# Courses Description

## *Required Courses:*

**ELEE 210 Electric Circuits I** **3(3, 0, 0)**
System of units. Circuit variables (charge, current, voltage, power, energy). Circuit elements, Basic laws: Ohm's, KVL, KCL, and Power calculations. Resistive circuits: voltage and current divider rules, Dependent sources. Circuit analysis techniques: Nodal and Mesh analysis. Network theorems: Thevenin's Norton's, Source transformation, Superposition, Maximum power transfer. Energy storage elements: definitions and voltage-current relationships. Responses of first order RL and RC circuits. Responses of second order RLC circuits. Phasor steady-state sinusoidal circuits analysis. ***Prerequisite: PHYS 102.***

**ELEE 220 Logic Design** **3(3, 0, 0)**
Number systems and codes, Boolean algebra; combinational circuit design; minimization methods; sequential logic design principles; latches and flip-flops, design of sequential circuits using flip flops, counters and registers, state machines. ***Prerequisite: CSC 101.***

**ELEE 230 Programming for Engineers** **3(3, 0, 0)**
This is an introductory programming course with an emphasis on problem-solving algorithmic ideas. Its topics include data types, selection, repetition, strings, functions, and pointers. Laboratory based lectures are an integral part of this course. ***Prerequisite: CSC 101.***

**ELEE 240 Electronics** **3(3, 0, 0)**
Operational amplifiers. Semiconductor material properties. P-N junctions and semiconductor diodes: structure, operation, and circuit applications. Special purpose diodes: Zener, varactor, LED, photodiode, laser and Schottky. Bipolar junction transistors (BJT) physics and I-V characteristics. Field effect transistors (FET) physics and I-V characteristics (JFET and MOSFET). DC biasing and AC small signal analysis. ***Prerequisite: ELEE 210.***

**ELEE 250 Electric Circuits II** **3(3, 0, 0)**
Sinusoidal steady state analysis. Techniques of AC circuit analysis, AC power analysis (instantaneous, average power maximum average power transfer, complex and apparent power, power factor and power factor correction). Three-phase circuit analysis. Mutual inductance and transformers. Resonance circuits. Filters. Frequency response and Bode plots. Two-port networks. ***Prerequisite: ELEE 210.***

**ELEE 250L Electric Circuits Laboratory** **1(0, 0, 2)**
A practical course on measurement devices (Ammeters, Voltmeters, Oscilloscope), DC Circuit analysis (Ohm’s Law, KCL, KVL, Current division, voltage division, Series/Parallel Combinations of Resistors, Thevenin’s and Norton’s Equivalent Circuits, Maximum Power Transfer), Frequency Response of RL and RC Circuits, Phase Measurements Using the Oscilloscope, Series Sinusoidal Circuits, Parallel sinusoidal Circuits, Series-Parallel Sinusoidal circuits, Series-Parallel sinusoidal Circuits, Resonant Circuits, Frequency response of filters (low-pass, high-pass, band-pass). ***Prerequisite: ELEE 250.***

**ELEE 290 Digital Systems** **3(3, 0, 0)**

This course introduces students to the basic concepts of microprocessor and microcontroller architecture and assembly language programming. Topics include computer organization and interfacing techniques; program-controlled and interrupt-driven I/O; memory organization; simple peripheral devices and controllers; bus interfaces; microcontroller-based designs, data paths (single cycle) in microprocessors and microcontrollers, Instruction Set Architecture: Intel 8086 instruction, addressing modes, instruction decoding, and assembly programming using Intel 8086 instructions. ***Prerequisite: ELEE 220 and ELEE 230.***

**ELEE 290L Digital Systems Lab** **1(0, 0, 2)**

This Lab provides students with the opportunity to gain experience in microprocessor-based system design, assembly language programming, and I/O interfacing to microprocessors. It mainly covers software and hardware aspects of an 8086/8088 microprocessor, structure, operation, and control; assembly language programming and techniques using different tools and utilities such as MIDA-8086 Kit, debugger, and Emu 8086 software. ***Prerequisite: ELEE 290.***

