German Jordanian University

School of Electrical Engineering and Information Technology

Bachelor of Science in Electrical and Communication Engineering

Introduction

Emerging global knowledge economies have created a demand for highly skilled Information and Communication Technology (ICT) workforce in all industries. As a result, ICT labor markets have become highly competitive. With the tremendous wealth recently generated in the Gulf States and subsequent industrial booms, such markets in the region became highly attractive to many Jordanian ICT workers. A large number of experienced ICT professionals leave the country every year. Faced with such conditions, the demand for a highly skilled ICT workforce has increased tremendously. Because of workforce migration, the ICT workforce in Jordan comprises of graduates who are young and possess little experiences and knowledge. Therefore, the necessity to educate and develop a qualified workforce to support Jordan economy and compete on an international level is paramount. In Jordan, current trends indicate that the skill set composition of the ICT workforce is changing. With a growing pool of 19,000 ICT related labor force and steadily inflowing 6,000 ICT graduates yearly, Jordan has a potential to become a regional leader in the ICT sector. The available evidence confirms that the current quality of ICT education cannot meet the labor market requirements; neither can it cope with the evolution of ICT technologies. In spite of the growing importance of ICT workforce, very little efforts have been made to implement quality and relevant ICT education in Jordan. The need for better quality and relevance of workforce skills has been identified by the Information Technology Association - Jordan as one of the challenges facing the ICT sector and affecting its growth, development and effectiveness.

To help meet these emerging demands on ICT education and address market needs, the School of Electrical Engineering and Information Technology envisioned since its inception in 2005 a unique approach to expand on the long experience of the German model of applied science and contribute to building a premier quality and relevant, industry oriented ICT education in Jordan. The goals are high-level quality in education and research, international co-operation, rich interaction and partnerships with enterprises, and focus on relevant academic programs.

The B.Sc. in Electrical and Communication Engineering program at GJU provides a unique educational environment. It offers small classes, outstanding facilities, and an extremely supportive staff. It also offers peer tutoring and technical support sessions that would help students move forward on a road towards success. Our faculty includes some of the distinguished professors and researchers that are specialized in various topics in the Electrical and Communication Engineering field. The projected unrivalled quality of education in the Department of Electrical and Communication Engineering at GJU not only contributes to the advancement and progress in the ICT sector in Jordan, but also began to serve as an icon within the country. The B.Sc. in Electrical and Communication Engineering program has been able to train professionals and experts who began to contribute to the Jordanian economy.

Degree requirements

Framework for B.Sc. Degree (Semester Credits)

The Bachelor degree in Electrical and Communication Engineering requires successful completion of the following course requirements:

Classification	Credit Hours		
	Compulsory	Elective	Total
University Requirements	21	6	27
School Requirements	26		26
Program Requirements	110	12	122
Total =	157	18	175

1. **University Requirements: (27 Credit Hours)**
    1. **University Compulsory Courses (21 Credit Hours):**

Course No.	Course Title	Credit Hours	Lectures/ Week	Labs/ Week	Prerequisite
ARB 99	Arabic *99	0	0	3	-
ARB 100	Arabic *	3	3	0	ARB 99
ENGL 98	English I*	0	0	3	-
ENGL 99	English II*	0	0	3	ENGL 98
ENGL 101	English III*	1	0	3	ENGL 99
ENGL 102	English IV*	1	0	3	ENGL 101
ENGL 201	English V*	2	0	3	ENGL 102
ENGL 202	English VI*	2	0	3	ENGL 201
GERL 101	German I	3	0	9	-
GERL 102	German II	3	0	9	GERL 101
MILS 100	Military Sciences	3	3	0	-
NE 101	National Education	3	3	0	-
	Total	**21**			

* Student's score on the Placement Test will decide the course level to start from.

    2. **University Elective Courses (6 Credit Hours) to be chosen from:**

Course No.	Course Title	Credit Hours	Lectures/ Week	Labs/ Week	Prerequisite
DES 101	Arts' Appreciation	3	3	0	-
EI 101	Leadership and Emotional Intelligence	3	3	0	-
IC 101	Intercultural Communications	3	3	0	-
PE 101	Sports and Health	3	3	0	-
BE 302 OR SE 301	Business Entrepreneurship OR Social Entrepreneurship and Enterprises	3 OR 3	3	0	-
SFTS 101	Soft Skills	3	3	0	-
	Total Required	**6**			

2. **School Requirements: (26 Credit Hours)**

Course No.	Course Title	Credit Hours	Lectures /week	Labs /week	Prerequisite
CE 212	Digital Systems	3	3	0	
CE 2120	Digital Systems Lab	1	0	3	Co-requisite CE 212
CE 352	Computer Networks	3	3	0	CE 201, CS 116
CS 116	Computing Fundamentals	3	3	0	
CS 1160	Computing Fundamentals Lab	1	0	3	Co-requisite CS 116
ECE 317	Linear Algebra	3	3	0	MATH 102
GERL 201	German III	3	9	0	GERL 102
GERL 202	German IV	3	9	0	GERL 201
MATH 101	Calculus I	3	3	0	MATH 099
MATH 102	Calculus II	3	3	0	MATH 101
	Total	**26**			

3. Program Requirements (122 Credit Hours)

1. **Compulsory Courses (110 Credit Hours):**

Course No.	Course Title	Credit Hours	Lectures /week	Labs /week	Prerequisite
BM 371	Numerical Analysis for Engineers	3	3	0	MATH 205, CS116
CE 201	Computer Architecture and Organization	3	3	0	CE 212, CE 2120
CE 331	Signals and Systems	3	3	0	MATH 203
CE 441	Embedded System Design	3	3	0	CE 201
CE 3561	Computer Networks Lab	1	0	3	CE 352
CHEM 103	General Chemistry	3	3	0	-
ECE 241	Electronics I	3	3	0	ENE 211
ECE 2410	Electronics I Lab	1	0	3	Co-requisite ECE 241
ECE 315	Random Variables and Stochastic Processes	3	3	0	MATH 102

ECE 321	Communication Systems I	3	3	0	CE 331
ECE 3210	Communication Systems I Lab	1	0	3	Co-requisite ECE 321
ECE 322	Communication Systems II	3	3	0	ECE 321, Co-requisite ECE 315
ECE 3220	Communication Systems II Lab	1	0	3	Co-requisite ECE 322
ECE 333	Electromagnetics	3	3	0	MATH 203
ECE 342	Electronics II	3	3	0	ECE 241
ECE 343	Digital Electronics	3	3	0	ECE 241
ECE 3430	Digital Electronics Lab	1	0	3	Co-requisite ECE 343
ECE 361	Modeling and Simulation of Electrical Systems	1	0	3	CE 331
ECE 393	Field Training	0	0	0	Department approval
ECE 492	Senior Project I	1	-	-	Department approval
ECE 493	International Internship	12	0	36	Department approval
ECE 510	Wireless and Mobile Communications	3	3	0	ECE 322
ECE 541	Electronic Communication Circuits	3	3	0	ECE 321, ECE 342
ECE 5410	Electronic Communication Circuits Lab	1	0	3	Co-requisite ECE 541
ECE 594	Senior Project II	3	-	-	ECE 492
ENE 211	Electrical Circuits I	3	3	0	PHYS 104
ENE 212	Electrical Circuits II	3	3	0	ENE 211
ENE 213	Electrical Circuits Lab	1	0	3	ENE 211
ENE 311	Electrical Machines	3	3	0	ENE 212
ENE 313	Electrical Machines Lab	1	0	3	Co-request ENE 311
ENE 312	Power Electronics	3	3	0	ECE 241
ENE 314	Power Electronics Lab	1	0	3	Co-request ENE 312
ENE 415	Power Systems	3	3	0	ENE 311
GERL 301	German V	3	9	0	GERL 202
GERL 302	German VI	3	9	0	GERL 301

