4D. ELECTRICAL ENGINEERING COURSE DESCRIPTIONS

4D.1. University and Faculty Requirements' Course Descriptions

Refer to Section#2.

4D.2. EE Specialty and Sub-Specialty Requirements' Courses

EEDxxx Courses

EED201	Electrical Circuits 1	4 CH (3,2,1)
Course Contents	Basic electrical quantities, Ohm's Law, Kirchhoff's Laws, Resistance and source combinations, Voltage and current division, Y-Δ transformation. Techniques of solving DC electric circuits: nodal and mesh analysis, source transformation. Circuit theorems: superposition, Thevenin, Norton and Maximum power transfer. AC sinusoidal sources, Time domain and phasor representation, Inductance and capacitance: Voltage and current relationships, Impedance and admittance, Voltages and currents phasor diagrams, Techniques of solving AC electric circuits: Nodal analysis, Mesh analysis, and source transformation. Theorems: superposition, Thevenin, and Norton. Steady state power analysis.	
Prerequisite (s)	EMP122	
Textbook	C.K. Alexander and M.N.O. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill, 5th edition, 2013.	
Lab./Computer work/Project	**Exp. 1:** Basic measurements and basic laws. **Exp. 2:** Theorems of electric circuit analysis.	

EED202	Electrical Circuits 2	3 CH (2,2,1)
Course Contents	Transient analysis in R-L, R-C, And RLC In DC Circuits. Three phase circuits; Y-Y, Δ-Δ, Y-Δ, Δ-Y Connections, Transformations, Power measurements. Magnetically coupled circuits: Linear transformer equivalent circuits, Ideal transformer. Frequency response: Series and parallel resonance circuits, Quality factor. Two port networks.	
Prerequisite (s)	EED201	
Textbook	C.K. Alexander and M.N.O. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill, 5th edition, 2013.	
Lab./Computer work/Project	**Exp. 1:** Transient Analysis of RL, RC, and RLC Circuits. **Exp. 2:** Three-phase circuits.	

EED210	Electronics	3 CH (2,2,1)
Course Contents	Models and characteristics of ideal and practical diodes. Diode circuit applications. Special diode types. MOSFET and BJT transistors: basic structure, I-V characteristics, DC circuits, transistor as an amplifier and a switch, small signal operation and models, amplifier configurations, Biasing circuits. Single stage integrated circuits amplifier.	
Prerequisite (s)	EED201 & EMP221	
Textbook	Adel S. Sedra, and Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press.	
Lab./Computer work/Project	**Exp. 1:** Equipment Familiarization: Establishing and Displaying Characteristics in AC Technology. **Exp. 2:** CAD tool familiarization. **Exp. 3:** Characteristics of different diodes. **Exp. 4:** Diode applications. **Exp. 5:** Single-stage amplifier circuits. **Exp. 6:** Simulation of selected Diode applications and transistor circuits.	

EED220	Logic Design	3 CH (2,2,1)
Course Contents	Digital systems, binary numbers, and coded number systems. Boolean algebra, canonical and standard forms, and digital logic gates and their integrated circuits. Gate-Level Minimization, and the map method for simplification and implementation. Combinational logic circuits: Analysis procedure, design procedure, binary adder–subtractor, binary multiplier, magnitude comparator, decoders, encoders, and multiplexers. Sequential logic circuits: Latches and Flip-Flops, analysis of clocked sequential circuits, and design procedure. Registers, counters, Memory, memory decoding, and programmable devices. Selected applied design examples with standard integrated circuits (ICs).	
Prerequisite (s)	CSC 101	
Textbook	M. Morris Mano, and Michael D. Ciletti; "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog"; 6th Edition; Pearson; 2018.	
Lab./Computer work/Project	**Exp. 1:** Some applications of basic logic gates **Exp. 2:** Applications of finite state machine. **Exp. 3:** Applications of finite state machine. **Course Project:** Design, implementation, and simulation of suggested circuits by the instructor.	

EED230	Signals & Systems	3 CH (2,2,1)
Course Contents	Continuous-time and discrete-time signals and systems. Linear time-invariant (LTI) systems: system properties, convolution sum and the convolution integral representation, system properties, LTI systems described by differential and difference equations. Fourier series: Representation of periodic continuous-time signals. Continuous time Fourier transform and its properties: Time and frequency shifting, conjugation, differentiation and integration, scaling, convolution, and the Parseval's relation. Case studies using S/W tools (e.g. MATLAB).	

Prerequisite (s)	EED201 & EMP213
Textbook	B. P. Lathi, "Linear Systems and Signals".
Lab./Computer work/Project	Solve related problems using S/W tools (MATLAB for example).

EED301	**Measurements & Instrumentation**	**3 CH (2,1,2)**
Course Contents	Introduction to Units, Standards, and Measurements Errors. Electromechanical Instruments and DC meters. Resistance, Inductance and Capacitance measurements and DC/AC bridges. Digital Basic Instruments, Digital counters, A/D & D/A converters. Digital measuring instruments: digital multimeters and frequency meters. Cathode Ray Oscilloscopes and its applications in phase and frequency measurements, Digital Storage Oscilloscopes, Signal Generators and Spectrum Analyzer. Introduction to Sensors: Electromechanical sensors, temperature sensors, light sensors, and biomedical sensors	
Prerequisite (s)	EED220 & EED201	
Textbook	David A. Bell, "Electronic Instrumentation and Measurements", OXFORD University Press.	
Lab./Computer work/Project	**Exp. 1:** Analog multi-meter applications: Voltmeter, Current meter, Ohmmeter and power meter. **Exp. 2:** Measurement of Resistance using bridges. **Exp. 3:** Digital multi-meter applications: Voltmeter, Current meter, Ohmmeter and power meter. **Exp. 4:** Cathode Ray Oscilloscope applications: Volt, phase, time and frequency measurements. **Exp. 5:** Digital Oscilloscope applications: Volt, phase, time and frequency measurements. **Exp. 6:** Signal generator applications: Signal amplitude and frequency measurements. **Exp. 7:** Spectrum analyzer applications: Signal amplitude and frequency measurements. **Exp. 8:** Electromechanical, Temperature and Light transducers. **Course Project:** Design and implementation of instruments suggested by the instructor.	

EED302	**Control Systems**	**3 CH (2,2,1)**
Course Contents	Introduction to feedback control systems. Block diagram reduction. Steady-state error. Transient response analysis: maximum overshoot, settling time, rise time and peak time. System stability and Routh's criterion. Root-Locus analysis: asymptotes, breakaway points, angles of departure. Design of PID controller using root-locus. Frequency response analysis techniques and Bode diagrams. Design of series compensators using Bode Diagrams. Applications using Matlab.	
Prerequisite (s)	EED230 & EMP214	
Textbook	Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Pearson, 2010.	
Lab./Computer work/Project	**Exp. 1:** Feedback control systems. **Project**: MATLAB-based design of a PID controller for a dynamic system under assigned specifications	

EED303	Digital Control Systems	3 CH (2,2,1)
Course Contents	Fundamentals of discrete-time system: Difference equations, z-Transform solution of difference equations, Convolution summation and convolution theorem, Frequency response. Modeling of digital control systems: ADC, DAC, ZOH, Transfer function of a cascade, Closed-loop transfer function, Steady-state error. Stability of digital control systems: Pole locations, Stability conditions, Routh-Hurwitz criterion, Jury test. Digital Control System design: Root locus, control system design, Digital implementation of analog controllers. State-space representation: Canonical forms, Solution of state-space equations, Transfer function matrix, Solution of state-space equations, Controllability, Observability. State feedback control: State and output feedback, Pole placement, State estimation, Observer state feedback.	
Prerequisite (s)	EED302	
Textbook	M. Sami Fadali, and Antonio Visioli, "Digital Control Engineering - Analysis and Design", Second Edition, Elsevier Inc., 2013.	
Lab./Computer work/Project	**Course Project**: MATLAB-based design of a digital controller for a dynamic system under assigned specifications	

EED311	Electronic Circuits	4 CH (3,2,1)
Course Contents	Differential pair, small signal operation of the differential amplifier, multistage amplifiers. Frequency response of amplifiers, Bode plot. Feedback: General structure and topologies. Operational Amplifier: function and characteristics, configurations, application circuits. Oscillators and Multivibrators: concept of oscillations, OPAMP oscillators, and the 555 timer.	
Prerequisite (s)	EED210	
Textbook	Adel S. Sedra, and Kenneth C. Smith, "Microelectronic Circuits", Oxford University.	
Lab./Computer work/Project	**Exp. 1:** Differential and multistage amplifier. **Exp. 2:** OPAMP applications. **Exp. 3:** Oscillators and 555 application circuits. **Course Project:** Design, implementation, and simulation of circuits suggested by the instructor.	

EED312	Integrated Circuits Devices	3 CH (2,2,1)
Course Contents	Semiconductor fundamentals review: Energy-band model, PN junction diodes. MOS capacitor: Energy-band diagrams, Capacitance, non-idealities, Threshold voltage adjustment. MOSFET: Structure and operation, Long-channel I-V relationship, Small-signal model, Velocity saturation (short-channel effects, scaling). Silicon device fabrication technology: CMOS technology, SOI technology. Charge-Coupled Devices. BJT: Fundamentals, Ebers-Moll model, Base-width modulation, Early voltage, non-ideal effects, Charge control model, Base transit time, Small-signal model, Transient response. Introduction to FinFET and Carbon Nanotubes. Basics of solar cells. MOSFET and BJT PSpice models.	
Prerequisite (s)	EMP221	

Textbook	Chenming Hu, "Modern Semiconductor Devices for Integrated Circuits", Prentice Hall, recent edition. **Reference Book**: D.A. Neamen, "Semiconductor Physics & Devices", McGraw-Hill, recent edition.
Lab./Computer work/Project	**Exp. 1:** Estimating the diode parameters from I-V characteristics. **Exp. 2:** Simulate the I-V characteristics for bulk, and SOI Field Effect Transistors. **Exp. 3:** Simulate the nanoscale multigate-FET structures (FinFET and nanowire). **Project Work:** Design a certain device with specific parameters and technology to meet specified performance requirements within some practical design constraints.