**ELEE 340 Electronic Circuits** **3(3, 0, 0)**

A course on BJT amplifiers; common emitter, common collector, common base; MOSFET amplifiers; common source, common gate; multistage amplifier; Darlington pair transistor; differential amplifiers; frequency response of amplifiers; practical considerations of operational amplifiers; oscillators. ***Prerequisite: ELEE 240.***

**ELEE 340L Electronics Lab** **(0, 0, 2)**

A practical course on silicon and germanium diode characteristic; light emitting diode (LED); Zener diode; half-wave rectifier; full-wave rectifier; BJT/MOSFET transistor characteristics and switching applications; op-amp circuits. ***Prerequisite: ELEE 340.***

**ELEE 350 Signals and Systems** **3(3, 0, 0)**

This course introduces electrical engineering students to core tools in continuous-time signals and linear systems characterization and analysis, time-domain analysis using convolution, frequency domain analysis using Fourier series and transform, and Laplace transform. ***Prerequisite: ELEE 210 and MATH 202.***

**ELEE 360 Electric Machines** **3(3, 0, 0)**

Magnetic circuits, ideal and real transformers, equivalent circuit of a power transformer, single phase, three phase, auto transformers construction, regulation, transformer taps and voltage regulation, the voltage and induced torque equations in DC machines, the construction of DC machines, power flow and losses in DC machines, motor equivalent circuit, motor starters, efficiency , DC generators, voltage control and regulation, construction of AC machines, principle of operation as motor and generator synchronous generators, construction, equivalent circuits, power and torque equations, parallel operation. Synchronous motors starting, equivalent circuit-synchronous condenser. Induction motors, construction, equivalent circuit, power and torque, speed control. ***Prerequisite: ELEE 250.***

**ELEE 371 Principles of Data Communication and Networking 3(3, 0, 0)**
Network basic concepts. Network layers: OSI model and TCP/IP protocol architecture. Physical layer protocols and digital transmission fundamentals. Data link layer. Network layer. Network topologies. Medium access control systems. Packet switching and circuit switching. Routing in packet switching. Multiplexing. ***Prerequisite: STAT 230.***

**ELEE 380 Control Systems 3(3, 0, 0)**
A course that covers mathematical modeling (transfer functions, block diagrams, signal flow graph) of linear continuous single input/single output dynamical systems; Open-loop and Closed-loop systems analysis; First and second order systems, Systems Stability (Routh-Hurwitz criterion); Steady-state error analysis of unity feedback control systems; Frequency response analysis (Bode plots, Nyquist, Root-locus method); Introduction to PID controllers (performances, Ziegler-Nichols tuning method). ***Prerequisite: ELEE 350.***

**ELEE 390 Electromagnetic Field Theory 3(3, 0, 0)**
This course covers the fundamentals of engineering electromagnetics. It deals with transmission line theory; the study of electrostatic fields in vacuum and dielectrics, conductors, capacitance, electrostatic potential energy; magnetostatic fields, Biot-Savart law, Ampere's law, vector magnetic potential, inductance. ***Prerequisites: ELEE 350.***

**ELEE 399L MATLAB for Engineers 1(0, 0, 2)**
This course covers MATLAB fundamentals and graphics; m-files programming; Simulink; electrical engineering (e.g. control, communication and power systems) related MATLAB toolboxes. Laboratory based lectures are an integral part of this course. ***Prerequisite: ELEE 230.***

**ELEE 400 Summer Internship for Electrical Students (1 Cr)**
This is an eight to twelve-week professional training course in electrical engineering. This course is open for students with senior standing (who have completed around 80% of the total credit requirement) to gain practical training experience during the summer prior to graduation, or during graduation semester, with either a company or an academic institution while involved in a practical experience. ***Prerequisite: Last Summer in the proposed study sequence & ENGL 206.***