IE 121	Workshop	1	0	3	
MATH 203	Applied Mathematics for Engineers	3	3	0	MATH 102
MATH 205	Differential Equations	3	3	0	MATH 102
ME 111	Computer Aided Engineering Drawing	3	2	3	
ME 343	Automatic Control Systems	3	3	0	CE 331
ME 3430	Automatic Control Systems Lab	1	0	3	Co-requisite ME 343
PHYS 103	Physics I	3	3	0	
PHYS 104	Physics II	3	3	0	PHYS 103
PHYS 106	Physics Lab	1	3	3	Co-requisite PHYS 104
	Total	110			

2. Elective Courses (12 Credit Hours):

Students have to choose **12 credit hours** from the following courses:

Course No.	Course Title	Credit Hours	Lectures /week	Labs /week	Prerequisite
CE 355	Data Communications	3	3	0	CE 331
CE 443	Microcomputer Interface and Peripheral Devices	3	3	3	CE 342, CE 3420
CE 4430	Microcomputer Interface and Peripheral Devices Lab	1	0	3	Co-requisite CE 443
CE 521	Robotics	3	3	0	CE 317
CE 552	Advanced Computer Networks	3	3	0	CE 352
ECE 461	Digital Signal Processing	3	3	0	CE 331
ECE 511	Satellite Communication Systems	3	3	0	ECE 322
ECE 514	Multimedia Communications	3	3	0	CE 331
ECE 515	Advanced Digital Communications	3	3	0	ECE 322
ECE 516	Information Theory and Coding	3	3	0	ECE 322

ECE 522	Digital Control	3	3	0	ME 343
ECE 531	Antennas	3	3	0	ECE 333
ECE 532	RF and Microwave Engineering	3	3	0	ECE 333
ECE 551	Optical Fiber Communications	3	3	0	ECE 333, ECE 322
ECE 560	Entrepreneurship in Electrical Engineering	3	3	0	
ECE 561	Areas of Future Research in Electrical Engineering	3	3	0	
ECE 562	Wireless Sensor Networks	3	3	0	CE 342, CE 352
ECE 563	Emerging Technologies in Electrical Engineering	3	3	0	
ECE 564	Introduction to Optimization	3	3	0	ECE 317
ECE 581	Protection of Power Systems	3	3	0	ENE 415
ECE 595A	Special Topics in Electrical Engineering	3	3	0	Department Approval
ECE 595B	Special Topics in Electrical Engineering	2	2	0	Department Approval
ECE 595C	Special Topics in Electrical Engineering	1	1	0	Department Approval
ECE 596A	Special Topics in Power Systems	3	3	0	Department Approval
ECE 596B	Special Topics in Power Systems	2	2	0	Department Approval
ECE 596C	Special Topics in Power Systems	1	1	0	Department Approval
ECE 597A	Special Topics in Communication Engineering	3	3	0	Department Approval
ECE 597B	Special Topics in Communication Engineering	2	2	0	Department Approval
ECE 597C	Special Topics in Communication Engineering	1	1	0	Department Approval
ECE 598A	Special Topics in Electronics	3	3	0	Department Approval
ECE 598B	Special Topics in Electronics	2	2	0	Department approval
ECE 598C	Special Topics in Electronics	1	1	0	Department Approval

ECE 5989A	Special Topics in Signal Processing	3	3	0	Department Approval
ECE 599B	Special Topics in Signal Processing	2	2	0	Department approval
ECE 599C	Special Topics in Signal Processing	1	1	0	Department Approval
ENE 433	Solar Energy I	3	3	0	ENE 431
ENE 516	Smart-Grid Power Systems	3	3	0	ENE 312
ENE 518	High Voltage Engineering	3	3	0	ENE 415
ENE 528	Energy Storage	3	3	0	Department approval
IE 545	Nonlinear Programming	3	3	0	Department Approval
IE 546	Fuzzy Logic and Neural Networks	3	3	0	Department Approval
	Total Required	**12**			

Note: Students may also select a maximum of six credits of 300 level and above courses from other departments in the School of Electrical Engineering and Information Technology in order to fulfill the elective requirements.

Note: German year is a default pre-requisite for all elective courses.

Study Plan Guide

First Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
ARB 100	Arabic	3	ARB 99
ENGL 101	English III	1	ENGL 99
GERL 101	German I	3	
MATH 101	Calculus I	3	MATH 99
PHYS 103	Physics I	3	
CS 116	Computing Fundamentals	3	
CS 1160	Computing Fundamentals Lab	1	Co-requisite CS 116
	University Elective Course	3	
	Total	**20**	
Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
ENGL 102	English IV	1	ENGL 101
GERL 102	German II	3	GERL 101
MATH 102	Calculus II	3	MATH 101
PHYS 104	Physics II	3	PHYS 103
PHYS 106	Physics Lab	1	Co-requisite PHYS 104
ME 111	Computer Aided Engineering Drawing	3	
CHEM 103	General Chemistry	3	
	Total	**17**	

Second Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
ENGL 201	English V	2	ENGL 102
GERL 201	German III	3	GERL 102
CE 212	Digital Systems	3	
CE 2120	Digital Systems Lab	1	Co-requisite CE 212
MATH 203	Applied Mathematics for Engineers	3	MATH 102
ENE 211	Electrical Circuits I	3	PHYS 104
ENE 213	Electrical Circuits Lab	1	Co-requisite ENE 211
IE 121	Workshop	1	
	University Elective Course	3	
	Total	**20**	
Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CE 201	Computer Architecture and Organization	3	CE 212, CE 2120
CE 331	Signals and Systems	3	MATH 102
ENE 212	Electrical Circuits II	3	ENE 211
ENGL 202	English VI	2	ENGL 201
GERL 202	German IV	3	GERL 201
ECE 315	Random Variables and Stochastic Processes	3	MATH 102
MATH 205	Differential Equations	3	MATH 102
	Total	**20**	