EED320	**Computer Organization**	**3 CH (2,2,1)**
Course Contents	Basic computer design and architecture: Design at the register transfer level, instruction codes, computer registers, timing and control, instruction cycle, memory-reference instructions, input-output, interrupt, and design of the accumulator logic, and arithmetic-logic-shift unit. Memory Hierarchy (internal, external, and cache memory). Principles of hardware design using hardware description language, and design process of digital circuit simulation including special effects; circuit design, routing, delay, and meta stability. Design examples with field programmable gate array (FPGA) chips.	
Prerequisite (s)	EED220	
Textbook	M. Morris Mano, "Computer System Architecture", Prentice Hall, International edition.	
Lab./Computer work/Project	**Exp. 1:** Programming of the input/output (I/O) Interface. **Exp. 2:** Programming of the Seven Segment Display. **Exp. 3:** Programming of the Scanning the keyboard. **Course Project:** Design and implement based on FPGA tool (Xilinx, for example), specific control circuits in the area of the course.	

EED321	**Microcontroller-based Systems**	**3 CH (2,2,1)**
Course Contents	Introduction to Microcontrollers and Embedded Systems; Microcontroller: Architecture, Programming Model, Instruction Set, Exception Handling, Interrupt Controller, Efficient Embedded Programming, Memory structure and Systems. Bus Interfaces, Integrated Circuit Interfacing, support chips. Data Converters. Application-level embedded system design concepts.	
Prerequisite (s)	EED320	
Textbook	1-Brey, Barry B., "The Intel microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium, Pro processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit extensions: architecture, programming, and interfacing", Pearson Prentice Hall™. 2- Muhammad Ali Mazidi, Danny Causey, and Rolin McKinlay, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18," 2nd Edition, Pearson (Prentice Hall), 2016.	
Lab./Computer work/Project	**Exp. 1:** Basic programming examples using assembly language of the memory Interface with a specific microprocessor. **Exp. 2:** Basic programming examples using assembly language of the I/O Interface with a specific microprocessor.	

	Exp. 3: Programming of basic I/O Interface with a specific microcontroller. **Course Project:** Design and implementation of a suggested application on either a specific microprocessor or a specific microcontroller by the instructor.

EED330	Analog Communication Systems	3 CH (2,2,1)
Course Contents	History of communication. Analog communication systems: Block diagram, Transmission media, Frequency bands, Channel capacity and Data rate. Review of signals and systems: Energy and power spectral densities (internal and external noise sources, noise figure, noise temperature, composite noise figure and composite noise temperature). Linear and nonlinear distortion. Link budget analysis. Amplitude modulation and demodulation (AM, SSB, DSB and VSB). Angle modulation and demodulation (PM and FM). FDM Systems. Broadcasting transmitters and receivers (AM, SSB, and FM). Automatic Gain Control (AGC). Automatic frequency control (AFC).	
Prerequisite (s)	EED230	
Textbook	B.P Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press, recent edition.	
Lab./Computer work/Project	**Exp. 1:** Modulation and Coding Principles, kit familiarization. **Exp. 2:** Amplitude Modulation waveforms and spectrum demo. **Exp. 3:** Modulation index measurements using waveform and spectrum of a modulated signal. **Exp.** 4: FM spectrum, tone modulation, the effect of modulating frequency f_m and modulation index β **Exp. 5:** AM radio transmitter and receiver demo and signal inspection. **Exp. 6**: Implementation of analog communication System using MATEXP.	

EED331	Electromagnetic Fields	3 CH (2,2,0)
Course Contents	Different coordinate systems. It is divided in two parts: **Stationary electric field:** force between electric charges. Coulomb's law. The electric field arising from different charge distribution- definition of electric flux and electric flux density- Gauss' law, and divergence theorem- electrostatic potential - gradient of potential- electric dipole- Laplace's and Poisson's equations- stored energy and capacitors- material electrical properties. **Stationary magnetic fields:** magnetic flux and flux density- Ampere' law- magnetic field intensity- field of wire carrying current- magnetic flux of solenoid- inductance- magnetic circuit- curl of a vector – curl of magnetic field- divergence of magnetic flux density- Stoke' theorem- magnetic field energy- magnetic materials.	
Prerequisite (s)	EMP311	
Textbook	William Hayat, and John Buck, “Engineering Electromagnetics”, McGraw Hill.	
Lab./Computer work/Project	N/A	

EED332	Digital Signal Processing	3 CH (2,1,1)
Course Contents	Sampling and Reconstruction of continuous time signals. Discrete time convolution, Z-transforms: Analysis, Properties, and System stability. The Discrete Fourier transform: Analysis, Properties, Circular convolution, and Overlap-Add and Overlap-Save Filtering. The Fast Fourier transform. Multi-rate signal processing (decimation and interpolation). Infinite Impulse Response and Finite Impulse Response digital filters design.	
Prerequisite (s)	EED230	
Textbook	Alan V. Oppenheim & Ronald W. Schafer, "Discrete-Time Signal Processing", Prentice-Hall, Signal Processing Series, recent edition.	
Lab./Computer work/Project	**Exp. 1:** Sampling and Quantization. **Exp. 2:** Fast Fourier Transform. **Exp. 3:** FIR filters. **Exp. 4:** Audio Effects.	

EED333	Electromagnetic Waves	3 CH (2,2,0)
Course Contents	Lumped and distributed elements circuits. Characteristics of the TL: Distributed parameters, Propagation constant, Attenuation constant, Characteristic impedance. Wave reflection, Input impedance and transmission. Voltage Standing Wave Ratio (VSWR). The Smith chart applications. Single stub line matching on Smith chart. Time harmonic wave equation. The wave equation (time harmonic, general medium). Polarization of electromagnetic waves. The reflection coefficient. Brewster angle for the vertical polarized waves. Atmospheric refraction of electromagnetic waves. Standard parameters of the troposphere. The refractive index. Health and safety standards. The wave propagation on a lossy and lossless TL.	
Prerequisite (s)	EED331	
Textbook	William Hayat, and John Buck, "Engineering Electro Magnetics", Mc-Graw Hill, recent edition.	
Lab./Computer work/Project	Matching Using Smith Chart.	

EED334	Communication Systems	2 CH (2,1,0)
Course Contents	Simplified block diagram, transmission media, signal impairments. SNR, and channel bandwidth, Shannon's equation. Analog and digital messages. Amplitude modulation and demodulation techniques, Angle modulation and demodulation (PM and FM), Broadcast transmitters and receivers (AM and FM). Principles of digital data transmission: Digital communication system: Sampling Theorem, A/D techniques-Optical fiber communication system, OPGW Cable System	
Prerequisite (s)	EED230	
Textbook	B.P Lathi, "Modern Digital and Analog Communication Systems", Fourth edition, Oxford University Press, 2010.	
Lab./Computer work/Project	None	

EED340	Electrical Power Engineering	3 CH (2,2,0)
Course Contents	Composition of Electrical Power Systems: generation, transmission, sub-transmission, distribution and loads. Single-Line Diagrams. Load characteristics: daily load curve, load duration curve, maximum and average loads, load, capacity, utilization, and diversity factors. Economics of power generation: fixed cost, depreciation, running cost. Tariffs and power factor improvement. Per-Unit system. Fault analysis: System modeling under fault conditions, Symmetrical faults. Circuit breakers and switchgear.	
Prerequisite (s)	EED202	
Textbook	1- Gupta, B R, "Generation of Electrical Energy", Seventh Edition, New Dwlhi : S. Chand Publishing, 2017. 2- Hadi Saadat, "Power System Analysis", Third edition, PSA publishing, 2011.	
Lab./Computer	N/A	

EED341	Electrical Power Transmission & Distribution	3 CH (2,2,0)
Course Contents	Transmission Systems: Different types of transmission systems, Economics of transmission systems. Electric parameters of transmission lines: Series resistance, Series inductance, Shunt capacitance. Models of transmission lines: Representation of short, medium and long transmission lines. Performance of Transmission lines: Voltage and current relations, Voltage regulation, Power calculation efficiency for the sending and receiving ends, Efficiency of transmission lines. Layout of distribution systems	
Prerequisite (s)	EED340	
Textbook	1- J. Glover, M. Sarma, T. Overbye, "Power System Analysis and Design", 5th Edition, Cengage Learning, 2012. 2- v.k.mehta & rohit Mehta, "principles of power system", 4th Edition, S.Chand Publications, 2008	
Lab./Computer	N/A	

EED342	High Voltage Engineering	3 CH (2,2,0)
Course Contents	Introduction to high voltage systems: Need and limitations. Generation and measurement of high voltage for testing: Generation of sinusoidal waves, Impulse generators, Specifications of high voltage laboratories. Insulators for transmission lines and substations. Insulator materials: Shapes and types, Factors affecting performance of insulators, Destructive and non-destructive insulation tests. Electrical breakdown in gases: Ionization and attachment coefficients, Electro-negative gases. Electrical breakdown in liquids and solids. Corona discharge. Single and three-core cables: Electrical stresses in cables, Equivalent circuits, High voltage cables, Thermal properties of cables. Earthing system: Soil resistivity, Ground resistance measurement.	
Prerequisite (s)	EED331 & EED340	
Textbook	E. Kuffel, W.S. Zaengl, J. Kuffel, "High Voltage Engineering Fundamentals", Second edition, Newnes, 2000.	
Lab./Computer work/Project	A course paper on one of the contemporary technologies and/or approaches relevant to the course topics is to be prepared by the student	

EED350	DC & Synchronous Machines	3 CH (2,2,1)
Course Contents	Magnetic systems: Simple systems, Complex systems. **DC Machine**: Construction. **DC Generator**: EMF equation, Equivalent circuit, Load characteristics, Efficiency, and testing. **DC Motors**: Torque equation, Equivalent circuit, Load characteristics , Efficiency, Testing, Starting and speed control. **3-ph Synchronous Generators**: Stator Design. Types of rotors, EMF equation, winding factor. Equivalent circuit, Characteristics and testing. Voltage regulation methods. Power angle (P-δ) characteristics. Loading conditions. **3-ph Synchronous Motor**: Equivalent circuit, loading conditions. **3-ph Salient Generators**: Equivalent circuit. Power angle (P-δ) characteristics.	
Prerequisite (s)	EED340	
Textbook	Chapman, S. J., "Electric Machinery fundamentals", McGraw Hill Co., 4th edition, 2005.	
Lab./Computer work/Project	**Exp. 1**: Characteristics of a separately excited DC generator. **Exp. 2**: Characteristics of a DC shunt motor. **Exp. 3**: Determination of the equivalent circuit parameters of a 3-phase synchronous machine. **Exp. 4**: Characteristics of a 3-phase alternator.	

