Department of Electrical and Computer Engineering

Electrical and computer engineering department offers two academic programs leading to the bachelor degree. The first one is electrical engineering in one of the following concentrations: communications, computer, control and power, or without a concentration (general track). The second program is computer engineering with the following concentrations: computer networks and information security, hardware and digital systems, intelligent systems, or without concentrations (general track).

First: Bachelor of Electrical Engineering

Students are accepted directly on competition basis, based on the results of their Palestinian General Secondary Examination (Tawjihi)- scientific branch or equivalent.

Electrical Engineering Program Admission Requirements

- Student must successfully complete and obtain a cumulative average of 70% or more in the following courses: MATH1411, MATH1321, PHYS141, PHYS132, ENME121
- Department approval based on its capacity. In case the number of applicants exceeds the enrolment capacity of the Department, only those with the highest overall competitive average grade will be admitted. The average grade will be calculated based on the grades of all course attempts.

Electrical Engineering Study Plan

The plan consists of 158 credits distributed as follows:

Requirements	**Credit Hours**
University Requirements	19-20
Faculty Requirements	30
Specialization Requirements	103
Free Elective Courses	6-5
Total	**158**

Electrical Engineering Specialization Requirements (103 credits):

a. Electrical Engineering Compulsory Courses: 90 credits as follows

Course No.	Course Title	Prerequisite(s)
MATH2311	Calculus 3	MATH1321
MATH234	Introduction to Linear Algebra	MATH1321
MATH330	Numerical Methods	MATH234, (COMP132 or COMP230 or COMP133 or COMP142)
MATH331	Ordinary Differential Equations	MATH1321
ENCS2110	Digital Electronics And Computer Organization Lab	(ENCS336 or ENCS3341 or ENCS238 or ENCS2380 or ENCS432 or ENCS2308) or concurrent
ENCS2340	Digital Systems	COMP142 or COMP132 or COMP133 or COMP230
ENCS2308	Computer Structure and Organization	ENCS234 or ENCS2340
ENCS4308	Microprocessor and Embedded Systems	ENCS238 or ENCS2308
ENCS5101	Microprocessor and Embedded Systems Lab	ENCS4308
BUSA2302	Engineering Project Management	
ENEE2102	Circuits Lab	(ENEE2305 or **ENEE2315** or concurrent) , PHYS112
ENEE2311	Circuit Analysis 1	PHYS132

ENEE2315	Circuit Analysis 2	ENEE2301 or **ENEE2311** , (ENEE2312 or Concurrent)
ENEE2307	Probability And Engineering Statistics	MATH1321
ENEE2312	Signals and Systems	MATH331
ENEE2313	Electronics 1	ENEE2301 or **ENEE2311**
ENEE3101	Electrical Machines Lab	ENEE2102, ENEE2408
ENEE2408	Electrical Machines	ENEE2301 or **ENEE2311**
ENEE3112	Electronics Lab	PHYS112 (or concurrent ENEE3304)
ENEE3304	Electronics 2	ENEE2313
ENEE3305	Power Electronics	ENEE2313, (ENEE2312 or concurrent)
ENEE3308	Electromechanical Principles and Applications	PHYS141
ENEE3309	Communication Systems	ENEE2312, ENEE2307 or concurrent
ENEE3318	Electromagnetics	PHYS132, MATH2311
ENEE3401	Communications and digital data networks	ENEE3309
ENEE4104	Engineering Simulation Lab	ENEE2408, ENEE3304
ENEE4105	Control And Power Electronics Lab	ENEE4302, ENEE3305

ENEE4113	Communication Lab	ENEE3309
ENEE4202	Electrical Installation And Drawing	ENEE2301 or ENEE2311
ENEE4300	Training	Fourth year student and Department permission
ENEE4302	Control Systems 1	(ENEE2305 or ENEE2315), ENEE2312
ENEE4304	Instrumentation and Measurement	ENEE3304, (ENCS238 or ENCS2308) or concurrent
ENEE4403	Power Systems	ENEE2408
ENEE5200	Introduction to Graduation Project	ENEE4300
ENEE5300	Graduation Project	ENEE5200, ENEE4300

b. Electrical Engineering Optional courses:

13 credit hours as chosen from the following:

1. Concentration students: have to finish all of the courses at one group (10 credit hours) plus 3 optional credit hours from the following:

2. General track (No concentration): have to finish **13** credit hours including a lab (**4** courses + lab) from the following:

Group	**Course No.**	**Course Title**	**Prerequisite(s)**
Group 1:	ENEE5111	Advanced Lab in Communication	ENEE4113, ENEE3401

Concentration of Communication	ENEE4305	Applied Electromagnetics	ENEE3318
	ENEE5304	Information and Coding Theory	ENEE3309 or ENEE339
	ENEE5305	Wireless Communication	ENEE3306 or ENEE3401
Group 2: Concentration of Computer	ENCS3390	Operating Systems	ENCS238 or ENCS2380 , ENCS2308 or ENCS336
	ENCS4130	Computer Networks Laboratory	ENCS433 or ENCS436 or ENCS3320
	ENCS3320	Computer Networks	COMP230 or COMP133
	ENCS4370	Computer Architecture	ENCS336 or ENCS238 or ENCS2380 or ENCS2308
Group 3: Concentration of Control and Power	ENEE5102	Power Lab	ENEE4403, (ENEE5303 or concurrent)
	ENEE5303	Electrical Machines And Special Electrical Machines Management	ENEE2408, ENEE3305
	ENEE5306	Protection And Automation In Electrical Power Systems	ENEE4403
	ENEE5307	Renewable Energy And Photovoltaic Power Systems	ENEE3305, ENEE2408
Group 4: **Concentration of Microelectronics**	ENCS3310	Advanced Digital Systems Design	ENCS2380

	ENCS3330	Digital Integrated Circuits	ENEE236 or ENEE2360, ENCS234 or ENCS2340
	ENCS5332	VLSI Design	ENCS3330
	ENCS5131	Hardware Design Lab	ENCS3330
Group **5**: More optional Courses	ENEE5311	Special Topic in Communication Engineering	Fourth year and department approval
	ENEE5312	Special Topic in Computer Engineering	Fourth year and department approval
	ENEE5313	Special Topic in Power Engineering	Fourth year and department approval
	ENEE5308	Control Systems 2	ENEE4302
	ENCS4330	Real Time And Embedded Systems	ENCS313 or ENCS3130, ENCS339 or ENCS3390
	ENCS5399	Special Topic in Computer Engineering	Fourth year and Department approval

Second: Bachelor's Degree in Computer Engineering

Students are accepted directly on competition basis, based on the results of their Palestinian General Secondary Examination (Tawjihi)- scientific branch or equivalent.

Computer Engineering Program Admission Requirements

1. Student must successfully complete and obtain a cumulative average of 70% or more in the following courses: MATH1411, MATH1321, PHYS141, PHYS132~~, ENME121~~

2. Student must successfully complete and obtain a grade of 70% or more in either COMP133 or COMP230.

3. Department approval based on its capacity. In case the number of applicants exceeds the enrolment capacity of the Department, only those with the highest overall competitive average grade will be admitted. The average grade will be calculated based on the grades of all course attempts.