Third Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
BM 371	Numerical Methods for Engineers	3	MATH 205, CS116
ECE 241	Electronics I	3	ENE 211
ECE 2410	Electronics I Lab	1	Co-requisite ECE 241
ECE 317	Linear Algebra	3	MATH 102
ECE 321	Communication Systems I	3	CE 331
ECE 3210	Communication Systems I Lab	1	Co-requisite ECE 321
ECE 333	Electromagnetics	3	MATH 203
GERL 301	German V	3	GERL 202
	Total	**20**	
Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
ENE 311	Electrical Machines	3	ENE 212, ECE 333
ENE 313	Electrical Machines Lab	1	Co-requisite ENE 311
ECE 322	Communication Systems II	3	ECE 321, Co-requisite ECE 315
ECE 3220	Communication Systems II Lab	1	Co-requisite ECE 322
ECE 361	Modeling and Simulation of Electrical Systems	1	CE 331
ECE 342	Electronics II	3	ECE 241
ECE 343	Digital Electronics	3	ECE 241
ECE 3430	Digital Electronics Lab	1	Co-requisite ECE 343
ECE 391	Field Training	0	Department Approval
GERL 302	German VI	3	GERL 301
	Total	**19**	

Fourth Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
	Program Elective Course	3	
	Program Elective Course	3	
	Program Elective Course	3	
	Program Elective Course	3	
	Total	**12**	
Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
ECE 493	International Internship	12	Department approval
	Total	**12**	

Fifth Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CE 352	Computer Networks	3	CE 201, CS 116
CE 3561	Computer Networks Lab	1	CE 352
CE 441	Embedded System Design	3	CE 201
ECE 492	Senior Project I	1	Department approval
ECE 510	Wireless and Mobile Communications	3	ECE 322
ECE 541	Electronic Communication Circuits	3	ECE 321, ECE 342
ECE 5410	Electronic Communication Circuits Lab	1	Co-requisite ECE 541
ENE 415	Power systems	3	ENE 311
	Total	**18**	
Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
ECE 594	Senior Project II	3	ECE 492
ENE 312	Power Electronics	3	ECE 241
ENE 314	Power Electronics Lab	1	Co-requisite ENE 312
MILS 100	Military Science	3	
ME 343	Automatic Control Systems	3	CE 331
ME 3430	Automatic Control Systems Lab	1	Co-requisite ME 343
NE 101	National Education	3	
	Total	**17**	

Appendix I: Description of Courses offered by the Electrical and Communication Engineering Department

ECE 241 Electronics I
Introduction to semiconductor electronic devices. Semiconductor diodes circuits and applications. Clipper, clamper, and rectifier circuits. npn and pnp BJT and JFET transistor. BJT and JFET DC analysis. BJT AC analysis. Introduction to MOSFET and MESFET transistors. Introduction to OP-amps circuits and applications.

Prerequisites: ENE 211
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 2410 Electronics I Lab
Diode and diode applications including clipper, full-wave and half-wave rectifier, clamper, and voltage Doubler and Tripler. BJT transistor DC analysis for different configurations: Common base, common emitter, and common collector. BJT AC analysis. JFET DC analysis. Introduction to Op-amp.

Co-requisite ECE 241
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

ECE 321 Communication Systems I
Introduction to communication system. Revision of basic signal and systems. Amplitude modulations, Angle Modulation, Signal spectrum. Signal-to-noise ratio. Introduction to digital systems. Analog to digital conversion. Sampling. Quantization. Line Coding. Delta and sigma-delta modulation.

Prerequisites: CE 331
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 3210 Communication Systems I Lab
AM modulation. Envelope detector. Coherent receiver. FM modulation transmission and reception, single sideband communication (SSB) communication technique. Noise Sources. Signal to noise ratio (SNR). Pulse modulation. Pulse code Modulation (PCM). Delta modulation, DPCM.

Co-requisite ECE 321
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

ECE 322 Communication Systems II
A brief revision of analog communication and A/D conversion including sampling theorem, quantization and line coding. Revision of basic probability theory and random process. Baseband and passband communication and their conversions. Mutual information and entropy. Signal space representation and Gram-Schmidt procedure. Optimum receiver correlator. Matched filter. Digital modulations: PAM, PSK, and QAM. Performance analysis over AWGN. Derivation of BER.

Prerequisites: ECE 321, Co-requisite ECE 315
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 3220 Communication Systems II Lab
A/D and D/A conversion. Sampling. Quantization. Line coding. Digital modulation. PSK, QAM, and PAM. SNR measurement. BER calculation. Eye diagram. Channel coding. Optimum receiver.

Co-requisite ECE 322
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

ECE 315: Random Variables and Stochastic Processes
Probability principles and set theory: set definitions, set operations, probability introduced through sets and relative frequency, joint and conditional probability, independent events, combined experiments, Bernoulli trials. Random variables (Univariate and Multivariate): distribution and density functions, relation between distribution and density functions, the Gaussian random variable, other distribution and density examples (binomial / Poisson / uniform / exponential / Rayleigh), conditional distribution and density functions. Operations on random variables: expectation, moments, functions that give moments, transformations of a random variable. Distribution and density of a sum of random variables, central limit theorem. Random processes: temporal characteristics and spectral characteristic. Concept of stationarity and ergodicity. Correlation function. Power spectrum density. Response of linear systems to random signals.

Prerequisite: MATH 102
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 317: Linear Algebra
Systems of linear equations. Vector spaces and linear transformations. Independence, bases and dimensions, bases transformation. The fundamental fours spaces. Understand a matrix as a linear transformation relative to a bases of a vector space. Orthogonality and Gram-Schmidt process. Projection and projection matrices. Linear models and least squares problems. Determinants and their properties. Eigenvalues and eigenvectors. Matrix decompositions such as LU decomposition, Eigen-decomposition, Singular Value Decomposition. Vector and matrix derivatives. Applying these tools in a wide range of engineering applications.

Prerequisite: MATH 102
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 333: Electromagnetics
Electrostatic fields, magneto-static fields, solution of Laplace's and Poisson's equations, faraday's law and applications, Maxwell's equations, plane waves: propagation, reflection and refraction, transmission lines.

Prerequisite: MATH 203
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 342 Electronics II
JFET, MOSFET and MESFET AC analysis. BJT and FET frequency response. Operational amplifiers analysis and applications. Power amplifiers (Class A, Class B and Class C). Cascade, cascode, Darlington and feedback transistor configurations.

Prerequisites: ECE 241
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 343 Digital Electronics
General properties and definitions of digital circuits. Review of BJT and its modes of operation. Resistor Transistor Logic (RTL). Diode Transistor Logic (DTL). Transistor – Transistor Logic (TTL). Emitter – coupled Logic (ECL). Review of Field Effect Transistors (FET). Metal Oxide Semiconductor FETs (MOSFETs). MOS digital Circuits: NMOS, N-channel MOSFET, PMOS, and CMOS families. Regenerative Logic Circuits: bistable, monostable and astable multivibrators. D/A and A/D converters.

Prerequisites: ECE 241
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 3430 Digital Electronics Lab
Electric Characteristics or the TTL logic gates; Multiplexer and De-multiplexer; R-S & J-K Flip-Flops; TTL Logic Family; CMOS Logic Family; Interfacing TTL and CMOS logic Gates; Comparator & Schmitt trigger; 555 Timer as Monostable and Astable Multivibrators; Square Wave & Ramp Generators.