EED351	Power Electronics 1	3 CH (2,2,1)
Course Contents	Introduction to power electronics. Characteristics of Power electronics devices: Diodes, Thyristors, BJTs, MOSFETs, IGBTs. Power computation in power electronics circuits. Rectifier circuits: Single phase rectifier circuits (uncontrolled, and fully controlled), Single phase rectifier circuits with free-wheeling diodes, Three phase rectifier circuits (uncontrolled, and fully controlled).	
Prerequisite (s)	EED210, EED202	
Textbook	D. W. Hart, **"**Power Electronics", 1st edition, McGraw Hill, 2011.	
Lab./Computer work/Project	**Exp. 1**. Single Phase Rectifiers. **Exp. 2**. Three Phase Rectifiers.	

EED361	Advanced Computer Programming	3 CH (2,0,2)
Course Contents	Data structures, Encapsulation, Abstract data types, Interfaces, and Algorithms for sorting and searching. You will get a taste of Software Engineering, the design and implementation of large programs.	
Prerequisite (s)	EED160	
Textbook	Kathy Sierra and Bert Bates, Head First Java, second edition, O'Reilly, 2005. ISBN # 0-596-00920-8. **Reference Book:** Michael T. Goodrich and Roberto Tamassia, Data Structures and Algorithms in Java, fifth edition, John Wiley & Sons, 2010. ISBN # 0-470-38326-7.	
Lab./Computer work/Project	**Exp. 1:** Setup: Setting Up Your Computer. **Exp. 2:** Defining and using classes and fields, and with conditionals and recursive functions.	

	Exp. 3: Practice with linked lists. **Exp. 4:** Demonstration of how a sentinel node can simplify a doubly-linked list implementation. **Exp. 5:** Practice writing code that uses inheritance and Java interfaces. **Exp. 6:** Introduction to Java's built-in facilities for exception handling.

EED381	**Data Communication**	**3 CH (2,2,1)**
Course Contents	Analog communication systems: Amplitude modulation and demodulation; Angle modulation and demodulation. Digital communication: Pulse modulation; TDM; Line Codes; Error Probability Performance for binary systems. Basics of data communications and computer networks. Timing diagrams and calculation of total delay. Addressing in computer networks: Port; MAC and IP address of IPv4 and IPv6. Network layered models: 7-Layers and 5-layers models. Protocols in TCP/IP models. Error control. Examples: LAN, WLAN, …etc.	
Prerequisite (s)	EED230	
Textbook	B.P Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press, recent edition. Behrouz Frouzan, "Data communications and Networking", McGraw-Hill, recent edition.	
Lab./Computer work/Project	**Exp. 1:** Amplitude Modulation waveforms and spectrum demo. **Exp. 2:** Analog and Digital Modulation formats. **Exp. 3:** Line Coding. **Exp. 4:** Identifying the important Windows networking utilities. **Exp. 5:** Packet sniffing. **Exp. 6:** Address Resolution Protocol (ARP). **Exp. 7:** Internet Protocol.	

EED401	**Electrical Installations**	**2 CH (2,1,0)**
Course Contents	Electrical Safety: Effect of current on the human body, Electric shock, Arc flash hazards, Fires. Standards, codes and regulations: IEC 60364, Egyptian code, NEC. Earthing in low voltage systems. Protection against direct contact: Enclosures, Degree of protection IP code. Protection against indirect contact: Residual current device (RCD), Automatic disconnection of supply for TN, TT and IT systems. Protection against fire: Arc fault detection device AFDD. Lighting circuits: Different lamp technologies, Design of indoor lighting system, DIALux program, Design of outdoor lighting (streets/sports area). Wiring systems: estimation of load current, Conductor sizing, Verification of voltage drop, Calculation of short circuit current, Selection of protective device.	
Prerequisite (s)	EED340	
Textbook	Schneider Electric, "Electrical Installation Guide According to IEC Int. Standards", 2016	
Lab./Computer work/Project	N/A	

EED402	Energy Management	2 CH (2,1,0)
Course Contents	Efficient energy management and operation of buildings. Energy conservation opportunities and revision of industrial systems: Generation, Lighting, Compressed air, Fans and pumping water, Air conditioning and water-cooled systems. Understanding utility rates and programs. Introduction to various thermal facilities for industrial systems. Energy management of industrial systems. Efficient operation of industrial systems. General principles for implementing and assessing energy management programs.	
Prerequisite (s)	EED340	
Textbook	Craig Smith, Kelly Parmenter "Energy Management Principles", Second edition, Elsevier publishing, 2015.	

EED403	Power Quality	2 CH (2,1,0)
Course Contents	Terms and Definitions: General classes of power quality problems, Transients, Long-duration voltage variations, Short-duration voltage variations, Voltage fluctuation, Flickers, Power frequency variations, CBEMA and ITI Curves. Voltage Sags and Interruptions: Sources of sags and interruptions, Analysis of voltage sag, Benchmarking, Mitigation. Fundamentals of Harmonics: Harmonic distortion, Voltage versus current distortion, Harmonic indices, Harmonic sources from commercial loads, Harmonic sources from industrial loads, Locating harmonic sources, Benchmarking, Mitigation.	
Prerequisite (s)	EED340	
Textbook	Surya Santoso, "Fundamentals of Electric Power Quality", Winter 2012 Edition, 2012.	
Lab./Computer work/Project	N/A	

EED404	Smart Grids	2 CH (2,1,0)
Course Contents	Introduction to smart grid. Elements of the power grid and measurement technologies: Generation, transmission, Distribution, and end-user. Basic concepts of Wide area monitoring system (WAMS): Advanced metering infrastructure (AMI), and phasor measurement units (PMU). Elements of communication and networking: Architectures, Standards and adaptation of power line communication (PLC), Machine to machine communication models for the smart grid. Home area networks (HAN) and neighborhood area networks (NAN). Elements of distributed energy resources (DER) and grid integration: Renewable energy, Energy storage, Solar energy, Wind energy, Biomass, Hydropower, Geothermal and fuel cell, Electric vehicles (EVs). Elements of management: Aspects of energy management in the smart grid, SCADA, Micro grids.	
Prerequisite (s)	EED441 & EED334	
Textbook	James Momoh, "Smart Grid Fundamentals of Design and Analysis", Wiley, 2012.	
Lab./Computer work/Project	N/A	

EED405	Utilization of Electric Energy	2 CH (2,1,0)
Course Contents	Electric lighting technology and harmonics suppression. Heating, electric welding and electric furnaces. Electrochemical processes: Electroplating, Metal extraction. Electrical transport systems: Elevators, Electrical stairs, Electric cars, Trains. Energy efficiency technologies in electrical systems.	
Prerequisite (s)	EED340	
Textbook	E. Openshaw Taylor and V. V. L. Rao, "Utilization of Electric Energy", Universities Press, 2009.	
Lab./Computer work/Project	N/A	

EED410	Digital Integrated-Circuits	3 CH (2,2,1)
Course Contents	Review of CMOS processing technology: Terminologies, and Design rules. Analysis and implementation of CMOS inverter. Design of static/dynamic combinational gates (optimizing the speed, area, or power and their applications). The influence of interconnect parasitic on circuit performance and approaches to mitigate their effects. Design and analysis technique of static/dynamic sequential circuits (clocking approaches and memories). Examination of design methodologies.	
Prerequisite (s)	EED312 & EED320	
Textbook	Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic "Digital Integrated Circuits," Prentice-Hall, recent edition.	
Lab./Computer work/Project	**Exp. 1:** CAD tool familiarization **Exp. 2:** Static/Dynamic Behaviour of CMOS Inverter **Exp. 3:** Static digital Circuits. **Exp. 4:** Dynamic digital Circuits. **Project Work:** Design full-custom digital integrated circuit using CAD tools.	

EED411	Electronic-Circuits for Communication	3 CH (2,2,1)
Course Contents	Analysis and design of electronic circuits for communication systems. Voltage multipliers: Structure, Phase detectors and AM modulators. Active filters: Design techniques, Filter realization of the RLC filter, First- and second-order RC section, Positive and negative feedback topologies. The inductor simulation. Frequency-dependent negative resistance. Power amplifier design and applications: Classifications, Classes A, B and AB, and conversion efficiency. Sinusoidal Oscillators: RC, LC, Crystal, Ring, and Voltage Controlled Oscillators. Introduction to Phase-Locked Loop.	
Prerequisite (s)	EED311	
Textbook	Frank R. Dungan, "Electronic Communications Systems", PWS Publishers, recent edition.	
Lab./Computer work/Project	**Exp. 1:** Analyzing Gilbert cell. **Exp. 2:** Simulating different types of filters. **Exp. 3:** Simulating different types of Oscillators **Project Work:** Design of communication systems formed from two (or several) transmitters and tuneable receiver. The results might be verified using PSpice simulation.	

EED412	Analog Integrated Circuits	3 CH (2,2,1)
Course Contents	Revision of CMOS processing technology and device characteristics. Layout & Matching Techniques. Transistor models in high frequency. Current mirrors. Single-ended amplifiers. Differential amplifiers. Operational amplifiers. Frequency response. Feedback theory. Stability analysis. Circuit non-idealities and noise. Output stages. D/A and A/D. CAD tools for circuit analysis and design.	
Prerequisite (s)	EED411	
Textbook	Behzad Razavi, "Design of Analog CMOS Integrated Circuits," McGraw-Hill, recent edition.	
Lab./Computer work/Project	**Exp. 1:** CAD tool familiarization. **Exp. 2:** Single-ended amplifier simulation. **Exp. 3:** Layout. **Project Work:** Using CAD tool to analyze and design of more advanced analog building block.	

EED413	Microwave Devices	2 CH (2,0,1)
Course Contents	Vacuum tube devices: The construction, Operation principles, Mathematical analysis, and Power calculation of the magnetron (crossed field tube), Klystron (velocity modulated tube), and The travelling wave tube. Solid state devices: The Gunn oscillator, The IMPATT diode, and Microwave amplifier.	
Prerequisite (s)	EED434	
Textbook	Samuel Liao, "Microwave Devices and Circuits ", Pearson, recent edition.	
Lab./Computer work/Project	**N/A**	

EED414	RF Circuits and Systems	2 CH (2,0,1)
Course Contents	Basic concepts: Harmonic and intermodulation distortion, Intercept point noise, Sensitivity and Dynamic range, Impedance matching. Low noise amplifiers (LNAs) and mixers: Bipolar and CMOS LNAs, Passive and active mixers, Noise in mixers, Image rejection. Oscillators: LC oscillator circuits, Phase noise, Bipolar and CMOS implementations, Generating quadrature pulse. Frequency synthesizers: Frequency synthesis PLLs, Frequency divider and Prescaler circuits. Power amplifiers: Efficiency vs. linearity, Linear PAs, Nonlinear PAs, Linearization methods. RF transceiver architectures: Heterodyne and direct conversion receivers, Transmitters.	
Prerequisite (s)	EED311	
Textbook	B. Razavi, "RF Microelectronics", Prentice-Hall, recent edition.	
Lab./Computer work/Project	**Exp. 1:** LC oscillator **Exp. 2:** Power amplifiers **Project Work:** Design a specified CMOS receiver.	