Computer Engineering Study Plan

The study plan consists of 158 credited hours distributed according to the following table:

Requirements	**Credit Hours**
University Requirements	19-20
Faculty Requirements	32
Concentration Requirements	101
Free Elective Courses	6-5
Total	**158**

Computer Engineering Specialization Requirements (101 credits):

a. Computer Engineering Compulsory Course for all tracks: 85 credits as follows:

Course No.	Course Title	Prerequisite(s)
COMP2310	Object Oriented Programming	COMP230 or COMP132 or COMP133 or COMP142
COMP2421	Data Structures and Algorithms	COMP230 or COMP132 or COMP133 or COMP142
COMP333	Database Systems	COMP242 or COMP2321 or COMP2421 or Concurrent
COMP433	Software Engineering	COMP333
ENCS2110	Digital Electronics and Computer Organization Lab	(ENCS336 or ENCS3341 or ENCS238 or ENCS2380 or ENCS432 or ENCS2308) or concurrent
ENCS2340	Digital Systems	COMP142 or COMP132 or COMP133 or COMP230
ENCS2380	Computer Organization and Microprocessor	ENCS234 or ENCS2340
ENCS3130	Linux Laboratory	COMP230 or COMP132 or COMP142 or COMP133
ENCS3310	Advanced Digital Systems Design	ENCS238 or ENCS2380
ENCS3320	Computer Networks	COMP230 or COMP133 and 3rd year level

ENCS3330	Digital Integrated Circuits	ENCS234 or ENCS2340, ENEE236 or ENEE2360
ENCS3340	Artificial Intelligence	COMP233, (COMP230 or COMP142 or COMP133)
ENCS3390	Operating Systems	ENCS238 or ENCS2380 , ENCS2308 or ENCS336
ENCS4110	Computer Design Lab	(ENCS338 or ENCS2380), (ENCS211 or ENCS2110)
ENCS4130	Computer Networks Laboratory	ENCS433 or ENCS436 or ENCS3320
ENCS4300	Practical Training	Passing 115 credited hours and department approval
ENCS4310	Digital Signal Processing	ENEE2312 and MATH234
ENCS4320	Applied Cryptography	COMP233, COMP133
ENCS4330	Real-Time Applications And Embedded Systems	ENCS313 or ENCS3130, ENCS339 or ENCS3390
ENCS4370	Computer Architecture	ENCS238 or ENCS336 or ENCS2380 or ENCS2308
ENCS4380	Interfacing Techniques	(ENEE236 or ENEE2360) , (ENCS338 or ENCS2380)
ENCS5140	Real-Time Systems and Interfacing Techniques Lab	ENCS531 or ENCS4330
ENCS5150	Advanced Computer Systems Engineering Laboratory	Passing 115 credited hours and department approval

ENCS5200	Introduction to Graduation Project	Passing 115 credited hours and department approval
ENCS4210	Computer Engineering Ethics	4th year level
ENCS5300	Graduation Project	ENCS5200 , ENCS4300
ENEE2103	Circuits And Electronics Lab	PHYS112, ENEE236 or ENEE2360
ENEE2312	Signals And Systems	MATH331
ENEE2304	Circuit Analysis	PHYS132, MATH331
ENEE2307	Probability And Engineering Statistics	MATH1321
ENEE2360	Analog Electronics	ENEE2304 or ENEE2301
ENEE33**0**9	Communication Systems	ENEE2312, ENEE2307 or concurrent
ENEE4113	Communications Lab	ENEE3309
MATH331	Ordinary Differential Equations	MATH1321

b. Computer Engineering Optional courses:

Students have to pass 16 credit hours as chosen from the following:

1. Concentration students: have to finish all of the courses at one group (10 credit hours; three courses and one lab) plus 6 optional credit hours from the following:

2. General Path (No Concentration): have to finish 16 credit hours including a lab (5 courses + lab) from the following:

Group	Course No.	Course Title	Prerequisite(s)
Group 1: Concentration of Computer Networks and Information Security	ENCS5321	Advanced Computer Networks	ENCS3320
	ENCS5322	Network Security Protocols	ENCS4320
	ENCS5323	Wireless and Mobile Networks	ENEE339 or ENEE3309, ENCS3320
	ENCS5121	Information Security and Computer Network Laboratory	ENCS5322
Group 2: Concentration of Hardware and Digital Systems	ENCS5331	Advanced Computer Architecture	ENCS4370, ENCS3390
	ENCS5332	VLSI Design	ENCS3330
	ENCS5333	Advanced Embedded Systems	ENCS4330
	ENCS5131	Hardware Design Lab	ENCS3330
Group 3: Concentration of Intelligent Systems	ENCS5341	Machine Learning and Data Science	ENCS3340
	ENCS5342	Information Retrieval with Applications of NLP	ENCS3340
	ENCS5343	Computer Vision	ENCS3340
	ENCS5141	Intelligent Systems Lab	ENCS3340
Group 4:	ENCS5324	Advanced Distributed Systems	ENCS3320, ENCS3390

More Optional Courses	ENCS5325	Wireless Sensor Networks and Internet of Things	ENCS3320
	ENCS5326	Network and System Defense	ENCS4320
	ENCS5327	Software Security	ENCS4320
	ENCS5334	VLSI Testing	ENCS3310, ENCS3330
	ENCS5335	SOC Design and Verification	ENCS3310, ENCS3330
	ENCS5336	Parallel Computing	ENCS4370, ENCS3390
	ENCS5344	Spoken Language Processing	ENCS3340, ENCS4310
	ENCS5345	Robotics	ENCS3340, ENCS4380
	ENCS5346	Automated Reasoning And Applications	ENCS3340
	ENCS5347	Natural Language Processing (NLP) with Emphasis on Arabic	ENCS3340
	ENCS5348	Big Data Analytics	ENCS3340
	ENCS5349	Deep Learning with Applications	ENCS5341
	COMP4341	Health Informatics	ENCS3340
	ENCS5399	Special Topic in Computer Engineering	***Passing 115 credited hours and department approval***

	Courses from Electrical Engineering Level 4 or 5 with Department Approval
	Courses from Computer Science Level 4 with Department Approval

Electrical Engineering Courses Description (ENEE):

ENEE2101 Basic Electrical Engineering Lab

(For Mechanical Engineering, Mechatronics Engineering Students)

Basic concepts and laws for DC circuits, network theorems, concept of impedance, measurement of phase difference for electrical circuits composed of resistors, capacitors and inductors (RLC circuits), power analysis and power factor, transformers, magnetic circuits, diodes characterization and applications. (Lab 3hours).

Prerequisite: ENEE2301, PHYS112

ENEE2102 Circuits Lab

Faults in electrical circuits, application of electrical network theorems, pulse response for first and second order electrical circuits, bridges and their applications, filter circuits, two-port circuits, resonance circuits, three-phase circuits, electrical transformers. (Lab 3hours).

Prerequisite: PHYS112, (ENEE2305 or ENEE2315 or concurrent)

ENEE2103 Circuits and Electronics Laboratory

(Computer Systems Engineering Students)

Application of electrical network theorems, step response for first and second order electrical circuits, filter circuits, Transistor characteristics and biasing, amplifier circuits, frequency response of amplifiers, operational amplifiers, oscillators, voltage regulators. (Lab 3hours).