Co-requisite: ECE 343
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

ECE 361 Modeling and Simulation of Electrical Systems
The course will cover the usage of simulation tools required to simulate electrical systems. In particular, Matlab/Simulink based simulation and Labview simulation platforms will be targeted. The course entails description of the simulation platform with particular focus in related application and Monte Carlo simulations. Different example and models will be built and simulated.

Prerequisites: CE 331
Credit Hours: 1, Lecture Hours: 0, Lab Hours: 48

ECE 393 Field Training
Students must complete 160 hours of field training in approved industries in Jordan by the end of their third academic year.

Prerequisites: Department approval
Credit Hours: 0, Lecture Hours: 0, Practical Hours: 160

ECE 492: Senior Project I
Theoretical investigation and practical implementation of a special project under the supervision of an academic faculty member, detailed report as well as an oral examination are required.

Prerequisites: Department Approval
Credit Hours: 1, Lecture Hours: -, Lab Hours: 0

ECE 493: International Internship
A training period of six months to be spent in the industry in Germany, under a follow up of academic faculty in Jordan and in Germany. Periodic reports and a final report need to be submitted for evaluation and an oral examination is required.

Prerequisites: Department Approval
Credit Hours: 12, Lecture Hours: 0, Practical Hours: 640 (40 Hours/week)

ECE 510 Wireless and Mobile Communications
Overview of current and future wireless systems and standards. Cellular concept and structure. Cellular queuing theory. Large-scale fading including Ferris model, two-ray model, random log-normal shadowing, diffraction losses and Fresnel-zone concept. Small-scale fading and channel specification. Coherence bandwidth and coherence time. Rayleigh fading and analysis. Characterization of the wireless channel. Introduction to advanced wireless techniques including: OFDM, MIMO, 3G, multiple access, etc.

Prerequisites: ECE 322
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 541 Electronic Communication Circuits
Introduction to noise, amplitude modulators and demodulators (mixers, conversion loss and intermodulation distortion in mixers) AM transmitters, super heterodyne receiver, angle modulators and discriminators, limiters, gain controlled amplifiers, phase detectors, voltage controlled oscillators (VCO), phase-locked loops (PLL), high-frequency amplifiers, FM receivers, digital modulation circuits and systems, time and frequency division multiplexing.

Prerequisites: ECE 321, ECE 342
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 5410 Electronic Communication Circuits Lab
Noise and noise sources. AM modulation and demodulation circuits including: mixers, super heterodyne receiver. Phase modulators and discriminators, limiters, gain controlled amplifiers, phase detectors, voltage controlled oscillators (VCO), phase-locked loops (PLL), high-frequency amplifiers, FM receiver.

Co-requisite ECE 541
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

ECE 594: Senior Project II
Theoretical investigation and practical implementation of a special project under the supervision of an academic faculty member. Detailed report as well as an oral examination are required.

Prerequisites: ECE 492
Credit Hours: 3, Lecture Hours: -, Practical Hours: -

Department Electives

ECE 461 Digital Signal Processing
Digital Signal Processing begins with a discussion of the analysis and representation of discrete-time signal systems, including discrete-time convolution, difference equations, the z-transform, and the discrete-time Fourier transform. The course proceeds to cover digital network. FIR and IIR digital filters design. The fast Fourier transform algorithm for computation of the discrete Fourier transform. This course include an internal lab, which is designed to introduce the students to the signal processing in digital domain. DSP Lab is equipped with complete set of Hardware and Software to perform wide range of experiments including: Quantization, Fast Fourier Transform, FIR and IIR Filter implementation, Audio signal processing.

Prerequisites: CE 331
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 511 Satellite Communication Systems
History of satellites. Orbital and geostationary satellites. Mechanical fundamentals for satellites. Orbital patterns. Look angles. Orbital spacing. Radiation pattern. Satellite system. Link models. Up link model. Down link model. Transponder. Link budget equations and calculations. Digital modulation and channel coding techniques used in satellites. Losses and attenuation of waves between satellites and earth. Impact of weather conditions.

Prerequisites: ECE 322
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 514: Multimedia Communications
Introduction to audio and video signals, audio and video Signal Compression, audio/video processing tools, computer graphic tools and Video Production tools, Design fundamentals: Points, lines, design and creativity, Multimedia Processors, Multimedia Networks and Applications: Audio and Video Conferencing. Multimedia application over the Intranet and the Internet. In the aspect of multimedia networking, special considerations for sending multimedia over the Internet and wireless networks, such as video adaptation, error resilience, error concealment, and quality of service will be discussed. Note: the course will encourage the usage of open access software such as Audacity, Speex, and FFMPEG.

Prerequisite: ECE 322
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ECE 515: Advanced Digital Communications
Performance analysis over AWGN channels. Performance analysis over Rayleigh fading channel. Carrier and symbol synchronization. Signal design for bandlimited channels. Digital Communication through fading multipath channels.

Prerequisite: ECE 322
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ECE 516: Information Theory and Coding
Review of probability theory, Entropy, Mutual information, Data compression, Binary Block coding. Binary symmetric channels. Huffman coding, Channel capacity, differential entropy, Block codes, Convolutional codes, and Viterbi algorithm. Reed-Muller codes. Reed Solomon Codes. BCJR algorithm.

Prerequisite: ECE 322
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ECE 522: Digital Control
Sampling and Hold operation, A/D , D/A, Z-transform , mapping between S-plane and Z plane Z-plane , analysis of discrete time control system , controllability and observability , Design of DT control systems.

Prerequisite: ME 343
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ECE 531 Antennas
Antenna parameters: gain, directivity, efficiency, input impedance, radiation pattern. Theory of transmitting and receiving antennas: reciprocity, equivalence, and induction theorems. Linear wire antennas: dipoles and monopoles. Loop and traveling-wave antennas. Antenna arrays: linear and phased arrays. Aperture antennas, reflector antennas, and microstrip antennas. Computer aided design: student projects using antenna simulation tools.

Prerequisites: ECE 333
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 532 RF and Microwave Engineering
Microwave applications (terrestrial and satellite communications, radar, remote sensing, wireless communications) and their system and component requirements. Review of Maxwell's equations. Propagation modes of transmission lines (TEM, waveguide, micro strip), S-parameter matrix modeling of discontinuities, junctions and circuits (impedance transformers, directional couplers, hybrids, filters, circulators, solid-state amplifiers and oscillators). Microwave computer aided design examples.

Prerequisites: ECE 333
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 551 Optical Fiber Communications
Components and system design of optical fiber communication. Types of fibers (single- and multi-mode and step-index and graded-index fibers), how they work, phenomena that degrade signals and how to mitigate them (attenuation, modal dispersion, group-velocity dispersion), light sources, detectors, amplifiers, networks, and systems. Wavelength-Division Multiplexing. Introduction to optical wireless communication.

Prerequisites: ECE 322, ECE 333.
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 560 Entrepreneurship in Electrical Engineering
The course will discuss the emergence of new technologies in electrical engineering focusing particularly on technology entrepreneurial opportunities and its process in electrical engineering industries. In addition, the course will identify high-potential, technology-intensive commercial opportunities and reviewing what is relevant and currently discussed in industry.