EED415	VLSI Testing and Design for Testability	2 CH (2,0,1)
Course Contents	Introduction to testing of digital electronic circuits and systems: Faults and fault modeling, Automatic test equipment (ATE), Automatic test pattern generation and Test compaction of combinational and sequential logic circuits. Fault simulation and its application to the fault diagnosis. Design for testability (full and partial internal scan, boundary scan, and logic-built-in self-test (LBIST)). Memory test techniques and memory-built-in self-test (MBIST). Delay test and at-speed test techniques. Introduction to the testing of analog and mixed-signal circuits.	
Prerequisite (s)	EED410	
Textbook	N. K. Jha and S. Gupta, "Testing of Digital Systems", Cambridge University Press, recent edition.	
Lab./Computer work/Project	Integrating several assignments/experiments in the applications of the testing and design for testability in electronic circuits.	

EED416	VLSI Design Automation	2 CH (2,0,1)
Course Contents	VLSI CAD Flow. Brief Exposition of Logic Synthesis and Tech. Mapping, Chip Layout Styles. High-Level Synthesis. Algorithmic Approaches Commonly used for VLSI CAD Problems. VLSI and Circuit Design Issues: Power and delay analysis and minimization, Partitioning, Floor-planning, Placement, Global and Detailed Routing.	
Prerequisite (s)	EED410	
Textbook	S.M. Sait and H. Youssef, "VLSI Physical Design Automation", World Scientific Publishing Company, recent edition.	
Lab./Computer work/Project	**Exp. 1:** Placement and Routing. **Exp. 2:** Design issues. **Exp. 3:** Timing-Driven Partitioner **Project Work:** Applications suggested by instructor.	

EED417	Optical Electronics	2 CH (2,0,1)
Course Contents	Introduction. Photons and Electrons-Maxwell's equations. Wave nature of light, fundamentals of optics. Interaction of radiation and atomic systems. Particle/wave property. De-Broglie wavelength. Uncertainty principle-optical coherence and correlation. Radiation and solids. Light and matter (light propagation in uniform dielectric medium, Rayleigh scattering, susceptibility, optical dispersion). Rate equations and gain medium for two level system. Theory of laser oscillation: Fabry-Perot laser, Three-level system, and four level system. Optical Sources: Gas Laser, Nd-YAG Laser, and Semiconductor sources (LEDs and LDs). Optical Modulators. Photo detectors (PINs and APDs).	
Prerequisite (s)	EMP221	
Textbook	Alan Rogers, Chapman and Hall, "Essentials of optoelectronics with applications", McGraw Hill, recent edition.	
Lab./Computer work/Project	**Exp. 1:** LED characteristic. **Exp. 2:** FSR of a laser diode. **Exp. 3:** Polarization effect on detection.	

EED420	Real-time Embedded Systems	3 CH (2,0,3)
Course Contents	This course introduces students: Basics of models, Analysis tools, and Control for embedded systems operating in real time. Students learn how to combine physical processes with computation. Topics include: Models of computation, Control, Analysis and verification, Interfacing with the physical world, Mapping to platforms, and Distributed embedded systems. The course has a strong Exp.oratory component with emphasis on a semester-long sequence of projects.	
Prerequisite (s)	EED321	
Textbook	E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems- A Cyber-Physical Systems Approach, Second Edition", 2nd Edition, 2015. **References Book**: Chapman, S. J., "Electric Machinery fundamentals",McGraw Hill, 4th edition, 2005.	
Lab./Computer work/Project		

EED421	Advanced Computer Hardware	2 CH (2,0,1)
Course Contents	Selected topics in recent developments in computer hardware design will be presented in this course. Course material will reflect the needs of the graduating students.	
Prerequisite (s)	EED320	
Textbook	Richard Y. Kain, "Advanced Computer Architecture: A Systems Design Approach", Recent Edition.	
Lab./Computer work/Project	**N/A**	

EED423	Introduction to Robotics	2 CH (2,0,1)
Course Contents	Robotics overview and applications. Homogeneous vector and plane. Homogeneous transformation. Position and orientation transformations. Kinematics and inverse kinematic solutions of robot manipulators and mobile robot. Robot programming using standard S/W robotics tools (MATEXP.) Implementation the right industrial robotics system for a plant.	
Prerequisite (s)	EED320	
Textbook	Saeed Niku, "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, recent edition	
Lab./Computer work/Project	**Exp. 1:** Design and plan one-axis rotation, Euler-angle rotation. **Exp. 2:** Path planning of industrial robots. **Exp. 3:** Mobile robot path planning. **Project Work:** Robot programming using standard S/W robotics tools (MATEXP.) and implementation.	

EED424	Intelligent Control Systems	3 CH (2,1,1)
Course Contents	The course provides a general introduction to intelligent systems, provide examples of rule-based control systems, describes design requirements of intelligent controllers. studies a range of methodologies for specifying and designing intelligent systems. understands control methodologies developed using soft computing tools such as fuzzy logic, neural nets and Gas, and describes and apply systems engineering methods and techniques in the design and analysis of intelligent control systems for mechatronics applications.	
Prerequisite (s)	EED471	
Textbook	Ali Zilouchian& Mo Jamshidi, Intelligent Control Systems Using Soft Computing Methodologies, CRC Press.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED430	Digital Communication Systems	2 CH (2,1,0)
Course Contents	Introduction to Digital communication. Sampling theorem. Pulse modulation. Analog to Digital Convertors: PCM, DPCM, ADPCM, and DM. Sampling. Quantization and Encoding. Signal to Quantization Noise Ratio. TDM (principles, framing bits, synchronization and signaling, total bit rate). Line Codes: Pulse shaping. Inter symbol interference ISI. Nyquist First Criterion. Introduction to Information Theory. Detection of Binary signals in Gaussian noise. Matched filter. Correlation realization of a matched filter. Digital Receivers, and Regenerative repeaters. Equalizers. Time Extraction. Error Probability Performance for binary systems.	
Prerequisite (s)	EED330	
Textbook	Bernard Sklar, "Digital Communication fundamentals and Applications", Prentice Hall PTR, recent edition. **Reference Book:** B. P. Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press, recent edition.	
Lab./Computer work/Project	**Exp. 1:** Sampling and TDM. **Exp. 2:** Digital Modulation formats (ASK, FSK, PSK). **Exp. 3:** PCM. **Exp. 4:** Line Coding. **Exp. 5**: Implementation of digital communication System using MATEXP.	

EED431	Wireless Communication	3 CH (2,2,1)
Course Contents	Overview of Wireless Communications, Path Loss and Shadowing Models, Millimeter wave propagation, Statistical Fading Models, Capacity and coding for Wireless Channels, digital Modulation and its Performance, Diversity, Adaptive Modulation, Multiple Input/Output Systems (MIMO), Multicarrier Systems, OFDM, Multiuser and Cellular Systems.	
Prerequisite (s)	EED430	
Textbook	Wireless Communications, Andrea Goldsmith, 2nd edition.	

Lab./Computer work/Project	**Exp. 1:** Simulation for Cahnnel model and Capacity. **Exp. 2:** Simulation of digital modulation techniques. **Exp. 3:** Simulation of channel coding and decoding techniques. **Exp. 4:** Simulation of MIMO system.

EED432	Satellite Communication	2 CH (2,0,1)
Course Contents	Satellite services and frequency allocations. Satellite orbits. Kepler's laws. Orbital parameters and terms. Effect of non-spherical Earth shape. Regression of Nodes. Rotation of absides. Atmospheric drag. Geostationary and non-geostationary satellites. Space dynamics and orbitography. Calenders and times. Tracking angles. The satellite subsystems, P/L, TCR, EPS, ADCS. The design of satellite communication links. Features and advantages of the satellite communications, and the station keeping manoeuvres. The satellite ground stations. Power Budget calculations. GCS Cassegranian Antenna system. AvaiExp.le Bitrate.	
Prerequisite (s)	EED430	
Textbook	Dennis Roddy, "Satellite Communications", McGraw Hill, recent edition.	
Lab./Computer work/Project	**N/A**	

EED433	Optical Fiber Communication Systems	2 CH (2,0,1)
Course Contents	Overview of optical fiber communications. Optical Fiber waveguides (structure and types). Ray theory transmission. Electromagnetic mode theory for optical propagation. Optical Fiber waveguides. Step index fiber, and graded index fiber. Single mode fiber parameters. Transmission Characteristics of optical fibers: Dispersion modified single mode fibers. Nonlinear effects, Optical fiber cables, Optical fiber connections, Direct detection receiver performance, Receiver noise, and Receiver structure. Optical fiber systems (direct detection): Digital system design considerations, Optical power budget, and Rise time budget. Fiber amplifiers and WDM techniques, and Optical fiber parameters measurements.	
Prerequisite (s)	EED430	
Textbook	John Senior, "Optical Fiber Communications: Principles and Practice", Prentice Hall, recent edition.	
Lab./Computer work/Project	**Exp. 1:** Optical fiber connections: joints, couplers and isolators. **Exp. 2:** Familiarization of EDFA. **Exp. 3:** Internal modulation of a LED. **Exp. 4:** Performing Splicing of fibers using the splicing machine. **Exp. 5:** Familiarization and application of OTDR.	

EED434	Microwave Engineering	3 CH (2,2,1)
Course Contents	Basic equations of uniform waveguides: Planar (rectangular cross section, circular c.s., and coaxial guide). TE and TM field configuration and modes for all previous guides and dominant mode. Power transmitted and attenuation (in the medium of the guides and due to surface currents). Dielectric waveguides and ridged waveguides. Properties of general cavity resonator. Resonance frequency of rectangular cavity resonator and cylindrical cavity	

	resonator. The quality factor (unloaded and loaded). Dielectric cavity resonator. Microwave networks. Scattering matrices for several junctions (Tee junction and magic Tee). Microwave filters (different types). Insertion loss solution.
Prerequisite (s)	EED333
Textbook	David Pozar, "Microwave Engineering", J.Wiley, recent edition.
Lab./Computer work/Project	N/A.