Prerequisite: PHYS112, ENEE236 or ENEE2360

ENEE2311 Circuit Analysis 1

Introduction to electrical engineering, electrical quantities and the basic elements of electrical circuits, dc circuit analysis, energy storage elements, first and second order circuits, sinusoidal steady state response, AC power and power factor correction, three phase circuits, magnetically coupled circuits and transformers, different applications in the electrical engineering. Using simulation tools for analysis and design of electric circuits.

Prerequisite: PHYS132

ENEE2304 Circuit Analysis

(Computer Engineering Students)

Electrical quantities and the basic elements of electrical circuits, DC circuit analysis, energy storage elements, first and second order circuits, sinusoidal steady state response, AC power, Power factor correction, three phase circuits, Laplace transform in circuit analysis, filter circuits' analysis and design, two port networks. Using simulation tools for analysis and design of electric circuits.

Prerequisites: PHYS132, (MATH331 or concurrent)

ENEE2315 Circuit Analysis 2

Operational amplifier, Laplace transform analysis and circuit application, network functions, frequency selective circuits, Active filters analysis and design, two port networks, circuit topology and general circuit analysis, Using simulation tools for analysis and design of electric circuits.

Prerequisite: ENEE2301, (ENEE2312 or concurrent)

ENEE2307 Probability and Engineering Statistics

Set operations, axioms of probability, Bayes' theorem, independent events, the random variable, probability density function, examples of discrete probability distributions (Binomial, Poisson, geometric, hyper-geometric, multinomial), examples of continuous probability distributions (Normal, uniform, Log-normal, Gamma, Beta, Weibell), multivariate probability density functions, normal approximation to the Binomial distribution, population and sampling, unbiased estimators, sampling distribution of the mean with known and unknown variance, point and interval estimation, elements of hypothesis testing, linear correlation

linear regression, least squares, the random process, stationarity and ergodicity, Gaussian random processes.
Prerequisite: MATH1321

ENEE2312 Signals and Systems
The concept of system, input and output signals, classification of systems and signals, linear time invariant systems and convolution theorem. System characterization by the impulse response, periodic signals and their Fourier series representation. Response of Linear time invariant systems to periodic input signals, Fourier transform, frequency response, and use of Fourier transform in system analysis. Applications of Fourier transform in communications. Sampling theorem, Definition and classification of discrete signals and systems, difference equations, Z-transform and applications.
Prerequisite: MATH331

ENEE2313 Electronics 1
Semiconductor materials and PN junction, diode circuit applications, bipolar junction transistor structure and operation, BJT biasing circuits, small signal BJT amplifiers (CB, CE, and CC). Field effect transistor structures and operations, FET biasing circuits small signal FET amplifiers (CG, CS, CD), multistage amplifiers, frequency response of amplifiers, introduction to digital logic families, using simulation tools for the analysis of electronic circuits.
Prerequisite: ENEE2301

ENEE2360 Analog Electronics
(For Computer Engineering and Mechatronics Engineering)
Semiconductor material and p-n junction, diode circuit applications, bipolar junction transistor (BJT); BJT biasing and small signal analysis, field effect transistor (FET); FET biasing and small signal analysis, multistage amplifiers, amplifier frequency response, applications of operational amplifiers, voltage regulation, thyristors and triggering circuits.
Prerequisite: ENEE2301 or ENEE2311 or ENEE2304

ENEE2408 Electrical Machines
(Not allowed for mechanical engineering and mechatronics engineering students)

DC and AC magnetic circuits and their solution by application of electromagnetic field theory, electromechanical energy conversion. Single and three phase transformers theory Synchronous Generators, construction, principle of operation and control. Synchronous motors principle of operation and applications. Single and Three-phase induction motors, types, principle of operation, characteristics. DC generators and motors types and principle of operation. Practical control circuits for AC and DC motors.
Prerequisite: ENEE2301

ENEE3101 Electrical Machines Lab
Selected experiments in the field of DC electrical machines (all types of motors and generators), single-phase and three-phase transformers, AC machines, three-phase induction machines, three-phase synchronous machines, single phase AC motors, contactors and relays application (Lab 3hours).
Prerequisite: ENEE2102, ENEE2408

ENEE3112 Electronics Lab
Selected experiments on diode characteristics and applications, Transistor characteristics and biasing, amplifier circuits, multistage amplifier design, frequency response of amplifiers, differential amplifiers, operational amplifiers, power amplifiers, feedback amplifiers, oscillators, and voltage regulators. (Lab 3hrs).
Prerequisite: PHYS112 (or concurrent ENEE3304)

ENEE3103 Analog Electronics Lab

(For mechatronic students)
Selected experiments on diode characteristics and applications, Transistor characteristics and biasing, BJT single stage amplifier circuits, FET single stage amplifier circuits , Multi-stage amplifier, Frequency response of BJT and FET single stage amplifiers, Operational (Lab 3hrs).
Prerequisite: PHYS112, ENEE236 or ENEE2360

ENEE3304 Electronics 2

Audio-frequency linear power amplifiers and heat sinks, current sources and their applications in IC, integrated differential and operational amplifier, applications of operational amplifiers, feedback amplifiers, discrete and integrated oscillators, voltage regulators, using simulation tools for the design, and analysis of electronic circuits.
Prerequisite: ENEE2313

ENEE3308 Electromechanical Principles and Applications

Newton's laws in translational and rotational motion, energy and work, motion of rigid body. Mechanisms, analytical calculation of velocity and acceleration of linkages, cams, gear trains, inertia forces in machines. Thermodynamic concept, the first and second thermodynamic laws and their applications. Thermodynamic cycles, internal combustion processes and combustion engines.
Prerequisite: PHYS141

ENEE3305 Power Electronics

Semiconductors, principles of modern power electronic devices and their characteristics, power diodes, Triacs and power Transistors, power MOSFETs and IGBTs. Thyristors and their operation, protection, triggering and commutation circuits. Principles of power electronic circuits (converters) that convert between different types of voltages: AC-AC converters including frequency changing converters (cycloconverters), AC-DC converters (controlled and uncontrolled rectifiers), DC-AC converters (inverters), and DC-DC converters (choppers), applications of power electronics in to controlling either power systems or AC and DC machines.
Prerequisites: ENEE2313, ENEE2312 or concurrent

ENEE3309 Communication Systems

Review of Fourier analysis, amplitude modulation systems (normal AM, DSB-SC, SSB-SC), frequency and phase modulation systems, stationary and ergodicity, transmission of a random process through a linear filter, the additive white Gaussian noise, noise in AM receivers, noise in FM receivers, pre-emphasis and de-emphasis, analog to digital conversion, pulse code modulation, delta modulation, differential pulse code modulation, transmission impairments over a communication channel, binary base-band and band-pass modulation schemes (ASK, PSK, FSK, QPSK). The optimum receiver for binary data transmission.
Prerequisite: ENEE2312, ENEE2307 or concurrent

ENEE3318 Electromagnetics

Introduction to vector analysis and coordinate systems, static electric field, electric field intensity vector, the curl and divergence, Coulombs Law, Gauss's law in differential and integral forms, the potential integral, gradient of the potential function, Maxwell's equations in integral and differential form, conductor properties, boundary conditions, , steady electric current, conservation of charge and the continuity equation, force and torque on current-carrying circuits, boundary conditions, Poynting theorem, retarded potentials, wave equation, uniform plane wave propagation, the uniform damped and undamped plane waves, the skin effect, reflection of plane waves (conductors and dielectrics), the normal incidence case.
Prerequisite: PHYS132, MATH2311