**ELEE 440L Electronic Circuits Lab 1(0, 0, 2)**
A practical course on BJT amplifiers; MOSFET amplifiers; differential amplifiers; frequency response of amplifiers; operational amplifiers practical considerations; oscillators. ***Prerequisite: ELEE 340.***

**ELEE 451 Digital Signal Processing 3(3, 0, 0)**
Discrete-time signals and systems; The z-transform; Frequency response; Discrete-Time Fourier Series (DTFS); Discrete-Time Fourier Transform (DTFT); Discrete Fourier Transform (DFT); Fast Fourier Transform (FFT); Digital filters design; Multi-rate; Correlation; Applications. ***Prerequisite: ELEE 350.***

**ELEE 460L Machines Lab 1(0, 0, 2)**
A practical course on Operation of Single-Phase Transformers, Three-Phase Transformers. DC Generator, Series, Shunt, Compound Generators. DC Motors, Series, Shunt, Compound Motors. Synchronous Generator, No-load test, parallel operation. Synchronous motors, Induction motors.

Single-Phase Induction motors. Plot curves of an AC machine characteristics. ***Prerequisite: ELEE 360.***

**ELEE 461 Fundamentals of Power Systems Analysis 3(3, 0, 0)**
Description: Introduction to Power systems, Review of Basic Principles (active, Reactive, and compels power, power factor, power factor correction, balanced three-phase circuits and analysis Y/Δ loads, per-phase analysis), power in single- and three-phase AC circuits. Power system analysis in normal operation and under symmetrical and unsymmetrical faults. Generator Model, Transformer Model (equivalent circuits, types), Per-Unit Systems and Calculations, Transmission Line Parameters and Calculation (resistance, capacitance, inductance, corona), current and voltage relations on a transmission line, Line Model and Performance (modeling of short, medium, and long lines, voltage and current waves, surge impedance loading, unit commitment, complex power flow, power transmission capability, line compensation). ***Prerequisite: ELEE 250***

**ELEE 470 Communication Systems 3(3, 0, 0)**
This is an introductory course that mainly introduces the basic techniques used in communication systems. It strongly depends on signal analysis; equivalent low-pass and band-pass models, Hilbert transform, and power spectral density. This course introduces students to amplitude modulation and demodulation: large carrier and suppressed carrier, single side-band, vestigial side band, and coherent and non-coherent detection; Angle modulation and demodulation: FM and PM, wideband and narrowband FM, transmission bandwidth, generation and demodulation of FM. Noise representation and analysis: SNR analysis of AM and FM systems. Pulse modulation techniques: sampling theorem, PAM, PPM, PWM, PCM, and Delta Modulation. Introduction to digital communications. ***Prerequisite: ELEE 350 and STAT 230.***

**ELEE 470L Communications Lab 1(0, 0, 2)**
A laboratory course with experiments covering the following topics: AM and FM modulation/demodulation, sampling and quantization, digital modulation (PSK, FSK, MSK, GMSK), digital demodulation, and inter-symbol interference. ***Prerequisite: ELEE 470.***

**ELEE 480L Control Lab 1(0, 0, 2)**
A laboratory course that covers analysis of linear systems; second order systems; effects of poles and zeros on the transient response; effect of gain on response and stability; compensation implementation. ***Prerequisite: ELEE 380.***

**ELEE 498 Final Year Project I 1(1, 0, 0)**
This course is intended to provide students with practical experience in a wide range of electrical engineering applications including electronics, power, control, computer, and communications. Students learn how to initiate a project in an engineering discipline by completing the main tasks: define the project, state the objectives, complete a literature survey, set project specifications, and select a design method. ***Prerequisite: Completion of 90 credit hours & ENGL 206.***

**ELEE 499 Final Year Project II 3(0, 3, 0)**
In this course, students work in groups to complete the project initiated in ELEE 498 under the supervision of an instructor. The course is offered either in lecture style with covered subjects including: design and implementation issues related to projects, progress evaluation, change

management, and closure; or as individual groups supervised by different instructors. ***Prerequisite: ELEE 498.***