EED435	**Antenna and Propagation**	**3 CH (2,2,1)**
Course Contents	Antenna definition and types. Fundamental antenna parameters. Radiation pattern. Main and minor lobes. Field regions. Directivity, Gain, H.P.B.W, F.N.B.W. Polarization, Effective aperture. The transmission equation and the link budget. Infinitesimal antenna. Wire antenna: Dipole- monopole, Loop antenna, Travelling wave antenna. Microstrip antennas. Aperture antenna. Rectangular aperture. Circular aperture. Electromagnetic horns. Array antennas. Phase scanning array. Broadband antenna. Helical antenna. Reflector antennas. Parabolic reflector antenna. Double reflector antennas. Cassegrain antenna. Gregorian antenna. Electromagnetic waves Health and Safety standards.	
Prerequisite (s)	EED333	
Textbook	Constantine Balanise, "Antenna Theory Analysis & Design", John Willy & Sons, recent edition.	
Lab./Computer work/Project	**Exp. 1**: Measurements of antenna Radiation Pattern. **Exp. 2**: Measurement of antenna HPBW, FNBW, SLL.	

EED436	**Digital Image Processing**	**2 CH (2,0,1)**
Course Contents	2-D sequences and systems. Separable systems. Projection slice. Reconstruction from projections. Partial Fourier information. Z transform, different equations. Recursive computability. 2D: DFT, FFT, FIR filter design. Human eye: Perception, Psychophysical vision properties, Photometry and colorimetry. Optics and image systems. Image compression: Scalar quantization, Lossless coding, Huffman coding, Arithmetic coding dictionary techniques, waveform and transform coding DCT, KLT, Hadammard, Multiresolution coding pyramid, Subband coding, Fractal coding, Vector quantization. Motion estimation and compensation standards. ScaExp.le image and Video coding. Image and video communication over noisy channels.	
Prerequisite (s)	EED230	
Textbook	R. C. Gonzalez and R. E. Woods, Digital Image Processing, Prentice Hall, 4th Edition.	
Lab./Computer work/Project	Selected Projects from the textbook.	

EED437	**Industrial Communication Networks**	**2 CH (2,1,0)**

Course Contents	Basics of data communication networks. The OSI 7 Layers. Industrial communication networks versus office/corporate data networks. Data network topologies. Network devices and their functions. Industrial networking protocols: Device net, Control Net, Modbus, Open protocols: Profibus DP, Profibus PA, Profinet, Protocols with HMI. Basics of Internet of Things (IoT). Industrial Internet of Things (IIoT).
Prerequisite (s)	EED334
Textbook	
Lab./Computer work/Project	N/A

EED438	**Speech Processing**	**2 CH (2,0,1)**
Course Contents	Speech Processing offers a practical and theoretical understanding of how human speech can be processed by computers. It covers speech recognition, speech synthesis and spoken dialog systems. The course involves practicals where the student will build working speech recognition systems, build their own synthetic voice and build a complete telephone spoken dialog system. Details of algorithms, techniques and limitations of state of the art speech systems will also be presented. This course is designed to process real data for real applications, applying statistical and machine learning techniques as well as working with limitations in the technology.	
Prerequisite (s)	EED475	
Textbook	Xuedong Huang, Alex Acero and Hsiao-wuen Hon. "Spoken Language Processing", Prentice Hall.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED440	**Power System Analysis 1**	**3 CH (2,2,0)**
Course Contents	Power System Modeling: Per unit system, Bus admittance and bus impedance matrices. Power flow: Problem description, Gauss-Seidel method, Newton-Raphson method, Fast decoupled solution. Fault analysis: System modeling under fault conditions, Symmetrical faults, Fault calculation using Z-bus. Symmetrical components: Definition, Sequence networks of loads, Sequence networks of series impedances, Sequence networks of machines, Sequence networks of transformers. Unsymmetrical faults: System representation, Single-Line to Ground fault, Line-Line Fault, Line-Line-Ground Fault. Computer solution of power flow using Power World Simulator and Matlab.	
Prerequisite (s)	EED341	
Textbook	Hadi Saadat, “Power System Analysis”, Third edition, PSA publishing, 2011.	
Lab./Computer work/Project	N/A	

EED441	Renewable Energy	3 CH (2,2,1)
Course Contents	Renewable energy resources. Wind Energy Conversion System: Power in the wind, Power extracted by turbine blades, Wind turbine power curve, Estimation of annual energy, Types of grid connected wind turbines, Environmental impacts of wind turbines. Photovoltaic Systems: The solar resource, Estimation of irradiance and radiation, The photovoltaic effect, Electric characteristics of solar cells, Types of solar cells, Modules and arrays, Mismatch in connected cells, Stand-alone PV systems, Grid connected PV systems, Estimation of annual energy.	
Prerequisite (s)	EED340	
Textbook	Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", 2nd Edition, August 2013, Wiley-IEEE Press.	
Lab./Computer work/Project	**Exp. 1:** Operation of Wind Energy Conversion Systems. **Exp. 2:** Photovoltaic Systems: Characteristics and Operation.	

EED442	Switchgear and Substations	2 CH (2,1,0)
Course Contents	Fundamentals of Switching Operations: Isolators, Break switches, Circuit breakers. Switching Operation: equivalent circuits, Arc formation and Extinction, Transient Recovery Voltage. Circuit Breakers (CBs) Technology: Oil, Vacuum, Air blast and SF6 CBs. Rated Characteristics of Circuit Breakers. Substation fundamentals: Substation components AIS versus GIS, circuit configuration: Single bus, Double bus single breaker, Ring bus, Breaker and a half. Dimensioning of switchgear installations and civil construction requirements. Substation grounding to meet step voltage, touch voltage regulations. Protection against lightning. Substation Automation.	
Prerequisite (s)	EED340	
Textbook	1. U.A.Bakshi, M.V.Bakshi, "Protection and Switchgear", Technical Publications, 2009. 2. V.K. Mehta and Rohit Mehta, "Principles of Power System", S. Chand Publisher, 2006.	
Lab./Computer work/Project	**Exp. 1**: Substation Bus Arrangement	

EED443	Power System Protection	3 CH (2,2,1)
Course Contents	Fundamentals of power system protection: Requirements of protection, Dependability, Security, Selectivity, Sensitivity, Speed, Zones of protection, Backup concept, Coordination concept. Voltage transformer, CCVT, Current transformers (CT): Equivalent circuit, Error calculation, IEC CT class. Overcurrent relays: Characteristics, Current setting, Time setting. Radial system protection, Coordination of overcurrent relays, Reclosers and fuses. Distance relay: Impedance, Directional impedance, Mho and Quadrilateral relays. Distance protection of Lines. Differential Relay, Differential protection of Transformers, Buses and Rotating machines.	
Prerequisite (s)	EED440	
Textbook	1. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, " Power System Analysis and Design", Fifth edition, Cengage Learning, 2012. 2. U.A.Bakshi, M.V.Bakshi, "Protection and Switchgear", Technical Publications, 2009.	

Lab./Computer work/Project	**Exp. 1**: Overcurrent Relay **Exp. 2**: Line Protection with OC Relays' Coordination. **Exp. 3**: Directional Overcurrent Relay. **Exp. 4**: Differential Protection of Transformers. **Course Paper**: Selected contemporary protection topic.

EED444	Power System Analysis 2	2 CH (2,1,0)
Course Contents	Fundamentals of power system stability: Types of stability, Swing equation, Equivalent circuits of power system elements. Small signal stability: Synchronizing and damping coefficients, Solution for second order system. Transient stability: Equal area criterion, Application to sudden change in load, Application to three-phase fault, Critical clearing angle. Numerical solution of swing equation: Euler and modified Euler methods. Voltage stability: Single-load infinite-bus system, Maximum deliverable power, PV curves, Reactive power requirement, Effect of VAR compensation, VQ curves.	
Prerequisite (s)	EED440	
Textbook	Hadi Saadat, "Power System Analysis", Third edition, PSA publishing, 2011.	
Lab./Computer work/Project	N/Y	

EED445	Power System Operation and Control	3 CH (2,2,0)
Course Contents	Optimal dispatch of generation: Nonlinear function optimization, Operating cost of a thermal plant, Economic dispatch under different assumptions: neglecting losses and constraints, considering generation constraints, including losses. Load frequency control: Model of single-area system, Steady state response, Dynamic response, root-locus, automatic generation control, Model of two area-system, Tie-line bias control, Steady state relationships. Under-frequency Load Shedding: utility schemes, effect of time delay. SCADA and Energy Management Systems. Smart Grid.	
Prerequisite (s)	EED440	
Textbook	Hadi Saadat, "Power System Analysis", Third edition, PSA publishing, 2011.	
Lab./Computer work/Project	**Course Project 1**: Economic dispatch using PowerWorld simulator. **Course Project 2**: Load frequency control of two area system using Simulink.	