ENEE3401 Communications and Digital Data Networks

M-ary modulation techniques, M-ASK, M-PSK, M-FSK, M-QAM, computing the probability of error of some band pass systems. Inter-symbol interference (ISI), Nyquist criterion for zero ISI, design of transmitting and receiving filters, Elements of data communication networks, network architecture, the OSI reference model, switching techniques, collision-free multiple access methods (time-division multiple access, frequency division multiple access, code-division multiple access), the M/M/1 queuing system and Little formula, medium access protocols: pure ALOHA, slotted ALOHA, carrier sense multiple access techniques CSMA, carrier sense multiple access collision detection CSMA/CD, token rings. Other topics in data network.
Prerequisite: ENEE3309

ENEE3307 Lighting and Acoustics Engineering
(for Architecture students)
Principles of natural and artificial lighting inside buildings, light sources and Illumination levels for both natural and artificial lighting and for different architectural spaces, principles of acoustics and acoustic isolation, resonance, reverberation time, basics of sound propagation in internal spaces and the relation of the space shape on propagation properties, sound and noise levels, isolation materials for walls and ceilings, introducing measurement instruments for both acoustics and lighting. (Lecture 3 hours.)
Prerequisite: ENAR3251

ENEE4102 Fundamentals of Electrical Machines Lab.
Introduction to power electronic devices (diodes, Thyristors, Triacs, power transistors, power MOSFETs, IGBTs and GTOs, their characteristics, and commutation circuits for Thyristors), controlled and uncontrolled rectifies (single phase & three Phase), DC-DC converters (choppers:buck and boost, and buck-Boost), single phase and three phase (half bridge and full bridge) inverters, AC-AC controllers including frequency changing converters (cycloconverters), DC Motor drives (starting, braking and speed control), AC Motor drives (starting, braking and speed control).
Prerequisite: ENEE2101, ENEE4303

ENEE4113 Communications Lab
Experiments on AM and FM modulation demodulation, experiments on sampling and multiplexing, Pulse Code Modulation (PCM), Delta Modulation (DM) and Sigma Modulation, experiments on noise in modulation techniques (digital and analog), digital carrier modulation, selected experiments on microwave, demonstration on transmission lines. (Lab 3hours).
Prerequisite: ENEE3309

ENEE4104 Engineering Simulation Lab
In this lab the student will be equipped with the necessary skills to design and implement integrated engineering projects starting with engineering simulation packages and ending with design of print circuit boards (PCB) (Lab 3hours).
Prerequisite: ENEE2408, ENEE3304

ENEE4105 Control and Power Electronics Lab
Selected experiments in the field of control systems, power electronics, speed control for electrical machines using power electronics, different methods for the design of electrical circuits for speed control of motors (voltage method, frequency method, ...etc.), AC-to-DC and DC-to-AC power conversion. (Lab 3hours).
Prerequisite: ENEE4302, ENEE3305

ENEE4202 Electrical Installation and Drawing

Introduction to electrical design in building, electrical loads and their types, electrical illuminations, single phase and three phase conductors, alarm systems, safety systems, control and protection systems, earthing systems, introduction to elevator and escalator systems, design and drawing of electrical installation systems using software packages, introduction to mechanical drawing practical experiments on electrical installations in buildings.
Prerequisite: ENEE2301 or ENEE2311

ENEE4300 Practical Training
Practical training for a period of not less than 240 actual hours in one of the accredited companies or organizations, under academic supervision, in the field of Electrical Engineering. This course provides an opportunity for students to gain practical experience and skills, which are directly related to the field of specialization, as well as to enhance their personal competences and develop their soft skills such as communication skills, time management, and teamwork enabling their smooth transition to the labor market.
Prerequisite: Fourth year standing and department approval

ENEE4305 Applied Electromagnetics
Gain and directivity, monopole antenna, half-wave antenna, elements of antenna array theory. Communication Systems: geostationary satellites, satellite channel characterization and link budget calculations, transponder model, frequency plans, and satellite access techniques. Metallic waveguide, transmission in waveguides, TE waves, TM waves. Microwave Engineering: Review of basic results on transmission lines, microwave network analysis, impedance matching, passive microwave devices, strip-line and micro-strip line circuits, microwave filters.
Prerequisite: ENEE3318

ENEE4302 Control Systems 1
(Not For Computer Systems Engineering Students)
System modeling with emphasis on controlled electrical systems, differential equation and transfer function models of linear time-invariant systems, response of first- and second-order linear systems, stability, Routh's stability criterion, performance and stability of feedback control systems, the root locus method, frequency response and Bode plots, Nyquist's stability criterion, compensation of control systems using root locus and frequency response, control of unstable systems.
Prerequisites: ENEE2312, ENEE2305 or ENEE2315

ENEE4303 Electrical Machines Fundamentals
(For Mechanical and Mechatronics Engineering Students)
Theory of electromagnetic conversion from electrical to mechanical and inversely. Transformers theory and Applications. Synchronous generator, synchronous motors, Single-phase and Three-phase induction motors (basic operation); DC generators and Motors (basic operation), Stepper motors.
Prerequisites: ENEE2301

ENEE4304 Instrumentation and Measurement
Elements and applications of measurement systems, instrument types and performance characteristics, errors and noise during measurement process and how to treat them, grounding techniques, types of bridges and their applications, sensors/transducers: basic characteristic and selected practical examples of transducers. Analog vs. digital measurements, analog to digital conversion (ADC) and digital to analog conversion (DAC) techniques and problems, basics of sampling. Various types of indicating instruments, structure and basic components of different measuring instruments, oscilloscopes, electronic measurement, data acquisition systems (DAS) using computers, case study of a selected data acquisition card.
Prerequisite: ENEE3304, (ENCS238 or ENCS2308) or concurrent.

ENEE4401 Power Electronics and Drive
Single-phase and three-phase uncontrolled and controlled rectifiers feeding resistive and inductive loads; step-down (buck) and step-up (boost) DC-DC converters; Chopper DC-DC converters; AC voltage controllers; half-bridge and full bridge single-phase and three-phase inverters feeding inductive loads; DC motor drives; Frequency and phase controlled induction motor drive, Frequency controlled wound field-synchronous machine drive, DC motor drive using phase controlled bridge rectifiers and chopper circuits. Stepper motors, switched reluctance motors, permanent magnet synchronous motors and their drives.
Prerequisite: ENEE236 or ENEE2360, ENEE4303

ENEE4403 Power Systems
The structure of electric power networks, generation, transmission and distribution subsystems, application of basic electromagnetics to transmission line power transfer calculations, relation between current, voltage and power in short, medium and long transmission lines, modeling of electric power networks as single-line systems, the per-unit system for power system quantities, steady-state modeling using circuit analogies, the power flow or load flow equations and their analysis and numerical solution, optimal economic dispatch of electric power networks, symmetrical components, symmetric and non-symmetric fault calculations. Simulation of power systems using computer packages.
Prerequisite: ENEE2408

ENEE5102 Power Lab
Selected experiments of training on power systems and power network calculations, analysis, solution of low power factor, reactive power and drop of voltage, study of the stability of the system, controlling of power networks using different approaches. DC and AC motor Drives, Choppers and Inverters, Programmable Logic Controllers (PLC) Application. (Lab 3hours).
Prerequisites: ENEE4403, (ENEE5303 or concurrent)