Prerequisites: -
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 561: Areas of Future Research in Electrical Engineering
The course will discuss future research directions in various electrical engineering fields, which may include but not limited to, antennas, microwave, optics, communication and information systems, quantum information, pattern analysis and machine intelligence.

Prerequisite: -
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ECE 562: Wireless Sensor Networks
Wireless Sensor Networks definition, applications, major components and architecture, clustering protocols, routing protocols, wireless communication protocols, implementation platforms, power saving modes. Interrupts, Security.

Prerequisite: CE 342, CE 352
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ECE 563 Emerging Technologies Applications in Electrical Engineering
This course introduces the students to the fundamentals of machine learning algorithms and their implementation in Matlab and/or Python programming languages, and then the application of different machine learning techniques in several fields of electrical engineering systems such as signal detection, channel estimation, configuration of intelligent surfaces, network traffic control, resource allocation and management in wireless and power networks, fault control in power systems, load forecasting.

Prerequisites: -
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 581: Protection of Power Systems
Protection of power systems Switch gear, busbar systems, couplers, cubicles, auxiliaries, and single line diagram. Relays, electromagnetic, static, thermal relay, and over current, voltage. Distance relays. Differential relays. Feeder protection system. Transformer protection system. Generator protection system. Motor protection. Pilot wire protection of feeders. Unit Protection of Feeders. Distance protection. Protection of Parallel and Multi-ended feeders. Auto-reclosing. Intertripping. Industrial Power system Protection. Rectifier Protection. The application of microprocessors to substation control.

Prerequisite: ENE 415
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ECE 595: Special Topics in Electrical Engineering
Selected topics in contemporary electrical engineering technologies, which may include but not limited to, circuit design and analysis, control systems, electromagnetic, antennas, RF and microwave, signal processing, image processing, compressive sensing and sparse recovery, nanotechnology, very large scale integrated circuits (VLSI), micro-electro-mechanical systems (MEMS), optical engineering.

Prerequisites: Department Approval
ECE 595-A: Credit Hours: 3.
ECE 595-B: Credit Hours: 2.
ECE 595-C: Credit Hours: 1.

ECE 596: Special Topics in Power Systems
Selected topics in contemporary power engineering technologies, which may include but not limited to power generation, transmission and storage, power economics, power system operation and planning, power quality control and monitoring, power system reliability and protection, renewable energy, smart grids.

Prerequisites: Department Approval
ECE 596-A: Credit Hours: 3.
ECE 596-B: Credit Hours: 2.
ECE 596-C: Credit Hours: 1.

ECE 597: Special Topics in Communication Engineering
The course will cover recent advances in communication engineering technologies, which may include but not limited to, IoT and applications, smart grids communication systems, wireless sensor networks, low range—low power wireless communication, MIMO system, multiple access techniques (TDMA, CDMA, OFDMA, NOMA), multi—carrier communication, free—space optics and visible light communication.

Prerequisites: Department Approval
ECE 597-A: Credit Hours: 3.
ECE 597-B: Credit Hours: 2.
ECE 597-C: Credit Hours: 1.

ECE 598: Special Topics in Electronic Engineering
The course will cover recent advances in electronic engineering technologies, which may include but not limited to, microelectronics, active filters, oscillators, data converters, signal generators, digital electronics, lasers and

optoelectronics, high speed circuits, advanced semiconductor devices, RF/Gigahertz/Terahertz circuits, integrated circuits, VLSI circuits.

Prerequisites: Department Approval
ECE 598-A: Credit Hours: 3.
ECE 598-B: Credit Hours: 2.
ECE 598-C: Credit Hours: 1.

ECE 599: Special Topics in Signal Processing
The course will cover recent advances in signal processing, which may include but not limited to, transforms, digital filters (structures, design, and implementation), numerical roundoff errors, quantization effects, introduction to multi-rate signal processing, power spectrum estimation, linear prediction, Weiner filtering, parameter estimation, signal detection, hypothesis tests, likelihood ratio tests, time-frequency analysis, space-time processing, the Short-time Fourier Transform, compressive sensing and sparse recovery.

Prerequisites: Department Approval
ECE 599-A: Credit Hours: 3.
ECE 599-B: Credit Hours: 2.
ECE 599-C: Credit Hours: 1.

Appendix II: Courses description from other departments
MILS 100: Military Sciences
History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development.
Prerequisites: - None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

Courses from Energy Engineering Department

Compulsory Courses
ENE 211 Electrical circuits I

SI units, voltage and current; Ohm's and Kirchhoff's Laws, circuits with dependent sources; simple resistive circuits: series, parallel and delta to wye; techniques of circuit analysis: nodal and mesh analyses, source transformation, Thevenin and Norton equivalents; amplifiers; inductance, capacitance and mutual inductance; natural and step responses of RL and RC circuits; natural and step response of series and parallel RLC circuits; sinusoidal steady state analysis.

Prerequisites**:** PHYS 104
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 48

ENE 212 Electrical circuits II

Average, reactive and complex power, power measurements; polyphase circuits, Laplace Transforms, frequency response, passive and active filters, Fourier series and the Fourier Transform, two-port circuits, self and mutual inductances.

Prerequisites**:** ENE 211
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENE 213 Electrical circuits Lab

Resistive circuits, potentiometers, superposition, Thevenin's theorem and maximum power transfer, RLC current and voltage characteristics, frequency response of RL and RC circuits, series and parallel resonant circuits.

Co-requisite: ENE 211
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

ENE 311: Electrical Machines
Transformers: performance characteristics, three-phase connections, autotransformers; DC machines: performance equations, generator and motor characteristics, starting and speed control of motors; single phase induction motors; three-phase induction motors: operation, performance calculations, starting and speed control; synchronous machines: generator and motor operation; small synchronous motors; universal motors;

Prerequisites**:** ENE 212, ECE 333
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENE 312: Power Electronics
Power semiconductor devices: types, drive circuits, protection circuits, and power loss calculation; AC-DC converters: uncontrolled and fully-controlled single-phase and three-phase rectifiers, half-controlled rectifiers; DC-DC converters: step-down, step-up, and step-down/up converters; DC-AC converters: single-phase and three-phase inverters; AC-AC converters: cycloconverters, ac voltage controllers.

Prerequisite: ECE 241
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENE 313: Electrical Machines Lab
Transformers, three-phase transformer methods of connection, DC motors, DC generators, three-phase induction motors, single-phase induction motors, three-phase synchronous generator and motor, AC series motor, lab project.

Co-requisite ENE 311
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

ENE 314: Power Electronics Lab
Uncontrolled single phase half wave rectifier, uncontrolled single phase full wave rectifier, uncontrolled three phase rectifiers, controlled single phase rectifiers, controlled three phase rectifiers, DC chopper (buck converter), DC chopper (boost converter), DC chopper (buck boost converter), single phase AC inverter, lab project.

Co-requisite ENE 312
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

ENE 415: Power Systems
Overall introduction of power systems, transformers, load flow of power systems, series impedance of transmission lines capacitance of transmission lines; current and voltage relations on a transmission line; the impedance and admittance models and network calculations. Gauss Siedel and Newton Raphson methods to solve nonlinear algebraic power flow equations, symmetrical and unsymmetrical fault analysis.