EED446	Advanced Power System Protection	2 CH (2,1,0)
Course Contents	The basic concepts of digital relaying. Construction of microprocessor relay. Sampling theorem, Aliasing, Anti-aliasing filter. Digital signal identification: three sample method, Four sample method, Phasor measurements. Performance of Current transformers in digital relaying. Implementation of overcurrent digital relay. Implementation of distance digital relay. Practical considerations of digital relays: Binary inputs, Binary outputs, Analysis of disturbance recorders. Fault Location using GPS system and PMUs technology. Application of artificial intelligence in protective schemes. Concept of Adaptive Relaying.	
Prerequisite (s)	EED443	

Textbook	1. Arun G. Phadke, James S. Thorp, "Computer Relaying For Power Systems", Second Edition, Wiley, 2009. 2. References:A. T. Johns and S. K. Salman, "Digital Protection for Power Systems", Peter Peregrinus Ltd., 1995.
Lab./Computer work/Project	N/A

EED447	**Power Distribution Systems**	**2 CH (2,1,0)**
Course Contents	Fundamentals of Distribution Systems: Distribution system elements, Distribution system configurations, Primary Voltage Levels, Distribution Substations, Sub-transmission network. Approximate Methods of Analysis: Voltage Drop, Line Impedance, "K" Factors, Power loss, Uniformly distributed Loads, Lumping Loads in Geometric Configurations; Rectangle, Triangle, Trapezoid. Voltage Regulation: Voltage Standards, Regulation Techniques, Regulators (autotransformers), Line-Drop Compensation, Load-Center Compensation. Capacitor Application: Capacitor Ratings, Reducing Line Losses, Switched Banks, Local Controls, Automated Controls.	
Prerequisite (s)	EED340	
Textbook	Turan Gonen, " Electric Power Distribution Engineering, Third Edition, CRC Press, 2016.	
Lab./Computer work/Project	N/A	

EED448	**Power System Planning**	**2 CH (2,1,0)**
Course Contents	Principles of power system planning. Load forecasting: Extrapolation techniques, Correlation techniques, Least Square method, Stochastic time series, Spatial load forecasting. Generation Cost Analysis: Levelized Cost of Energy (LCE). Reliability of supply systems: Basic reliability mathematics, Series systems, Parallel systems. Reliability of Generation Systems: Building the Capacity Outage Probability Table (COPT) using Binomial expansion and Recursive algorithm, Loss of Load Expectation (LOLE), Generation Expansion Planning. Distribution System Planning: Reliability indices: SAIFI, SAIDI, CAIDI. Transmission planning and substation expansion planning. Demand Side Management (DSM).	
Prerequisite (s)	EED340	
Textbook	1. Turan Gonen, " Electric Power Distribution Engineering, Third Edition, CRC Press, 2016. 2. Roy Billinton and Ronald Allan, "Reliability evaluation of power systems", 2nd ed., Springer, 1996.	
Lab./Computer work/Project	N/A	

EED450	**Transformers & Induction Machines**	**3 CH (2,2,1)**
Course Contents	**Single-phase transformers:** Construction, EMF equation, equivalent circuits. Efficiency and voltage regulation. OC & SC tests. Parallel operation. **3-phase Transformers** and **Autotransformers**: Construction, theory of operation, Equivalent circuit. **3-ph Induction**	

	Motors: Construction, Theory of operation, Equivalent circuit, power and torque equations, Load characteristics, Modes of operations, Testing , Starting methods, Speed control. Double cage IM.
Prerequisite (s)	EED350
Textbook	Chapman, S. J., "Electric Machinery fundamentals", McGraw Hill Co., 4th edition, 2005.
Lab./Computer work/Project	**Exp. 1**: Determination of the equivalent circuit parameters of a 1-phase transformer. **Exp. 2**: Characteristics of a single-phase transformer. **Exp. 3**: Characteristics of a 3-phase squirrel-cage IM. **Exp. 4**: Characteristics of a 3-phase Slip-ring IM.

EED451	Power Electronics 2	2 CH (2,1,0)
Course Contents	AC voltage controllers. DC Choppers, DC-DC voltage regulators: Buck, Boost, Buck-Boost, Ćuk converters. Inverters: Single phase inverters, Pulse width modulation techniques, three phase inverters.	
Prerequisite (s)	EED351	
Textbook	D. W. Hart, "Power Electronics", 1st edition, McGraw Hill, 2011.	
Lab./Computer work/Project	**Exp. 1**. Phase Angle Control AC Voltage Controller. **Exp. 2**. Step Down DC- DC voltage Converter.	

EED452	PLC & Applications	3 CH (2,2,1)
Course Contents	Components of classic control systems and their applications. Examples of classic control circuits. Introduction to PLCs and their types. PLC hardware configuration. Input and output devices. signal conditioning of inputs and outputs. Input and output modules. Basics of PLC programming using ladder (LD) and function block diagram (FBD) languages. Timers: types and programming. Counters: types and programming. Examples of Industrial Applications. Introduction to industrial communication networks and SCADA.	
Prerequisite (s)	EED220, EED450	
Textbook	F. Petruzella, "Programmable Logic Controllers," McGraw-Hill Education, 5th ed., 2017	
Lab./Computer work/Project	**Exp. 1.** Timers. **Exp. 2.** Counters.	

EED453	Special Electrical Machines	3 CH (2,2,1)
Course Contents	Two-phase induction motors. Single-phase induction motors: starting and steady-state operation. AC single-phase series motors. Permanent magnet synchronous motors. Stepper motors: permanent magnet and switched reluctance. Permanent magnet brushless DC motors. Linear induction motors. Induction generators.	
Prerequisite (s)	EED450	
Textbook	E.G. Janardanan, "Special Electrical Machines", Prentice-Hall of India Pvt. Ltd; 1st edition, 2014.	

Lab./Computer work/Project	**Exp. 1**: Characteristics of a single-phase capacitor-start IM.

EED454	**Electric Motor Drives**	**3 CH (2,2,1)**
Course Contents	Components of modern Electric drives system, Equations of motion. DC Drives: speed control using controlled rectifiers, Speed control using DC choppers. AC Drives: stator voltage control, stator frequency control, V/f control. Switched reluctance motor drives. Brushless DC Motor Drives. Permanent Magnetic Brush-Less DC Motor Drives	
Prerequisite (s)	EED450 & EED451	
Textbook	Muhammad H. Rashid, "Power Electronics: Circuits, Devices & Applications", 4th Ed., Pearson; 2014	
Lab./Computer work/Project	**Exp. 1.** Speed Control of DC Motor Using DC Chopper. **Exp. 2.** Speed Control of Three Phase Induction Motor.	

EED455	**Advanced Power Electronics**	**2 CH (2,1,0)**
Course Contents	DC Power supplies. Resonant Switch Converters: zero-voltage and zero-current switching, Series resonant inverter. High frequency link DC-DC converters. Multilevel inverters	
Prerequisite (s)	EED451	
Textbook	D. W. Hart, "Power Electronics", 1st edition, McGraw Hill, 2011.	
Lab./Computer work/Project	**Exp. 1.** Simulation of the zero-voltage Resonant Switch Converter **Exp. 2.** Simulation of the zero-current Resonant Switch Converter	

EED456	**Electric Vehicles**	**2 CH (2,1,0)**
Course Contents	Environmental impact and history of electric vehicles. Electric Vehicles: traction motor characteristics, tractive effort and transmission requirement, energy Consumption. Energy storages: electrochemical batteries, ultracapacitors. Electric propulsion systems: permanent magnet brushless DC motor drives, switched reluctance motor drives. Brake system of EVs, antilock brake system (ABS). Design of drive train parameters: design of electric motor drive power, capacity transmission design, energy storage design, simulations.	
Prerequisite (s)	EED451 & EED453	
Textbook		
Lab./Computer work/Project	N/A	

EED457	**Electrical Power Sources**	**2 CH (2,1,0)**
Course Contents	Power system structure: Generation, Transmission, Distribution. Transformers: Types, Structure, Equivalent circuit, Operation, Performance. Synchronous generators: Structure, Equivalent circuit, Operation, performance, Backup generators. Batteries: Types,	

	Operation, Performance. Uninterruptable power supplies: Structure, Operation, Topologies. Standalone photovoltaic systems: Components, Performance, Sizing. Smart Grids: Concept, Structure, Communication Aspects.
Prerequisite (s)	EED202
Textbook	1. Theodore Wildi, "Electric Machines, Drives and Power Systems", Prentice Hall, 6th edition, 2006. 2. Chapman, S. J., "Electric Machinery fundamentals", Mc Graw Hill, 4th edition, 2005.
Lab./Computer work/Project	**Exp. 1**: Determination of the equivalent circuit parameters of a single-phase transformer. **Exp. 2**: Determination of the equivalent circuit parameters of a 3-phase synchronous machine. **Exp. 3:** Photovoltaic Systems: Characteristics and Operation.

EED460	**Data Structures and Algorithms**	**2 CH (2,0,1)**
Course Contents	Fundamental dynamic data structures: Linear lists, Queues, Trees, and Other linked structures (arrays strings, and hash tables). Storage management. Elementary principles of software engineering. Abstract data types. Algorithms for sorting and searching. Introduction to the Java programming language.	
Prerequisite (s)	EED361	
Textbook	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 3rd Edition, ISBN-13: 978-0262033848.	
Lab./Computer work/Project	**Exp. 1:** Setup: Setting Up Your Computer. **Exp. 2**: JUnit Tests and Debugging. **Exp. 3:** Timing Tests and Randomized Comparison Tests. **Exp. 4:** Git and Debugging. **Exp. 5:** BSTMap and HashMap.	

EED461	**Analysis and Design of Algorithms**	**3 CH (2,2,1)**
Course Contents	This is an intermediate algorithms course with an emphasis on teaching techniques for the design and analysis of efficient algorithms. Emphasizing methods of application. Topics: Divide-and-conquer, Randomization, Dynamic programming, Greedy algorithms, Incremental improvement, Complexity, and Cryptography. We will focus on studying basic algorithms at a finer level of detail and more advanced algorithms and data structures.	
Prerequisite (s)	EED460	
Textbook	Cormen, Thomas, Charles Leiserson, et al. Introduction to Algorithms. 3rd ed. MIT Press, 2009. ISBN: 9780262033848.	
Lab./Computer work/Project	We will set programming assignments in Python3. These assignments will require basic **Exp. 1:** knowledge of writing programs in Python3. **Exp. 2:** Python3 functions, and control loops. **Exp. 3:** Data structures: lists, dictionaries and sets. **Exp. 4:** Classes and Inheritance. **Exp. 5:** Ability to write small projects in Python3, test and debug**.**	

EED462	Software Engineering	3 CH (2,1,2)
Course Contents	Ideas and techniques for designing. Developing and modifying large software systems. Function-oriented and object-oriented modular design techniques (designing for re-use and maintainability). Specification and documentation. Verification and validation. Cost and quality metrics and estimation. Project team organization and management. Students will work in teams on a substantial programming project.	
Prerequisite (s)	EED361	
Textbook	Robert C. Martin, "Clean Code: A Handbook of Agile Software Craftsmanship", 1st Edition, 2008.	
Lab./Computer work/Project		

EED463	Operating System	3 CH (2,1,2)
Course Contents	Basic concepts of operating systems and system programming: Utility programs, Subsystems, Multiple-program systems. Processes. Inter-process communication, and synchronization. Memory allocation. Segmentation. Paging. Loading and linking. Libraries. Resource allocation. Scheduling. Performance evaluation. File systems. Storage devices, I/O systems. Protection, security, and privacy.	
Prerequisite (s)	EED320	
Textbook	Avi Silberschatz, Peter Baer Galvin, and Greg Gagne, "Operating System Concepts", 9th Edition, 2012.	
Lab./Computer work/Project	**N/A**	

EED464	Database Management Systems	2 CH (2,0,1)
Course Contents	Access methods and file systems to facilitate data access. Hierarchical, network. Relational and object-oriented data models. Query languages for models. Embedding query languages in programming languages. Database services: Protection, Integrity control, and Alternative views of data. High-level interfaces: Application generators, Browsers, and Report writers. Introduction to transaction processing. Database system implementation to be done as term project.	
Prerequisite (s)	EED460	
Textbook	C.J. Date, "An Introduction to Database Systems", 8th Edition, ISBN-13: 978-0321197849	
Lab./Computer work/Project		

EED465	Fundamentals of Big Data Analysis	2 CH (2,0,1)
Course Contents	Definition. Fundamentals of Big data technologies and tools. Distributed processing ecosystem. Big Data Storage and Analytics. Big data analytics machine learning algorithms. Graph analytics. Big data visualization.	