ENEE5111 Advanced Communication Laboratory
Selected experiments on amplitude and angle modulation using digital signal processing techniques and computer simulation programs. Selected experiments on the antennas with focus on the directivity, gain, beamwidth, and bandwidth. Selected experiments on the utilization of optical fibers in communication and a comprehensive study of the phenomena of scattering and total internal reflection. (Lab 3hours).
Prerequisites: ENEE4113, ENEE3401

ENEE5200 Introduction to Graduation Project
Introduction to the final graduation project, the main aim is to gather the necessary information and materials about the final project, students present at the end of the semester the ongoing steps to be applied during the following semester.
Prerequisites: ENEE4300

ENEE5300 Graduation Project
Final graduation project, students should either design and implement a system related to the electrical engineering field or do research on a particular subject under supervision of an electrical engineering department member.
Prerequisite: ENEE5200, ENEE4300

ENEE5303 Electrical Machine Drives and Special Machines
Special purpose and single-phase fractional horsepower motors and their applications in light industry, types of motors used in computer controlled processes and their control. Selecting the proper motor for doing a certain job. DC and AC motors control and drives. Power Electronics applications for AC and DC

motor drive; soft starting, speed control and Soft Braking. Conventional and advanced control (microcomputer control). Programmable Logic Controllers (PLCs) and their applications.
Prerequisites: ENEE2408, ENEE3305

ENEE5304 Information and Coding Theory
Information measure, information sources, entropy, source coding, unique optimal codes, the first Shannon's theorem, discrete channels, mutual information, conditional entropy, channel capacity, Shannon's second theorem, error detection and correction codes, transmission strategies, linear block codes, cyclic codes, convolutional codes, Trellis.
Prerequisites: ENEE3309 or ENEE339

ENEE5305 Wireless Communications
Mobile Radio Signal Propagation, Path Loss and Channel Models, Large Scale Path Loss, Small Scale Path Loss, Modulation Techniques for Wireless Communication, Multiplexing, Multiple Access Techniques, Channel Equalizers, Cellular Concept and Cellular System Fundamentals, Trunking, Cell Splitting and Sectoring, Multipath Propagation, Diversity and Combining Techniques, Capacity of Cellular Communications, Wireless Generations and Standards, Global System for Mobile Communication (GSM), Code Division Multiple Access (CDMA) System, Multiple-Input Multiple-Output (MIMO) System, Modern Communications Systems.
Prerequisites: ENEE3306 or ENEE3401

ENEE5306 Protection and Automation in Electrical Power Systems
Transient Stability analysis of power systems, dynamic modeling and the swing equations. The protection system and its elements (current transformers, voltage transformers, circuit breakers, re-closers, fuses, relays), fault analysis (short circuit current calculation, selection of protection components), Relay operating principles, over-current, differential, distance, and pilot protection, digital relays. Protection of generators, motors, transformers, bus-bars and transmission lines. Systems for the automatic regulation of voltage, reactive power and frequency (AVR, ALFC and AFR).
Prerequisite: ENEE4403

ENEE5307 Renewable Energy and Photovoltic Power Systems
Energy Fundamentals, review of conventional power systems, overview of renewable energy sources and systems, photovoltaic "PV" fundamentals, detailed study of PV systems, comparison of solar cell technologies, PV system components and design, wind resources, wind energy systems and their basic components, electrical generators for wind energy systems, site survey and Preplanning, standalone and grid-connected systems, system sizing and economic aspects.
Prerequisite: ENEE2408, ENEE3305

ENEE5308 Control Systems 2
The concept of state, state-space linear models and their solution in the time and frequency domains, stability analysis with linear state space models in terms of system poles, controllability of linear systems and controllability tests, observability of linear systems and observability tests. State feedback and state estimation, pole placement method for SISO and MIMO systems, linear systems observers. Optimal control systems. Non linear models and linearization, Lyapunov's methods for stability analysis of nonlinear systems, transformation of linear state-space models into transfer functions, the concept of system internal representation. Introduction to discrete control.
Prerequisite: ENEE4302

ENEE5311 Special Topic in Communication Engineering
Study of a particular subject related to Communications depending on students' needs and instructors interests.

Prerequisite: Fourth year standing and department approval

ENEE5312 Special Topic in Computer Engineering
Study of a particular subject related to Computers depending on students' needs and instructors interests.
Prerequisite: Fourth year standing and department approval

ENEE5313 Special Topic in Power Engineering
Study of a particular subject related to power systems depending on student's needs and instructors interests.
Prerequisite: Fourth year standing and department approval

Computer Engineering Courses Description (ENCS):

ENCS2110 Digital Electronics and Computer Organization Laboratory
Selected experiments on Logic gates, bi-stables, registers, counters, adders, design of combinational and sequential systems, design and implementation of ALUs including floating-point adders and multipliers, memory devices, processing units (3 practical hours).
Prerequisite: (ENCS238 or ENCS3360 or ENCS432 or ENCS3341or ENCS2380) or concurrent.

ENCS2301 Fundamentals of Electronics and Digital Systems
(For Mechanical Engineering Students)
Basics of semiconductor materials, diodes and diode applications, BJT transistor construction and operation as a switch or an amplifier, biasing circuits, single stage amplifiers, operational amplifiers and their main applications, voltage regulators, number system, Boolean algebra postulates, Boolean algebra manipulations, combinational logic: logic gates, Boolean functions minimization two-level and multi-level implementations, design procedure, and main combinational circuits.
Prerequisite: COMP230, ENEE2301

ENCS2308 Computer Structure and Organization
(For Electrical Engineering)
Basic Computer Organization, multiple-Level machine, virtual and real machines. Processors and microcontrollers, bus, ALU, memory types, Cache memory, General-purpose and accumulator based processor organization. CISC, RISC, and Harvard organization. Instructions and data representation, machine language, symbolic representation, and Assembly language. Program control and execution. Branching, subroutines, and Interrupts. Hardwired and micro-program control. Peripheral devices, data transfer modes, transfer control, interfaces, and standards. Embedded system concept, Pipelining, fundamentals of parallel processing and vector computation. Hardware Design Language (HDL) application in computer structure.
Prerequisite: ENCS2340

ENCS2340 Digital Systems
Number Systems. Boolean Algebra. Logic gates. Design of Combinational Logic. Logic families, interfacing between logic families. Sequential logic: latches, flip-flops, state diagrams and excitation tables. Design of registers, counters, and sequential systems, derivation of state tables and state diagrams. Memory devices. Intro to Programmable Logic Devices, and Hardware Description Languages. Overview on digital Integrated circuits.
Prerequisite: COMP132 or COMP142 or COMP133 or COMP230

ENCS2380 Computer Organization and Microprocessor
Central Processing Unit. Assembly Language. Arithmetic Operations. Memory Organization. Hard Drive. Using assembly language to control computer peripherals: input devices, screen, parallel port, serial port. Interrupts in personal Computers.
Prerequisite: ENCS2340

ENCS3130 Linux Laboratory
Fundamental concepts about UNIX and Linux. File system, Process Control, System Administration. Editors, shells and debuggers. Shell scripting. Graphics and advanced topics.
Prerequisite: COMP132 or COMP142 or COMP133 or COMP230

ENCS3310 Advanced Digital Systems Design

Advanced features of a Hardware Description Language (HDL). CAD tools; logic synthesis and optimization, timing simulation, design flow, and examples from HDL code. Digital systems design; building block circuits, case studies from the building blocks of ALU and control unit. Asynchronous sequential circuits, race conditions and hazards. Testing logic circuits.