## *Elective Courses:*

**ELEE 403 Special Topics in Electrical Engineering 3(3, 0, 0)**
Any selected topic in the state-of-the-art in Electrical Engineering. ***Prerequisite:*** *discretion of advisor.*

**ELEE 422 Computer Architecture 3(3, 0, 0)**
A course on the principles, techniques, and trade-offs used in designing modern processor architectures. Topics include: benchmarking and performance evaluation, long-latency instruction pipelining, hardware and software techniques for exploiting instruction-level parallelism (out-of-order, speculative, and predicated instruction execution; multithreading; loop unrolling, software pipelining, and trace scheduling), high performance memory systems, and multiprocessor systems and programming. ***Prerequisite: ELEE 290.***

**ELEE 423 Embedded Systems Design 3(3, 0, 0)**
This is a course on embedded hardware and software design. The system design process: requirements analysis, specification, hardware/software co-design, testing; Embedded computing platforms: general- and special-purpose processors, hardware accelerators, systems-on-a-chip, intellectual property (IP) core-based design, embedded networks; Software design tools and technologies: CAD tools, compilers, and assemblers. Hardware design tools and technologies: hardware-description languages, high-level synthesis tools, ASIC and FPGA design flows; Real-time operating systems: multiple tasks and processes, context switching, task scheduling, inter-process communication mechanisms; Low-power computing: circuit, architecture, and application techniques; System reliability and fault tolerance. ***Prerequisite: ELEE 290.***

**ELEE 431 Computer Networks 3(3, 0, 0)**
A course that outlines data communications; wide area networks; circuit and packet switching; routing; congestion control; local area networks; communications architecture and protocols; internetworking. ***Prerequisite: ELEE 371.***

**ELEE 442 Digital Integrated Circuits 3(3, 0, 0)**
A course on digital electronic circuits; models, current equations, and parasitic of CMOS transistors for digital design; study of CMOS inverter and logic gates, including analysis, design, simulation, layout, and verification; advanced circuit styles; sequential circuits; advanced topics: semiconductor memories, power grid, clocking strategies, data-path building blocks, deep-submicron design issues, interconnect. ***Prerequisite: ELEE 290 and ELEE 340.***

**ELEE 443 RF and Microwave Circuits for Communications 3(3, 0, 0)**
The course focuses on the analysis and design of high-frequency electronic circuits, with emphasis on RF and Microwave circuits and components for communication systems. The course covers the basic principles of radio-frequency (RF) and microwave circuits design, as applied to the design of micro-strip and coplanar lines, impedance transformers, low-pass and band-pass filters, directional couplers, power dividers, amplifiers, mixers, and diode detectors. It provides

understanding of S-parameters and signal-flow graph analysis techniques. The course enables the student to get hands-on experience in RF and Microwave circuit design through the use of computer-aided design tools to simulate and analyze high frequency circuits, build them as part of a course project, and perform measurements in the lab using network and spectrum analyzers. ***Prerequisite: ELEE 340 and ELEE 390.***

**ELEE 462 Power Electronics** **3(3, 0, 0)**

Introduction to power semiconductor devices. Signals and integration. AC-DC converters (Rectifiers), Un-/controlled rectifiers. DC-DC, DC-AC, AC-AC power conversion circuits, power converter supporting circuits. Basic buck, buck-boost and boost converters, power electronics for utility interface, current and voltage source inverters, power electronics for modern portable energy, and several applications of power electronics. Single-Phase and three-phase converters. Step-down and step-up converters. Switching mode regulations. Applications, DC drivers, DC power supplies. ***Prerequisite: ELEE 340.***

**ELEE 463 Electric Drives** **3(3, 0, 0)**

Fundamental and basic principles of electric motor drive systems are studied. Selecting the proper electric motor for different applications based on the characteristics of the electrical machine and the mechanical load are introduced. Moreover, designing a suitable power electronics converter and its associated control system (speed control, position control, and current control) for industrial drives are presented. Electric drives for dc motors, brushless dc motors, three-phase induction motors, and electronic low-power motors are thoroughly explained. ***Prerequisite: ELEE 360.***

