed spaces. ***Pre-requisite: COME 372***.

COME 478 MICROWAVE TRANSMISSION NETWORKS (3 Crs.: 3Lec, 0Lab): Network topologies, systems configurations, frequency bands, performance planning objectives and available ITU recommendations, path profile and line of sight analysis, link budget and link performance prediction, diversity (types and improvement calculation), radio equipment and microwave antennas, frequency planning and interference calculation, introduction to microwave links planning tools. ***Pre-requisite: COME 485***.

COME 528 RADIO FREQUENCY COMMUNICATION CIRCUITS (3 Crs.: 3Lec, 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-requisite: COME 222 and COME 473***.

COME 520 ADVANCED ANTENNA DESIGN (3 Crs.: 3Lec, 0Lab): Antenna measurements. Antenna arrays design and feeding networks. Smart antennas. Antennas beamforming. Antennas for wireless cellular networks. High power microwave antennas. ***Pre-requisite: COME 473***.

COME 535 EMBEDDED SYSTEMS (3 Crs.: 3Lec, 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-requisite: COMP 426***.

COME 537 VLSI DESIGN (3 Crs.: 3Lec, 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-requisite: COMP 225***.

COME 564 SEMICONDUCTOR DEVICES (3 Crs.: 3Lec, 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.

COME 576 MILLIMETER WAVE INTEGRATED CIRCUIT (MMIC) DESIGN (3 Crs.: 3Lec, 0Lab): Introduction to mm-Wave systems and applications. Introduction to MMIC Design: Merits, Limitations and Applications. Types of MMICs. Types of MMICs, Fabrication Techniques and Processes. Passive MMIC Elements: Capacitors, Inductors, Transmission line, Via holes, Power Dividers/Combiners and Couplers. Testing Passive MMIC Elements. Introduction to mmWave active elements. ***Pre-requisite: COME 472***.

COME 589 CELLULAR COMMUNICATIONS (3 Crs.: 3Lec, 0Lab)
Cellular concept, cellular architecture and terminology, cellular network dimensioning, radio network planning and optimization. Cellular handover types that occur in real cellular systems. Drivers and advanced techniques for cellular evolution. Properties of 2G,3G, 4G technologies. Introduction to beyond 5G cellular technologies. ***Pre-requisite: COME 485***.

Study Plan
Bachelor of Engineering in Communications and Electronics Engineering (150 Credits)

First Semester (17 Credits)		**Crs.**	**Pre/Co-requisites**
MATH 281	Linear Algebra	3	MATH 112
MATH 282	Calculus	3	MATH 111
MCHE 213	Dynamics	3	
PHYS 281	Electricity and Magnetism	3	PHYS 120
ENGR 002	Introduction to Engineering	2	
BLAW001	Human Rights	1	
ARAB001	Arabic Language	2	

Second Semester (17 Credits)		**Crs.**	**Pre/Co-requisites**
COMP 225	Digital Systems I	3	
MATH 283	Differential Equations	3	Pre: MATH 281, MATH 282
PHYS 282	Material Properties and Heat	3	
COMP 208	Programming I	3	
POWE 212	Electric Circuits I	3	
ENGL001	English Language	2	

Summer I (9 Credits)		**Crs.**	**Pre/Co-requisites**
CHEM 241	Principles of Chemistry	3	
ENGL 211	Advanced Writing	2	
	Elective(General)	2	
	Elective(General)	2	

Third Semester (16 Credits)		**Crs.**	**Pre/Co-requisites**
COMP 210	Programming II	3	Pre: COMP 208
COME 221	Electronic Circuits I	3	Pre: POWE 212
COME 214	Electric Circuits II	3	Pre: POWE 212
COME 212L	Electric Circuits LAB	1	Co: COME 214
POWE 271	Electromagnetic Fundamentals	3	Pre: PHYS281
COMP226	Digital Systems II	3	Pre: COMP 225

Fourth Semester (18 Credits)		**Crs.**	**Pre/Co-requisites**
MATH 381	Probability and Statistics	3	Pre: MATH 282
MATH 284	Numerical Analysis	3	Pre: MATH 283
COMP 328	CPU Design	3	Pre: COMP 226
COME 222	Electronic Circuits II	3	Pre: COME 221
COME 222L	Electronic Circuits LAB	1	Co: COME 222
INME 221	Engineering Economy	3	
ENGL 300	Speech Communications	2	Pre: ENGL 211

Summer II (9 Credits)		Crs.	Pre/Co-requisites
CHEM 405	Solid State Chemistry	2	CHEM 241
ENGR 001	Engineering Ethics	1	
	Elective(General)	2	
MGMT 002	Entrepreneurship	2	
	Elective (General)	2	

Fifth Semester (16 Credits)		Crs.	Pre/Co-requisites
COME 411	Instrumentation	3	COME 222
COMP 426	Microprocessor Interfacing	3	Pre: COMP 328
INME 423	Project Planning and Management	3	Pre: ENGL 300
COME 372	Propagation and Antennas I	4	Pre: POWE 271
COME 381	Signals and Systems	3	

Sixth Semester (17 Credits)		Crs.	Pre/Co-requisites
COME 473	Propagation and Antennas II	3	Pre: COME 372
COME 473L	Propagation and Antennas Lab	1	Co: COME 473
COME 380	Communication Theory and Systems I	3	Pre: COME 381, MATH 381
COME 580	Communication Networks	3	
COME 580L	Communication Networks LAB	1	Co: COME 580
COME384	Digital Signal Processing	3	Pre: COME 381, MATH 284
	Technical Elective	3	

Seventh Semester (17 Credits)		Crs.	Pre/Co-requisites
COME 576	Optical Communications	3	Pre: POWE 271
COME 472	Microwave Engineering	3	Pre: COME 372
COME 485	Communication Theory and Systems II	3	Pre: COME 380
COME 485L	Communication LAB	1	Co: COME 485
COME 499	Internship (Approved Experience / Independent Study)	1	
COME 500	Research Methodology	2	Pre: ENGR 003
COME 501	Final Year Project I	1	Pre/Co: COME 500
	Technical Elective	3	

Eighth Semester (14 Credits)		Crs.	Pre/Co-requisites
COME 502	Final Year Project II	3	Pre: COME 501
COME 588	Wireless Communications	3	Pre: COME 485
COME 588L	Wireless Communications LAB	1	Co: COME 588
COME 573L	Microwave LAB	1	Pre: COME 472
	Technical Elective	3	
	Technical Elective	3	