Prerequisite: ENCS238 or ENCS2380

ENCS3320 Computer Networks

Data communication networks and open system standards, layered network architecture, local area networks (LANs), high-speed and Bridge LANs, wide area networks (WANs), internetworking, transport protocols, error detection and correction, ARQ strategies, framing, identification and addressing, M/M/1 queuing system, multiple access communication, routing and flow control.

Prerequisite: COMP230 or COMP133 and 3rd year level

ENCS3330 Digital Integrated Circuits

Analysis and design of digital integrated circuits; MOS logic circuit families; logic gate construction, modeling MOS devices - equations and SPICE models, MOS invertors; voltage transfer characteristics; noise margin; propagation delay; MOS logic circuits; static logic; transfer gates; clocked static circuits; dynamic logic; Precharged logic; domino CMOS; buffer and I/O circuits; high capacitance drivers; semiconductor memories-DRAM, SRAM, ROM. A set of laboratory experiments will provide hands-on experience.

Prerequisite: ENEE236 or ENEE2360, ENCS234 or ENCS2340

ENCS3360 Computer Organization and Assembly Language

(For Computer Science Students)

Basic Computer Organization, computer structure and machine language, processing and input/output units, registers, principal machine instruction types and their formats, character representation, program control, fetch, indirect, execute, and interrupt cycles, timing, input/output operations. Memory hierarchy, Cache memory, Internal memory, External memory. Assembly Language and programming: data representation, arithmetic and logic operations, instructions, interrupt processing.

Prerequisite: ENCS234 or ENCS2340

ENCS3340 Artificial Intelligence

A study of what is required to produce intelligent, human-like behavior in a computer system. Fundamental issues in intelligent systems. Search and optimization methods. Knowledge representation and reasoning. Learning. Agents. Multi-agent systems. Game theory and auctions.

Prerequisite: (COMP142 or COMP230 or COMP133), COMP233

ENCS3341 Embedded Systems

(For Mechatronics)

Basic concepts of computer components and functions. Introduction to instruction set architectures. Introduction to practical aspects of embedded systems and mechatronics applications. Microcontroller types and applications. Microcontroller hardware and software features and implementation such as the use of timers and interrupts. Principles of programming and interfacing peripheral devices such as sensors and actuators to build a small embedded system. The use of methods such as Analogue to Digital

Conversions and Pulse Width modulation (PWM) in embedded systems. Basic concepts of data communication such as serial communication. Case studies.
Prerequisite: ENCS234 or ENCS2340

ENCS336 Computer Organization and Assembly Language
(For Computer Science Students)
Basic Computer Organization, computer structure and machine language, processing and input/output units, registers, principal machine instruction types and their formats, character representation, program control, fetch, indirect, execute, and interrupt cycles, timing, input/output operations. Memory hierarchy, Cache memory, Internal memory, External memory. Assembly Language and programming: data representation, arithmetic and logic operations, instructions, interrupt processing.
Prerequisite: ENCS234 or ENCS2340

ENCS3390 Operating Systems
The role of an Operating System in computer operations, memory management and virtual memory, process management, multiprogramming and multiprocessor systems, interrupt processing, input/output management and spooling, information management and security, introduction to distributed and networked operating systems, a comparative study of selected operating systems.
Prerequisite: ENCS238 or ENCS2380 , ENCS2308 or ENCS336

ENCS3341 Embedded Systems
(For Mechatronics)
Basic concepts of computer components and functions. Introduction to instruction set architectures. Introduction to practical aspects of embedded systems and mechatronics applications. Microcontroller types and applications. Microcontroller hardware and software features and implementation such as the use of timers and interrupts. Principles of programming and interfacing peripheral devices such as sensors and actuators to build a small embedded system. The use of methods such as Analogue to Digital Conversions and Pulse Width modulation (PWM) in embedded systems. Basic concepts of data communication such as serial communication. Case studies.
Prerequisite: ENCS234 or ENCS2340

ENCS4101 Embedded Systems Lab
(For Mechatronics)
Practical aspects of the embedded systems. Microcontroller hardware and software features and implementation. Introduce different microcontrollers. Experiments on topics such as I/O, sensors, motors, interrupts and serial communication.
Prerequisite: ENCS3341

ENCS4110 Computer Design Laboratory
Internal representation of data, addressing modes. Arithmetic operations and logic statements. Machine instructions. Assembler directives and macro definitions. Subroutine linkage and data-structures. I/O programming and interrupts. Using computers for process control and operation timing. Serial interfacing terminals. Parallel interfacing. Peripheral devices.
Prerequisite: (ENC2380 or ENCS338 or ENCS2308), (ENCS2110 or ENCS211)

ENCS4130 Computer Network Laboratory
Experiments on administration, security, integration, UNIX and other operating systems like windows, UNIX system administration, Network administration, switching, advanced IP routing, securing the network. (3 practical hours).

Prerequisite: ENCS433 or ENCS436 or ENCS3320

ENCS4300 Practical Training

Practical training for a period of not less than 240 actual hours in one of the accredited companies or IT-organizations, under academic supervision, in the field of Computer Engineering. This course provides an opportunity for students to gain practical experience and skills, which are directly related to the field of specialization, as well as to enhance their personal competences and develop their soft skills such as communication skills, time management, and teamwork enabling their smooth transition to the labor market.

Prerequisite: Finishing a minimum of 115 credit hours and department approval

ENCS4308 Microprocessor and Embedded Systems

(For Electrical Engineering)

Microprocessor and microcontrollers: Interfacing microprocessors and microcontrollers with memory, input/output, and interfacing devices. Driving capabilities, Input and output signal characteristics, buffering and electric level conversion. Digital to analog and analog to digital conversion. Embedded systems and microcontrollers programming using assembly and high-level languages. Programming of counters, timers, digital to analog converters, PWM unit, communication interfaces. External and internal events synchronization, delay cycles, interruption handling. Control application using digital and analog devices such as keyboards, displays, motors, and digital and analog sensors.

Prerequisite: ENCS2308

ENCS4310 Digital Signal Processing (DSP)

Modeling of discrete systems in time domain and frequency domain, discrete convolution, DFT and FFT algorithms, design and implementation of FIR and IIR digital filters, Structures and implementation of digital filters.

Prerequisite: ENEE2312 and MATH234

ENCS4320 Applied Cryptography

Cryptographic primitives and how they are applied within security systems, number theory foundations, finite fields, brief overview of classical cryptographic algorithms, symmetric-key encryption algorithms, Stream ciphers, Block cipher modes of operation, secure hash algorithms, message authentication codes, asymmetric ciphers, digital signatures, public key infrastructure, pseudorandom number generation, and design of cryptographic protocols, such as user authentication protocols.

Prerequisite: COMP233, COMP133

ENCS4330 Real-Time Applications and Embedded Systems

Variety of issues regarding the real-time application of embedded microprocessor systems, problems of real-time computer applications in process control or similar areas, digital processing, the physics of sensors and transducers, signal representation, and system design and software development, applications on automotive control, biomedical instrumentation, communication systems, speech processing, data compression and audio processing.