Prerequisite: ENE 311
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

Elective Courses

ENE 433: Solar Energy I

Heat transfer phenomena (radiation, convection, conduction) in solar thermal systems; materials used in solar thermal applications and their properties: selective treatments, phase change materials, transparent insulating surfaces; design methodologies and calculation of solar thermal systems and equipment; heat transfer calculation software; testing of solar thermal collectors and solar thermal systems; applications of solar energy: absorption cooling systems, solar thermal energy system as a primary source of electricity; solar thermal concentration (solar thermo-electric).

Prerequisite: ENE 431
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENE 516: Smart-Grid Power Systems

This course presents a new concept in power systems, by integrating three areas of electrical engineering, (Power systems, Power electronics, and electric energy conversion systems). It addresses the fundamental design of renewable energy, such as wind and solar energies, and the integration to electrical power grid via smart switching elements (DC-DC converter, DC-AC inverter, and AC-DC rectifier). In addition, the concept of involving intelligent control SCADA system in smart power grid will be presented.

Prerequisite: ENE 312
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENE 518: High Voltage Engineering

Topics include introduction to high-voltage engineering; calculation methods of electric field strength, Discharge phenomena in gaseous, fluid and solid insulation materials, evaluation of onset and breakdown voltage of technical device, generation of high voltages (AC, DC, impulse, pulse); measurements of high voltages; destructive and nondestructive insulation test techniques; shielding and grounding; electric shock and safety.

Prerequisite: ENE 415
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ENE 528: Energy Storage

Thermal and electric storage is crucial for the implementation of renewable energy technologies because of the fluctuating nature of the renewable energy resources. Energy storage allows better management for energy use from renewable energy systems, in which the available energy will be used only when required. The energy storage course will introduce renewable energy engineering students to the different energy storing technologies with emphasis on electrical and thermal energies storage. Furthermore, energy storage strategies for system optimization will be covered in this course.

Prerequisites: Department approval
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

Courses from Computer Engineering Department

Compulsory Courses

CE 201: Computer Architecture and Organization

Basic computer organization, central processing unit, micro-program control and control unit, arithmetic processor, memory units, bus structures, interrupt structures. Taxonomies of computer architectures; addressing methods, programs control, processing units, I-O organization, arithmetic, main-memory organization,

peripherals, microprocessor families, RISC architectures and multiprocessors. Von Neumann; Baseline of processor architecture; Memory organization; Parallel computing;

Prerequisites: CE 212, CE 2120
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 212: Digital Systems
Fundamentals of digital electronics, Binary number system; Boolean algebra, logic operations, algebra and gates, digital circuits analysis, gate-level and block level design of digital circuits, adders, subtractors, comparators, multiplexers, decoders, analysis, design and applications of sequential circuits: flip-flops, registers, counter, and their design procedures, RAM and ROM memory elements.

Prerequisites: -
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 2120: Digital Systems Lab
The course also includes 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the CE 212 course, including basic logic gate experiments, combinational logic circuits experiments, and sequential logic circuits experiments. The experiments on all topics vary from functional troubleshooting to gate and block level design implementation.

Co-requisite: CE 212
Credit Hours: 1, Lecture Hours: 0, Lab Hours: 48

CE 331: Signals and Systems
Concepts and mathematical tools in continuous and discrete-time signal processing and linear systems analysis with examples from digital signal processing, communications, and control. Discrete-time signal models. Continuous-discrete-continuous signal conversion. Discrete-time impulse and step response. Frequency domain representations: Fourier series and transforms. Connection between continuous and discrete time frequency representations. Discrete Fourier transform (DFT) and fast Fourier transform (FFT). Digital filter and signal processing examples. Discrete-time and hybrid linear systems. Stability and causality. Z transforms and their connection to Laplace transforms. Frequency response of discrete-time systems.

Prerequisites: MATH 203
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

CE 352: Computer Networks
Study of computer network architectures, protocols, and interfaces. The OSI reference model and Internet architecture. Network models: LAN and WAN; Networking techniques such as multiple access, packet/cell switching, inter-networking, end-to-end protocols, and congestion control; IP, UDP and TCP protocols; Internet application protocols and applications: http; DNS; Web services; email protocols: SMTP, POP3; Network security. The students are expected to implement a project in the field of computer networks and to use open source network simulators such as NS2.

Prerequisites: CE 201, CS 116
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

CE 3561: Computer Networks Lab
Gain hands on experience on computer network protocols and interfaces, OSI reference model, and Internet protocols.

Prerequisites: CE 352
Credit Hours: 3, Lecture Hours: 0, Lab Hours: 48.

CE 441: Embedded System Design
Embedded system concepts, hardware architecture, design and debugging, embedded processor selection, software development methodologies, real-time Linux, synchronization mechanisms, interrupt latency, application programming interface, interrupt service routine, application design considerations.

Prerequisites: CE 201.
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

Elective Courses
CE 355: Data Communication
Fundamentals of Data Communications. Transmission Media, Data Encoding, Transmission Techniques, Protocols, Switching Networks, Broadcast Networks, Local Area Networks (LANs) and Wide Area Networks (WANs). Transmissions Technique and Cables. Troubleshooting Methods. Communication Interfaces. Network Security. Error Detection and Correction Methods. Modems Modulation Techniques for Digital Data Transmission, Data Link Protocols. High-Speed Packet Switching and Message Switching. OSI Reference Model. TCP/IP Protocols. Routing and Flow Control. Fundamentals of Frame Relay, ATM, X.25. Application Services, HTTP, Cryptography, MIME, E-mail. Telecommunication Services, ISDN, xDSL. New Technologies, IP Telephony, H323, WAP.

Prerequisites: CE 331
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 443: Microcomputer Interface and Peripheral Devices
This course covers various topics relative to microprocessor/microcontroller interfacing in addition to peripheral devices and their properties. Topics include: Processor Architecture Overview, Memory Models, GPIO interfacing, Interrupt handling, ADCs and DACs, Timers and PWM, Serial Interface Controllers, External sensor interfacing, Driving outputs. The course also has a practical part which uses Microcontrollers to conduct experiments based on assembly and the C language that interface with different input and output peripherals.

Prerequisites: CE 342, CE 3420.
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 4430: Microcomputer Interface and Peripheral Devices Lab
The course also includes 3-hours lab session every week to apply microcontroller interfacing concepts hands-on on a hardware development board. Also includes getting introduced to the necessary toolchain and development tools required for creating and deploying code on a microcontroller platform. Experiments include a variety of interfacing with inputs and outputs, developing mixed code applications in assembly and C, analyzing interrupt sequences, and learning how to debug code by stepping though instructions and reading/interpreting data in microcontroller memory.

Prerequisites: Co-requisite CE 443
Credit Hours: 1, Lecture Hours: 0, Lab Hours: 48.

CE 521: Robotics
Introduction to basics of modeling, design, planning, and control of robot systems. Topics include: robotics foundations in kinematics, dynamics, control, motion planning, trajectory generation, programming and design.