Prerequisite (s)	EED160 & EMP312
Textbook	Thomas Erl, Wajid Khattak and Paul Buhler, " Big Data Fundamentals: Concepts, Drivers & Techniques", 1st Edition, 2016.
Lab./Computer work/Project	Dependent on the selected topic.

EED466	**Data Mining**	**2 CH (2,0,1)**
Course Contents	Data Mining studies algorithms and computational paradigms that allow computers to find patterns and regularities in databases, perform prediction and forecasting, and generally improve their performance through interaction with data. It is currently regarded as the key element of a more general process called Knowledge Discovery that deals with extracting useful knowledge from raw data. The knowledge discovery process includes data selection, cleaning, coding, using different statistical and machine learning techniques, and visualization of the generated structures.	
Prerequisite (s)	EMP312	
Textbook	Ian Witten Eibe Frank Mark Hall Christopher Pal, " Data Mining: Practical Machine Learning Tools and Techniques ", Springer.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED467	**Natural Language Processing**	**2 CH (2,0,1)**
Course Contents	This course introduces the fundamental concepts and theory of Natural Language Processing (NLP; a.k.a. computational linguistics) and its practical tasks. The primary focus of this course is on the fundamental concepts and algorithms/techniques of NLP. The theoretical side is complemented by case studies, practical implementations/programming and projects. Topics to be covered include language models, sentiment analysis, parsing, information extraction and neural language models.	
Prerequisite (s)	EED475	
Textbook	Jurafsky and Martin. Speech and Language Processing.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED468	**Cloud Computing**	**2 CH (2,0,1)**
Course Contents	This course introduces students to fundamentals of cloud computing and software development for cloud platforms. It covers topics such as virtualization, architecture of cloud systems, programming for the cloud, resource management, as well as privacy and security issues. Students gain practical experience developing applications for cloud	

	platforms through a series of hands-on assignments.
Prerequisite (s)	EED381
Textbook	Marinescu, Dan. Cloud Computing Theory and Practice (2nd Ed.), Elsevier, 2017
Lab./Computer work/Project	**Exp. 1:** **Project:**

EED469	**Fundamentals of Big Data Analysis**	**3 CH (2,1,1)**
Course Contents	Definition. Fundamentals of Big data technologies and tools. Distributed processing ecosystem. Big Data Storage and Analytics. Big data analytics machine learning algorithms. Graph analytics. Big data visualization.	
Prerequisite (s)	EED160, EMP312	
Textbook	Thomas Erl, Wajid Khattak and Paul Buhler, " Big Data Fundamentals: Concepts, Drivers & Techniques".	
Lab./Computer work/Project	Dependent on the selected topic.	

EED470	**Artificial Intelligence**	**2 CH (2,0,1)**
Course Contents	Ideas and techniques underlying the design of intelligent computer systems. Topics: Search, Game playing, Knowledge representation, Inference, Planning, Reasoning under uncertainty, Machine learning, Robotics, Perception, and Language understanding.	
Prerequisite (s)	EMP312	
Textbook	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, 2020.	
Lab./Computer work/Project	**Exp. 1:** UNIX/Python Tutorial. **Exp. 2:** Implementation of depth-first, breadth-first, uniform cost, and A* search algorithms. **Exp. 3:** Implementation of multiagent minimax and expectimax algorithms **Exp. 4:** logical inference to solve planning tasks as well as localization, mapping, and SLAM. **Project:** Applying an array of AI techniques to playing Pac-Man.	

EED471	**Computational Intelligence**	**2 CH (2,0,1)**
Course Contents	Definitions. Learning theory. Soft-computing paradigm. Fuzzy systems: Fuzzy sets and relations, Operations on fuzzy sets, Fuzzy logic, Approximate reasoning, Fuzzy control. Neural networks: Machine learning using neural networks, Supervised learning, Unsupervised learning, Competitive learning, Reinforcement learning, Neuro-dynamic programming, Neuro-fuzzy systems. Evolutionary computation: Genetic algorithms,	

	Genetic programming, Genetic optimization, Machine learning using genetic algorithms. Particle swarm optimization. Bayes networks. Artificial immune systems. Rough theory. Granular computing. Chaos theory. Tools used in developing computational intelligence algorithms. Applications: intelligent control systems, object recognition, applications in mobile robots.
Prerequisite (s)	EED160 & EMP312
Textbook	Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition, ISBN-13: 978-0470035610.
Lab./Computer work/Project	

EED472	**Machine Learning and Pattern Recognition**	**3 CH (2,1,2)**
Course Contents	Introduction to Machine Learning: Concepts, Instances, Attributes, Simple Examples, Application Domains. Machine Learning and Statistics. Data Pre-processing and Exploration: Sampling, Principal Component Analysis, Feature Extraction, Exploratory Data Analysis. Fundamental Classification Strategies. Clustering Techniques. Statistical and structural pattern recognition approaches. Bayesian decision theory. Maximum-Likelihood and Bayesian parameter estimation. Nearest neighbour rule. Non-parametric classifiers. Linear discriminate functions. Non-linear classifiers. Multi-layer neural networks. Features selection. Template matching. Unsupervised learning and Cluster analysis. Supervised learning.	
Prerequisite (s)	EED361 & EMP312	
Textbook	Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, "An Introduction to Statistical Learning with Applications" Springer, New York, 2013. ISBN # 978-1-4614-7137-0.	
Lab./Computer work/Project	**Exp. 1:** Google Cloud Compute Jupyter Exp. setup guide. **Exp. 2:** CoExp. GPU Acceleration Setup Guide.	

EED473	**Computer Vision**	**3 CH (2,2,1)**
Course Contents	An introduction to the analysis of images and video in order to recognize, reconstruct and model objects in the three-dimensional world. We will study the geometry of image formation; basic concepts in image processing such as smoothing, edge and feature detection, color, and texture; motion estimation; segmentation; stereo vision; 3-D modeling; and statistical recognition.	
Prerequisite (s)	EED361, EED436	
Textbook	Richard Szeliski, Computer Vision: Algorithms and Applications", 4th Edition, 2021.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED474	High Performance Computing	2 CH (2,0,1)
Course Contents	GPUs are high-performance many-core processors. Students will learn massively parallel programming using CUDA C and develop parallel algorithms to solve real problems. Topics include parallel computing, GPUs architecture, threads, performance issues, and floating point representation.	
Prerequisite (s)	EED320, EED361	
Textbook	Robert Robey and Yuliana Zamora, Parallel and High Performance Computing", Manning Pub.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED475	Fundamentals of Deep Learning	3 CH (2,2,1)
Course Contents	Introduction to deep learning and its underlying theory. The range of applications to which it has been applied. Architectures commonly associated with deep learning: Basic neural networks, Convolutional neural networks, and Recurrent neural networks. Methods to train and optimize the architectures and methods to perform effective inference.	
Prerequisite (s)	EED472	
Textbook	Nikhil Buduma and Nicholas Locascio, " Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms ".	
Lab./Computer work/Project	Exp. 1: Python Basics with Numpy. Exp. 2: Logistic Regression with a neural network mindset. Exp. 3: Building your Deep Neural Network: step by step. Exp. 4: Deep Neural Network – Application Exp. 5: Initialization and Regularization of Deep Neural Network. Exp. 6: Gradient Checking and Optimization of Deep Neural network.	

EED476	Autonomous Vehicles	3 CH (2,2,1)
Course Contents	This course aims to teach the core concepts that make Self-driving vehicles (SDVs) possible. It is aimed at people who want to get their teeth into self-driving vehicle technology, by providing genuine technical insights into the field. The course tackles everything from sensors and perception to functional safety and cybersecurity. It also passes on some practical know-how and discusses concrete SDV applications, along with a discussion of where this technology is heading. It will serve as a good starting point to learn more about the basics of SDV algorithms.	
Prerequisite (s)	EED473	
Textbook	Hanky Sjafrie, Introduction to Self-Driving Vehicle Technology", Springer, 2020.	
Lab./Computer	**Exp. 1:**	

EED477	Reinforcement Learning	2 CH (2,0,1)
Course Contents	This course provides an introduction to reinforcement learning, a very active research sub-field of machine learning. Reinforcement learning is concerned with building programs that learn how to predict and act in a stochastic environment, based on past experience. Applications of reinforcement learning range from classical control problems, such as powerplant optimization or dynamical system control, to game playing, inventory control, and many other fields. Notably, reinforcement learning has also produced very compelling models of animal and human learning.	
Prerequisite (s)	EED361. EED475	
Textbook	Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning," 2rd Ed., MIT Press, 2018.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED478	Intelligent Games	3 CH (2,1,1)
Course Contents	The primary focus of this course is on the use of AI techniques for generating efficient, intelligent behaviour in games. Additional attention is given to AI algorithms for improving game play experience.	
Prerequisite (s)	EED361. EED470	
Textbook	Ian Millington. "AI for Games". Routledge	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED479	Advanced Deep Learning	3 CH (2,1,1)
Course Contents	This class is designed to help students develop a deeper understanding of deep learning and explore new research directions and applications of AI/deep learning. The course goes in depth on cutting-edge topics within deep learning and their applications, including recent advances in neural architecture design, robustness and reliability of neural networks under adversarial and anomalous attack, learning with less supervision, deep generative modeling, theoretical understanding of deep learning, as well as explaining black-box deep learning models to enhance their transparency. It assumes that students already have a basic understanding of deep learning.	
Prerequisite (s)	EED475	
Textbook	Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED480	Data Communication and Computer Networks	3 CH (2,2,1)
Course Contents	Basics of data communications and computer networks. Timing diagrams and calculation of total delay (real and non-real time applications). Addressing in computer networks: Port, MAC and IP address (classful and classless) of IPv4 and IPv6. Network layered models: 7-Layers (ISO/OSI) and 5-layers (TCP/IP) models. Protocols in TCP/IP models. Error control: Linear block codes and Hamming distance, CRC error detecting codes. Local Area Networks: Wired (Ethernet) generations up to 100Giga Ethernet, Wireless LAN generations, IEEE802.11, ISM bands, Bluetooth, WiMax (IEEE802, 16).	
Prerequisite (s)	EED430	
Textbook	Behrouz Frouzan. "Data communications and Networking". McGraw-Hill. recent edition.	
Lab./Computer work/Project	**Exp. 1:** Identifying the important Windows networking utilities. **Exp. 2:** Packet sniffing. **Exp. 3:** Address Resolution Protocol (ARP). **Exp. 4:** Internet Protocol.	