Prerequisite: ENCS313 or ENCS3130, ENCS339 or ENCS3390

ENCS4370 Computer Architecture

Traditional computer architectures, architecture of micro-programmed computer, pipeline systems, array systems, multi-processor systems, multi-computer systems, technology impact on computer

system architecture, modular computers, adaptable architectures, parallel network processors associative processors, dedicated architectures, mixed architectures, mixed architectures, distributed processing, client-server systems, case studies.
Prerequisite: ENCS238 or ENCS336 or ENCS2380 or ENCS2308

ENCS4380 Interfacing Techniques
Sensor types and characteristics. Examples on Temperature, displacement, pressure, strain, force, torque, etc. measurement will be studied. Analog signal conditioning circuit design and filtering. Advanced topics in Analog to Digital conversion and Digital to Analog converters and selection criteria. Speed versus hardware cost tradeoffs. Data Acquisition Systems (DAS), comparison and selection of DAS. Data acquisition and processing using serial, parallel, and USB ports. Microcontroller types and application
Prerequisite: (ENEE236 or ENEE2360), (ENCS338 or ENCS2380)

ENCS5101 Microprocessor and Embedded Systems Laboratory
(For Electrical Engineering)
Using computers and embedded systems for process control and operation timing. Serial interfacing terminals. Parallel interfacing. Peripheral devices. Applications of microprocessors and microcontrollers. (Lab 3hrs)
Prerequisite: ENCS4308

ENCS5140 Real-Time System and Interfacing Techniques Laboratory
Design and implementation of embedded microprocessor based systems and real-time applications. Experiments on the concepts of timing, concurrency, inter-process communication, and input/output.
Prerequisite: ENCS531 or ENCS4330

ENCS5150 Advanced Computer Systems Engineering Laboratory
Selected experiments on smart systems and robotics, experiments on small devices using the new web technologies and its application in developing innovative solutions in computer systems engineering field (3 practical hours).
Prerequisite: Passing 115 credited hours and department approval

ENCS5200 Introduction to Graduation Project
Data, information and material collection and analysis in area of study under the supervision of a faculty member, student presentations of findings and procedures and actions to be applied to complete the project in the following semester.
Prerequisite: Passing 115 credited hours and department approval

ENCS4210 Computer Engineering Ethics
Introduction to Professionalism, Ethical Dilemmas, Choices, and Codes of Ethics. Moral Frameworks for Engineering Professionalism. Safety and Risk Engineer Responsibilities and Rights. Copyright and Licensing Issues, Censorship and the Internet, Information Privacy Issues. Cautious Optimism and Moral Leadership.
Prerequisite: Fourth year standing

ENCS5300 Graduation Project
Final graduation project. Students should either design or implement a system related to the computer system engineering field or do research on a particular subject under supervision of a faculty staff members.

Prerequisite: ENCS4300, ENCS5200

ENCS5121 Information Security and Computer Network Laboratory

The essential concepts in cryptography, including secrete-key encryption, secure hash function, and public-key encryption and Public Key Infrastructure (PKI). Also, Experiments about conducting attacks against network protocols that include UDP, TCP, ICMP, IP and ARP, traffic sniffing attacks, DNS hacking, SYN flooding. Introduction to Mininet and Mininet and Open vSwitch.

Prerequisite: ENCS5322

ENCS5131 Hardware Design Lab

Apply knowledge and skills earned in the hardware track courses. Some experiments focus on the basics of embedded systems design, hardware verification, VLS design and testing. Others focus on some tools used in this area.

Prerequisite: ENCS3330

ENCS5141 Intelligent Systems Lab

Apply knowledge earned in the intelligent track course on a real-life application. Some experiments focus on the basics of machine learning techniques using artificial data. Others focus on some applications and tools in information retrieval, image processing, speech processing, robotics and NLP for Arabic language.

Prerequisite: ENCS3340

ENCS5321 Advanced Computer Networks

Principles, architectures, and protocols used in modern networked systems such as IPv6, BGP, multicast, network management and monitoring, software defined networking, data centres, cloud computing and overlay networks. Network protocol design and analysis, performance evaluation, as well as simulation and measurement studies of different protocols.

Prerequisite: ENCS3320

ENCS5322 Network Security Protocols

Network and distributed systems security threat model, TCP/IP security attacks, Authentication protocols, Kerberos, e-mail security, Transport Layer Security (TLS), IPsec, Internet Key Exchange (IKE), Domain Name System security (DNSSEC), WLAN security, Cellular network security and Routing Security. Other topics; anonymity and privacy, electronic-identity (single sign on), Remote electronic voting.

Prerequisite: ENCS4320

ENCS5323 Wireless and Mobile Networks

Practical design aspects of mobile and wireless networks, wireless transmission fundamentals, digital modulation techniques, multiplexing techniques, channel coding, capacity and error control, radio propagation and propagation path-loss models, introduction to antennas and diversity, multiple access techniques, spread spectrum technology, channel allocation methods, cellular networks concepts and design, GSM architecture and design from 2G to 5G, WLANs, mobile Ad Hoc networks, mobility management in wireless networks, mobile IP, and wireless TCP.

Prerequisite: ENEE339 or ENEE3309, ENCS3320

ENCS5324 Advanced Distributed Systems

Modern distributed systems. Research in the field of distributed systems. Big-data processing frameworks, large-scale data storage, and distributed systems security. Modern distributed systems can reach scalability, consistency, fault tolerance and exploit hardware capabilities. Powerful distributed approaches and their tradeoffs.
Prerequisite: ENCS3320, ENCS3390

ENCS5325 Wireless Sensor Networks and Internet of Things
Wireless sensor networks (WSNs) and Internet of Things (IoT). Specific issue in sensor networks such as localization, time synchronization, and energy and power management, Basics of networking and communication protocols in IoT, machine-to-machine networks, Interoperability in IoT, Introduction to SDN, IoT for smart cities and smart homes, Industrial IoT (IIoT). Case studies in agriculture, healthcare, Activity monitoring, and transportation.
Prerequisite: ENCS3320

ENCS5326 Network and System Defense
Internet infrastructure security, denial of service attacks, Botnets, memory protection, file system security, firewalls and virtual private networks (VPN), deep packet inspection, Intrusion Detection and Prevention Systems, Authentication systems (passwords, biometrics), Authorization (Access control lists), attack tracing, backup and system recovery, and continuity of operation, wireless security and network security auditing tools, Security strategies and security policies (ISMS).