Prerequisites: ECE 317

Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 552: Advanced Computer Networks
High-speed local networks; metropolitan area networks; bridges; routers; gateways; TCP/IP; application services; IP addressing; IP forwarding, encapsulation, and fragmentation; Address Resolution (ARP& RARP); IP next generation (IPv6); Inter Control Message Protocol (ICMP). Routing Algorithms, MPLS networking technology, VPNs, Network applications and services, Multimedia over internet, Network performance, and Network design. A set of laboratory experiments will provide hands-on experience in related topics.

Prerequisites: CE 352
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

Courses from Computer Science Department

CS 116: Computing Fundamentals
Basic computer skills, programming concepts, algorithms, variables and data types; arithmetic, logical, relational, Boolean, and assignment operators; simple input and output statements, selection structures, loop structures, single and multidimensional arrays, character strings, functions, data structures, pointers, input/output file operations.
Prerequisites: -
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CS 1160: Computing Fundamentals Lab
Lab session every week to offer hands-on experience on the topics that are covered in CS116, which are: algorithms, variables and data types; arithmetic, logical, relational, Boolean, and assignment operators; simple input and output statements, selection structures, loop structures, single and multidimensional arrays, character strings, functions, data structures, pointers, input/output file operations.

Co-requisite: CS116
Credit hours: 1, Lecture Hours: 0, Lab Hours: 48

Courses from the School of Humanities and Languages
GERL 101: German I
Can understand and use familiar, everyday expressions and very simple sentences, which aim at the satisfaction of specific needs. Can introduce oneself, and others, and ask others questions to themselves - e.g. where they live, which people they know or what kind of things they have - and can give answers on questions of this kind. Can communicate on a basic level if those involved with him/ her in a conversation speak slowly and clearly and are willing to help.

Prerequisites: None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

GERL 102: German II
Can understand sentences and frequently used expressions if those are connected with things of immediate meaning (e.g. information to the person and to the family, buying, work, closer environment). Can communicate in simple, routine situations, with the purpose of a simple and direct exchange of information about familiar and common things. Can describe with simple means their own origin and training, direct environment and things that are in connection with direct needs.

Prerequisites: GERL 101
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

GERL 201: German III
Can understand the main points if no dialect is used and if it concerns familiar things about work, school, spare time etc. Can master most situations which one encounters on journeys in a German speaking area. Can express oneself simply and coherently about familiar topics and areas of personal interest. Can report experiences and events, describe dreams, hopes and goals and give short reasons or explanations about plans and opinions.

Prerequisites: GERL 102
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

GERL 202: German IV
Can understand the main contents of complex texts, as well as concrete and abstract topics; even discussions between specialists in his/ her own special field. Can communicate spontaneously and fluidly a normal discussion with native speakers, without larger effort on both sides. Can express oneself clearly and in detail in a broad spectrum of topics, describe a point of view to a current question and indicate the pro and cons of different possibilities.

Prerequisites: GERL 201
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

GERL 301: German V

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

Prerequisites: GERL 202
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

Courses from the School of Basic Sciences and Humanities

PHYS 103: Physics I
Physics and measurement. Motion in one dimension. Vectors. Motion in two dimensions. Force and motion. Kinetic energy and work. Potential energy and conservation of energy. Linear momentum and collisions. Rotation. Rolling and angular momentum.

Prerequisites**:** None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

PHYS 104 Physics II
Electric Fields. Gauss's Law. Electric Potential. Capacitance and Dielectrics. Current and Resistance. Direct Current Circuits. Magnetic Fields. Sources of Magnetic Field. Faraday's Law.

Prerequisites**:** PHYS 103
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

PHYS 106: Physics Lab
Developing a good understanding of a few important concepts in Mechanics, Electricity and Magnetism. Learning to apply these concepts to familiar and unfamiliar situations and Gaining the ability to reason qualitatively and quantitatively. This lab consists of 12 experiments, six in Mechanics and six in Electricity and Magnetism.

Co-requisite PHYS 104
Credit Hours: 0, Lecture Hours: 0, Practical Hours: 48

MATH 101: Calculus I
This course introduces the student to the calculus of single-valued functions. Topics include: limits, continuity, rates of change, rules for differentiating, differentials and local linear approximations, maxima and minima problems, L'Hôpital's rule, related rates, logarithmic and implicit differentiation, inverse trigonometric and hyperbolic functions, Rolle's theorem, the mean-value theorem, and applications of derivatives and integrals.

Prerequisites**:** None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

MATH 102: Calculus II
Sequences and series, power series, convergence theorems: integral, ratio, and alternating - series tests, Polar coordinates and functions, integration and differentiation of polar functions, Vectors in three-dimensional space, spherical and cylindrical coordinates, Vector valued functions, Partial derivatives, Multiple integrals, Topics in vector calculus.

Prerequisites**:** MATH 101
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

MATH 203: Applied Math for Engineers
Vector analysis in Cartesian coordinates. General Curvilinear Coordinates, Vector calculus in general curvilinear coordinates with emphasis on Spherical and Cylindrical coordinates, transformations between different coordinate systems, vector differentiation. Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors. Complex Numbers and Complex Variables; Representation of complex numbers, Powers and roots of complex numbers, Functions of a complex variable. Review of Infinite Series; Infinite series of constant terms, Convergence tests, Power series and radius of convergence, Taylor, and Maclaurin series and Fourier series.

Prerequisites: MATH 102
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

MATH 205: Differential Equations
First-order ordinary differential equations, Second-order ordinary differential equations, System of ODEs. Solution Techniques including Laplace transforms, Fourier series: eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in Applied Mathematics; Applications to illustrate typical problems and methods of applied mathematics in solid and fluid mechanics, fields of physics, dynamics and vibrations, wave phenomena, diffusion phenomena, heat conduction, and biological processes.

Prerequisites**:** MATH 102
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ARB 99: Arabic
This course aims to develop student's ability to read, comprehend, literary analyze, grammatically analyze, linguistically analyze, poetically analyze, and rhetorically analyze texts properly. The course also includes a selection of Arabic literature in poetry and prose representing different literary ages, in addition to several common forms of writing such as scientific article, news article, and others.

Prerequisites: None
Credit Hours: 0, Lecture Hours: 48, Practical Hours: 0

ARB 100: Arabic
Grammar and structure. Rectifying weakness in linguistic application; training in sound reading. Dictation; use of language in a manner free from grammatical and linguistic errors; accurate expression of intended meaning. Study and analysis of literary texts through the discussion of linguistic, grammatical and writing skills therein.

Prerequisites: ARB 99
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENGL 98: English I (Elementary English)
Students will focus on English at an elementary level concentrating on the receptive skills of reading and listening, and the productive skills of writing and speaking. These will include such things as independent clauses, verb tenses, model verbs, and adverbs, short dialogues, reading simple material and answering short questions, writing short meaningful sentences, listening to short conversations.