EED481	Modelling and Analysis of Telecommunication	2 CH (2,0,1)
Course Contents	Selected topics in recent directions and advances in telecommunication networks.	
Prerequisite (s)	EED430	
Textbook	Jeremiah F. Hayes and Thimma V. J. Ganesh Babu, "Modeling and Analysis of Telecommunications Networks", ISBN-13: 978-0471348450.	
Lab./Computer work/Project	**N/A**	

EED482	Cryptography and Communication Security	2 CH (2,0,1)
Course Contents	Cryptography or cryptology is the science of designing algorithms and protocols for enabling parties to communicate and compute securely in an untrusted environment (e.g. secure communication, digital signature, etc.) Over the last four decades, cryptography has transformed from an ad hoc collection of mysterious tricks into a rigorous science based on firm complexity-theoretic foundations. This modern complexity-theoretic approach to cryptography will be the focus. E.g., in the context of encryption we will begin by giving a precise mathematical definition for what it means to be a secure encryption scheme and then give a construction (realizing this security notion) assuming various computational hardness assumptions (e.g. factoring).	
Prerequisite (s)	EED430	
Textbook	Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography", 3rd Edition.	
Lab./Computer work/Project		

EED483	Introduction to Data Security	3 CH (2,2,1)
Course Contents	This is an introductory course on the methods, algorithms, techniques, and tools of data security and cryptography. After studying the theoretical aspects of cryptographic algorithms and protocols, we show how these techniques can be integrated to solve particular data and communication security problems. This course material is of use to computer and communication engineers who are interested in embedding security into an information system, and thus, providing integrity, confidentiality, and authenticity of the documents and the communicating parties.	
Prerequisite (s)	EED361. EED381	
Textbook	William Stallings, Network Security Essentials: Applications and Standards,6th Ed, Pearson, 2017.	
Lab./Computer work/Project	**Exp. 1:** **Project:**	

EED491	Selected Topics in Electronics and Communication	2 CH (2,1,0)
Course Contents	Independent study in various problem areas of electronic and communication engineering may be assigned to individual students or to groups. Readings assigned and frequent consultations held.	
Prerequisite (s)	As Advised	
Textbook	Dependent on the selected topic.	
Lab./Computer work/Project	Dependent on the selected topic.	

EED492	Selected Topics in Computer Engineering	2 CH (2,1,0)
Course Contents	Independent study in various problem areas of computer engineering may be assigned to individual students or to groups. Readings assigned and frequent consultations held.	
Prerequisite (s)	As Advised	
Textbook	Dependent on the selected topic.	
Lab./Computer work/Project	Dependent on the selected topic.	

EED493	Selected Topics in Electrical Power Engineering	2 CH (2,1,0)
Course Contents	This course covers a number of advanced "selected topics" on the field of electrical machines, power systems and/or power electronics.	
Prerequisite (s)	As advised	
Textbook	As advised	
Lab./Computer	As advised	

EED498	Graduation Project 1	1 CH (0,0,3)
Course Contents	The Graduation Project represents the crowning achievement of an Electrical Engineering student's undergraduate experience. It requires application of engineering principles to the solution of a real-world problem. The work done has to be based on the knowledge and skills acquired during the course work. This course is the first part of the graduation project, which lasts two semesters. At the beginning of the first semester, a group of at least two students will select a project (from a given list approved by the department's council). At the end of the semester, the student should present a technical report includes at least the following items: a survey on the project subject using the appropriate literature, a time schedule for the design and implementation phases of the project, and the work done to acquire the necessary skills, and knowledge .The student has to take into consideration the appropriate engineering standards and multiple constraints during the different phases of the project. The supervisor evaluates the contribution of each student at the end of the semester.	
Prerequisite (s)	Completion of 120 Credit hours	
Textbook	As advised.	
Lab./Computer work/Project	As advised.	

EED499	Graduation Project 2	4 CH (1,0,3)
Course Contents	This course represents the second part of the graduation project. It fulfills the deliverables stated in Graduation Project 1 under the supervision of the same faculty member. The supervisor has to emphasize on the teamwork concept during the phases of the work. One extra month is available for the student to finalize his/her work after the end of the second semester. A printed version of the project report beside the final product of the project work should be submitted to the department prior to the date of discussion. The jury members from academy and industry evaluate the student work based on a submitted documents and final product, oral presentation and discussion. In case the student failed in the project, he is given a chance for one more semester and will be eligible to present and defend the project by the end of that semester.	
Prerequisite (s)	EED498	
Textbook	As advised.	
Lab./Computer work/Project	As advised.	

Other Courses: EMP, GEN, MECME

EMP213	Differential Equations	3 CH (2,2,0)
Course Contents	Functions of several variables; First order differential equations; Second order linear differential equation; Series solutions of differential equations; Special functions (Bessel Functions and Legendre polynomials); System of linear differential equations; Initial and boundary value problems; Introduction to partial differential equations; Applications of differential equation using MATLAB	
Prerequisite (s)	EMP112	
Textbook	Warren S. Wright, Dennis G. Zill, "Advanced Engineering Mathematics", Jones & Bartlett Learning.	
Lab./Computer work/Project	**N/A**	

EMP214	Transformations & Complex Analysis	3 CH (2,2,0)
Course Contents	Theories; Cauchy integral theorem; Singularity and residue theorem; Convolution and Laplace transform; Inverse Laplace transform methods; Conformal mapping; Fundamentals of z transform; Inverse z-transform methods; Difference equation and solution using z-transform technique; Applications using MATLAB.	
Prerequisite (s)	EMP213	
Textbook	Warren S. Wright, Dennis G. Zill, "Advanced Engineering Mathematics", Jones & Bartlett Learning.	
Lab./Computer work/Project	**N/A**	

EMP221	Solid State Physics	3 CH (2,2,0)
Course Contents	Semiconductor material properties: Crystal structure of solids, Introduction to quantum mechanics, Introduction to the quantum theory of solids, Semiconductor in equilibrium, Carrier transport phenomena, Non-equilibrium excess carriers in semiconductors. pn junction: Basic structure, reverse applied bias, junction breakdown, pn junction current, Generation–recombination currents, and Small-signal model of the pn junction.	
Prerequisite (s)	EMP122	
Textbook	Donald A. Neamen, "Semiconductor Physics and Devices: Basic Principles", 4th Edition. McGraw-Hill.	
Lab./Computer work/Project	**Exp. 1:** Photoelectric Effect. **Exp. 2:** Specific Charge of Electron. **Exp. 3:** PN Junction I/V Characteristics. **Exp. 4:** Several NanoHub simulations of PN junction.	

EMP311	Discrete Mathematics & Numerical Methods	3 CH (2,2,0)
Course Contents	Sets: basics, set operations; Functions: one-to-one, onto, inverse, composition, graphs; Euclidean algorithm; Sequences and Summations; Mathematical reasoning: Proof strategies, Mathematical Induction, Recursive definitions, Structural Induction; Counting: basic rules, Pigeon Hall principle; Permutations and combinations, Binomial coefficients and Pascal triangle. Relations: properties, Combining relations, Closures, Equivalence, partial ordering; Graphs, directed, undirected graphs. Numerical methods: interpolation, Least-Squares methods, numerical solutions to initial & boundary value problems: Euler and Rung-Kutta methods, numerical differentiation and integration, solution of non-linear algebraic equation. Applications using MATLAB.	
Prerequisite (s)	EMP213	
Textbook	• Kenneth H. Rosen, "Discrete Mathematics and its Applications" McGraw-Hill, Inc. • Warren S. Wright, Dennis G. Zill, "Advanced Engineering Mathematics", Jones & Bartlett Learning.	
Lab./Computer work/Project	**N/A.**	

EMP312	Probability & Statistics	3 CH (2,2)
Course Contents	Probability definitions and concepts; Conditional probability; Statistical independence and Bayes theorem; Discrete and continuous random variables; Distribution functions; Probability distributions and moments; Random variables and their probability distributions including uniform, binomial, geometric, Poisson, normal, and exponential distributions; Expected value and variance; Stochastic simulation; Sampling distributions; Maximum likelihood and least squares methods of estimation; Statistical inference including hypothesis testing and interval estimation; Applications using MATLAB	
Prerequisite (s)	EMP213	
Textbook	A.G. Bluman, "Elementary Statistics a Step by Step Approach", McGraw Hill.	
Lab./Computer work/Project	N/A	

GEN442	Project Management & Entrepreneurship	2 CH (2,1,0)
Course Contents	Basic project initiation and planning processes: scope definition, project estimation and work breakdown structure. Tools and techniques to develop well-designed project implementation schedule. Project performance monitoring, control and evaluation. Role of innovation in creating new ventures and fundamentals of entrepreneurship.	
Prerequisite (s)	-	
Textbook	Claude H. Maley, "Project Management Concepts, Methods, and Techniques", Auerbach Publications.	
Lab./Computer work/Project	**N/A**	

MEC460	Engineering Economy	2 CH (2,1,0)
Course Contents	Introductory finance: time value of money, cash flow analysis. Investment evaluation methods: present worth, annual worth and internal rate of return, Depreciation models and asset replacement analysis, the impact of inflation, taxation, uncertainty and risk on investment decisions.	
Prerequisite (s)	-	
Textbook	Blank, Leland& Traquin, Anthony; "Engineering Economy", McGraw Hill, Latest edition	
Lab./Computer work/Project	**Project**: A group project where students should select an investment, which has multiple mutually exclusive alternatives. In selecting the preferred alternative, the group must use the different principles of engineering economic analysis learned in the course. Every group is required to submit a technical report and provide an oral presentation	