Prerequisite ENCS4320

ENCS5327 Software Security
The basic concepts and methods of software security, the software vulnerabilities and attacks, such as buffer overflows, SQL injection, session hijacking, cross-site scripting, weak error handling, and defenses that prevent or mitigate these attacks, including threat modelling, attack surface analysis, fuzzing based security testing and program analysis techniques.
Prerequisite: ENCS4320

ENCS5331 Advanced Computer Architecture
Pipelining, Instruction level Parallelism (Tomasulo Algorithm, Reorder buffer, multiple issues, Dynamic branch prediction, Speculation, Super scalar processor), Data level Parallelism (Vector processors, SIMD, GPUs), Thread level Parallelism and multiprocessing, Cache design and optimization, Virtual memory. Performance Evaluation/Benchmarking
Prerequisite: ENCS4370, ENCS3390

ENCS5332 VLSI Design
The design and synthesis of Very Large Scale Integrated (VLSI) chips using CMOS technology. Design issues at layout, schematic, logic and RTL levels. Computer-aided design. Schematic design, timing verification, place and route, and post-layout timing closure.
Prerequisite: ENCS3330

ENCS5333 Advanced Embedded Systems
Analyzing real time constraints, Hardware /software co-design and partitioning, custom single-purpose processors (IP CORES) design and testing, building embedded systems using General-purpose and single-purpose processors, embedded bus architectures, embedded and real time operating systems. Embedded Linux device drivers.
Prerequisite: ENCS4330

ENCS5334 VLSI Testing

Fault analysis, test generation, and design for testability for digital VLSI circuits and systems. Fault modeling; fault simulation; test generation algorithms; testability measures; design for testability and scan design; built-in self-test, delay testing; memory testing; system-on-a-chip test; test compression.

Prerequisite: ENCS3310, ENCS3330

ENCS5335 System-on-a-chip (SOC) Design and Verification

SOC systems: Analyze the functional and nonfunctional performance of the system early in the design process to support design decisions. Analyze hardware/software tradeoffs, algorithms, and architectures to optimize the system based on requirements and implementation constraints. Issues in system-on-a-chip design associated with co-design, such as intellectual property, reuse, and verification. Verifying digital systems, from theory to industry practice. Logic Equivalence Checking. Assertion Based Verification. Universal Verification Methodology. Formal Verification.

Prerequisite: ENCS3310, ENCS3330

ENCS5336 Parallel Computing

Parallel architectures: parallel computers taxonomy, examples of parallel computers, Distributed memory systems, Shared memory systems and cache coherence, Heterogeneous system architecture (GPU and Xeon Phi), Interconnection networks and routing, performance metrics. Parallel algorithms. Decomposition techniques, Characteristics of tasks and interactions, mapping techniques for load balancing, parallel algorithm models. Examples on sorting, matrix problems, and graph problems. Parallel programming: types of parallelism, Programming scalable systems. Programming heterogeneous systems. Analytical modelling of parallel program, Scalability of parallel systems, Sources of overhead in parallel programs, asymptotic analysis of parallel programs.

Prerequisite: ENCS4370, ENCS3390

ENCS5341 Machine Learning and Data Science

Data Science Life Cycle, Exploratory Data Analysis, Data Visualization, Data Preprocessing, Dimensionality Reduction and Feature Selection, Linear and polynomial Regression, Overfitting and Regularization, Logistic Regression, Neural networks, K-Nearest Neighbours, Linear Discernment Analysis, Support Vector Machines, Ensembles Methods, Bayesian Networks, Hidden Markov Model, Model Selection and Assessments, Cluster Analysis, K-Means, Hierarchal Clustering, EM and Mixture Models – EM-GMM, Cluster Validation Methods, Reinforcement learning.

Prerequisite: ENCS3340

ENCS5342 Information Retrieval with Applications of NLP

Techniques for text-based information systems: efficient text indexing; Boolean and vector space retrieval models; evaluation and interface issues; Web search including crawling, link-based algorithms, and Web metadata; text clustering, classification and text mining; Cross-lingual aspects of information retrieval (CLIR) with emphasis on Arabic. Emphasis will be on recent developments in search engines, querying, and CLIR. Interaction between NLP and IR tools. Widely used tools for information retrieval.

Prerequisite: ENCS3340

ENCS5343 Computer Vision

Digital image processing review, Contrast Enhancement, Image Filtering, Denoising, Morphological Operations, Color Models, Feature Extraction and representation, Local Features, Color Features, Shape

Features, HOG, Bag-of Words, Camera Models and Calibration, Optical flow, Motion Model, and Object Tracking, Image Segmentation, Object Recognition, Object Detection, Deep learning in Computer Vision, Case Studies.
Prerequisite: ENCS3340

ENCS5344 Spoken Language Processing
Speech production, hearing and perception, speech sounds (phonemes and phones), speech production models, short-time time-frequency analysis, basics features extraction, Mel-frequency Cepstral coefficients, linear predictive coding, audio pattern recognition, automatic speech recognition, hidden Markov models, Viterbi decoding and Baum Welch algorithms, speaker and dialect recognition, language identification.
Prerequisite: ENCS3340, ENCS4310

ENCS5345 Robotics
Basic concepts of robotic topology, geometry, and mobility. Robotic vision and sensing. Principles on proximity, tactile, and force sensing, vision sensors, camera calibration and motion detection. Fundamentals of mobile Robotics, localization, environment modelling, map construction, path planning and execution, supervised/unsupervised learning in robotics with emphasis on mobile robots, multi-robot cooperation in achieving goals.
Prerequisite: ENCS3340, ENCS4380

ENCS5346 Automated Reasoning and Applications
Methods of automated deductive reasoning. Foundations of logical and probabilistic methods of automated reasoning. Implement algorithms for logical and probabilistic reasoning, the role of negation in inference and ways to define it. Propositional logic, predicate logic, resolution proof, production systems, Prolog, uncertain reasoning, Bayesian decision theory, exact inference, approximate inference, Non-monotonic reasoning and negation, reasoning with big data and applications like proving properties of programs and circuit verification.
Prerequisite: ENCS3340

ENCS5347 Natural Language Processing (NLP) With Emphasis on Arabic
Basic and engineering aspects of natural language processing, text and speech, with heavy emphasis on Arabic. Modern quantitative techniques in natural language processing and their applicability to Arabic such as using large corpora, statistical models for acquisition, disambiguation, and parsing and the construction of representative systems. Natural language processing in Interface design, information Retrieval including cross lingual, language issues in text to speech (TTS) Systems and translation.
Prerequisite: ENCS3340

ENCS5348 Big Data Analytics
Introduction to Big Data Analytics, Big Data Platforms, Big Data Storage, databases and Analytics, Big Data Analytics ML Algorithms, Graph Analytics, Linked Big Data -- Graph Computing, Machine Reasoning for Big Data, Big Data Visualization, GPU and Big Data Analytics. Case studies and statistical analysis tools.
Prerequisite: ENCS3340

ENCS5349 Deep Learning with Applications
Neural networks review, learning in neural networks, Deep learning strategies, Deep neural networks, Convolution Neural networks CNN, Recurrent neural network RNNs, Long Short-Term memory (LSTM),

Restricted Boltzmann Machines, Autoencoders, Deep Belief Networks, Deep learning tools and platforms, Vision applications, NLP applications.
Prerequisite: ENCS5341

ENCS5399 Special Topic in Computer Engineering
Study of a particular subject related to computer engineering depending on students' needs and instructors' interests.
Prerequisite: Passing 115 credited hours and department approval

COMP4341 Health informatics
Introduction to health informatics, basic principles of data science and decision-making, fundamentals of data visualization, data mining, machine learning, computing techniques for health data. Information extraction form health data, communicate and share this information. Team working and research skills.
Prerequisite: ENCS3340

BUSA2302 Engineering Project Management
(For Electrical and Computer Engineering)
Basics of project management and its importance in project success and the achievements of objectives within constraints of time, budget, and standards. Comprehensive integrated planning for all the activities required for project success using the project life cycle. Gantt chart, activity on arrow, activity on node for scheduling time, expenditure, and resources. Time/Cost analysis and resource allocation. Project control and evaluation."