Prerequisites: None
Credit Hours: 0, Lecture Hours: 48, Practical Hours: 0

ENGL 99: English II (Pre-Intermediate English)
Students will focus on English at a pre-intermediate level concentrating on the receiver skills of reading and listening and the productive skills of writing and speaking. These will include such things as comparatives and superlatives, quantifiers, possessive adjectives and pronouns, vocabulary building, role play activities for speaking, reading comprehension and writing short descriptive paragraphs.

Prerequisites: ENGL 98
Credit Hours: 0, Lecture Hours: 48, Practical Hours: 0

ENGL 101: English III (Intermediate English)
Students will focus on English at an intermediate level concentrating on the receiver skills of reading and listening and the productive skills of writing and speaking. These will include collocations, tense review, affirmative, negative statements, synonyms and antonyms, time clauses, conditionals, active and passive forms, reported speech, phrasal verbs, reading comprehension with detailed questions, vocabulary and writing developed descriptive and opinion essays.

Prerequisites: ENGL 99
Credit Hours: 1, Lecture Hours: 48, Practical Hours: 0

ENGL 102: English IV (Upper-Intermediate English)
Students will focus on English at an upper-intermediate level concentrating on the receiver skills of reading and listening and the productive skills of writing and speaking. Model verb review, silent letters and proper pronunciation, jobs and careers, requests and offers, more phrasal verbs with vocabulary building, relative clauses and relative pronouns, narrative tenses for writing exercises, wishes and regrets, reading and comprehending longer passages with direct and inference questions of medium difficulty, hypothesizing, and writing fully developed descriptive, argumentative and analytical essays of 350 words.

Prerequisites: ENGL 101
Credit Hours: 1, Lecture Hours: 48, Practical Hours: 0

ENGL 201: English V (Advanced English I)

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

Prerequisites: ENGL 102
Credit Hours: 2, Lecture Hours: 48, Practical Hours: 0

ENGL 202: English VI (Advanced English II)
Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.

Prerequisites: ENGL 201
Credit Hours: 2, Lecture Hours: 48, Practical Hours: 0

NE 101: National Education
In a context of striving towards democracy like the one Jordan enjoys today, the meaning and practice of active and responsible citizenship becomes more crucial. It is often argued that democracy requires "democrats" to flourish and become well established. Democrats are those women and men who recognize pluralism, inclusion, positive engagement, and participation as the main values that govern their interaction with the state as citizens and with each other as diverse people of different interests. In this course you will be able to understand your rights and responsibilities as Jordanian citizen, expand your knowledge about the frameworks, and processes that regulates citizen-state relationships as well as the basic necessary skills for you to practice your citizenship rights in a civic manner.

Prerequisites**:** None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

IC 101: Intercultural Communications
This course is designed to provide prospective students (whose majors have an international flavor) with tools that offer powerful possibilities for improving the communication process. We will examine the process of sending and receiving messages between people whose cultural background could lead them to interpret verbal and nonverbal signs differently. We will learn about the diversity of these cultural differences and at the same time learn how we might overcome them. Our efforts to recognize and surmount cultural differences will hopefully open up business opportunities throughout the world and maximize the contribution of all the employees in a diverse workforce.

Prerequisites**:** None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

SFTS 101: Soft Skills
This course is designed to help develop strong oral and written communication skills. The student will be given opportunities to practice writing and editing professional correspondence and technical reports. Additionally, the

student will compose and deliver oral presentations. Assignments will include the use of inductive and deductive approaches to conveying a variety of messages. The course emphasis the use of software tools to prepare presentations, stress management, confidence, and sensitivity to others. It also stresses on resume writing and conducting interviews.

Prerequisites**:** None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

SE 301: Social Entrepreneurship and Enterprises
This course will serve as an introduction to the field of social entrepreneurship and social enterprises. Through lectures, field visits, analyses of relevant literature, case studies and exercises, this course will explore social entrepreneurship's potentials, opportunities and limitations. The topics will cover: Defining Social Entrepreneurship. Contextualizing Social Entrepreneurship (need, motives, forms, criteria). Role of Leadership, Creativity and Innovation. Locating SE on the profit/non-profit continuum. SE in the larger fields of development, social change, community activism. Social Enterprises (Missions, Markets, Finances). Ethical business and corporate social responsibility.

Prerequisites**:** None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

Courses from Industrial Engineering Department

Compulsory Courses

IE 121: Workshop
General safety, materials and their classifications, measuring devices and their accuracy, theoretical background and practical exercises including, carpentry, welding, mechanical fasteners, drills, lathes, milling machines, and sheet-metal working.

Prerequisites**:** None
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

IE 211: Probability and Statistics
Descriptive statistics, probability concepts, discrete and continuous random variables and distributions, joint probability distributions, covariance and correlation of random variables, point and interval estimation for single sample, sampling distributions, and statistical inference for single sample.

Prerequisites**:** MATH 102
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

Elective Courses

IE 545: Nonlinear Programming
Develop nonlinear models, convex sets and functions, optimality conditions, Lagrangian duality, unconstrained minimization techniques. Constrained minimization techniques covering penalty and barrier functions, sequential quadratic programming and the reduced gradient method.

Prerequisites: Department Approval
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

IE 546: Fuzzy Logic and Neural Networks

Fuzzy set theory, membership functions, fuzzification, fuzzy decision-making systems and types, fuzzy logic controllers. Methods and techniques of neural networks. Single-layer and multi-layer feed forward networks, recurrent networks, Supervised and unsupervised learning. Neural network controllers. Adaptive neural fuzzy inference system (ANFIS). Use of software such as Matlab.

Prerequisites: Department Approval
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

Courses from the Mechatronics Engineering Department

ME 111: Computer Aided Engineering Drawing
The Use of computer aided software in drawing such as AutoCAD. Geometric constructions. Orthographic and Isometric projections; Sketching, sectioning, dimensioning and layering. Model layout (wire-frame, surface, and solid modeling), plotting to scale, blocks and attributes, Introduction to descriptive geometry, perspective drawing. Engineering applications.

Prerequisites**:** None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ME 343: Automatic Control System
Modeling of electrical, pneumatic, hydraulic and mechanical systems, Transfer functions, block diagrams, and signal flow graph. Time domain analysis, test signals, transient response, steady state error and stability. Root locus, bode plots, PID control, phase-lead, phase lag. Software application such as MATLAB and Simulink.
Practical experience on several physical setups designed to teach the principles of automatic control systems, including systems modeling, controller simulation, as well as, sensors and actuators interface and control. Most of the setups are programmed using MATLAB and Simulink, where the students will develop and simulate numerical models and controllers and test their behavior on the physical setup.

Prerequisites**:** CE 331
Credit Hours: 4, Lecture Hours: 48, Practical Hours: 48

Courses from the Biomedical Engineering Department

BM 371 Numerical Methods for Engineers
Fundamentals of error analysis, numerical solutions of linear and nonlinear equations, numerical solution of system of equations, curve fitting, numerical integration and differentiation, numerical solution of ordinary differential equations. Application of numerical methods using relevant software packages.

Prerequisites**:** MATH 205, CS116.
Credit Hours: 4, Lecture Hours: 48, Practical Hours: 0