**ELEE 465 Power System Planning** **3(3, 0, 0)**

Basic power system load forecast methodologies, Electric power system loads types and characteristics, Electric power system energy consumer categories, Power system generation and transmission reliability evaluation, Power system cost assessment, Electric power system load management and energy conservation strategies. Power system generation planning, Transmission system planning, and substation expansion planning. ***Prerequisite: ELEE 461.***

**ELEE 468 Renewable Energy Systems** **3(3, 0, 0)**

Renewable energy resources, Wind energy, types of wind turbines, solar thermal energy and solar PV, waste energy and biomass, tidal and water wave power, Hydropower plants, Micro-hydro generation technology, geothermal energy, fuel cells and hydrogen. Grid integration, recent integration requirements, micro-grid, Nano-grid, installation, large- and small scale renewables systems, role of renewable energy sources toward achieving the sustainable development goals, technical and sustainability challenges, and the future outlook for each of the renewable sources. Technical, economic, environmental, and social aspects of renewable energy. The strengths and weaknesses of different renewable energy policy options (feed-in tariffs, scheduling, energy management, quotas, etc.). ***Prerequisite: ELEE 250.***

**ELEE 469 Power System Protection** **3(3, 0, 0)**

It is an introductory course for the fundamentals of power System protection that reviews the different types of faults in the power system, principles and components of power system protection, types and operating principles of protective relays, protection of transmission lines (overcurrent, distance and pilot protection), apparatus protection (Bus bar-reactor, transformer,

generator, motor), power fuses, circuit breakers, overvoltage protection and mitigation techniques. ***Prerequisite: ELEE 461.***

**ELEE 471 Wireless Communications 3(3, 0, 0)**
A course on wireless channel models; performance of digital modulation schemes in wireless channels; diversity techniques; channel coding and interleaving in fading channels; adaptive equalization in wireless channels; multiple access techniques; fundamentals of cellular communications; current wireless communication systems. ***Prerequisite: ELEE 470.***

**ELEE 474 RF and Microwave Communication Systems 3(3, 0, 0)**
This course introduces students to system blocks, system parameters and architectures of RF and microwave systems for wireless communications. It mainly targets the physical layer of a communication system, addresses the operation of the components that reside within the RF chain, details the functional level modeling of RF systems by accounting for the gain, noise, non-linearity, sensitivity and dynamic range parameters, and overviews link budget analysis of RF radio links. ***Prerequisite: ELEE 340 and ELEE 390.***

**ELEE 476 Digital Communications 3(3, 0, 0)**
Pulse code Modulation (PCM). Baseband transmission: Pulse shaping and line coding. Nyquist's criterion for distortion less transmission. Digital transmission techniques: Binary and Multilevel ASK, FSK and PSK. Detection principles for digital communication signals in noise. Coherent and non-coherent detection. Performance analysis of digital modulation schemes in the presence of noise. Evaluation of symbol and bit error rate. Channel coding. ***Prerequisite: ELEE 470.***

**ELEE 485 Instrumentation 3(3, 0, 0)**
This is a design course for complete instrumentation systems including measurements, sensors, data acquisition, and component integration. Application areas and course projects include industrial control, laboratory measurements, automation systems, and the like. This course is completed with a set of laboratory experiments. ***Prerequisite: ELEE 380.***

**ELEE 490 Electromagnetic Waves and Transmission 3(3, 0, 0)**
This course covers basic concepts and methods related to time-varying electromagnetic fields. It deals with impedance matching using the Smith Chart, Maxwell's equations for time varying fields, plane-wave propagation, and wave reflection and transmission. ***Prerequisite: ELEE 390.***

**ELEE 491 Antenna Theory and Design 3(3, 0, 0)**
This course presents the basic principles of antenna theory analysis and design for wireless communications. It covers the fundamental parameters of antennas and the analytical methods used to design linear antennas, loop antennas, antenna arrays and microstrip antennas. ***Prerequisite: ELEE 390 and ELEE 470 (CO).***