ELECTRONICS (ELEC)

ELEC1000 INTRODUCTION TO ENGINEERING AND TECHNOLOGY
This initial course introduces technology concepts and engineering drawing. Students will learn about basic systems, get an overview of their major, and become acquainted with the skill sets they will need to be successful in their field. **Prerequisite:** Enrollment in BCOT or BEET program (4 credits)

ELEC1100 CIRCUIT THEORY I
The concepts of current, voltage, power, energy, and resistance are studied. Topics include DC and AC sources, capacitance, inductance, and magnetism. Resistive circuits are analyzed using Ohm’s and Kirchhoff’s Laws and computer-aided circuit analysis using SPICE is included. **Corequisite:** MATH1000 or MATH1035 (4 credits)

ELEC1500 CIRCUIT THEORY II
The concepts of impedance and admittance in sinusoidal circuits are examined. Circuits are solved using superposition, Thévenin, Norton, nodal, and mesh analysis. Resonant circuits and transformer theory are also studied. Laboratory work and computer-aided analysis techniques are designed to correlate with theory. **Prerequisite:** ELEC1100; **Corequisite:** MATH1500 (4 credits)

ELEC2000 SEMICONDUCTOR DEVICES
A variety of semiconductor devices are introduced. Emphasis is placed on diodes, BJTs, oscillators and FET. A variety of applications including triacs, SCRs, optoisolators, and other devices are also included. **Prerequisite:** ELEC1500; **Corequisite:** MATH1700 (4 credits)

ELEC2100 LOGIC CIRCUITS
This course introduces the Boolean algebra, combination logic circuits, counters, registers, ALUs, encoders, decoders and multiplexer. Circuit simulation software is used in laboratory work. **Prerequisite:** ELEC1100 (4 credits)

ELEC2250 NETWORK THEORY I
The fundamental concepts of current, voltage, and power are studied along with the properties of passive circuit elements as well as network theorems. Transient analysis R-L, R-C, and R-L-C circuits and initial conditions are studied. Laboratory experiments parallel classroom theory and include circuit simulation. **Prerequisite:** MATH1850 or MATH1875; **Corequisite:** MATH2500 (4 credits)

ELEC2275 DIGITAL LOGIC
This course introduces digital logic and circuits. Topics include continuous and discrete number representations, binary arithmetic, combinational logic (Boolean algebra, truth tables, Karnaugh maps, encoders, decoders, multiplexer), sequential logic (flip-flops, timing diagrams, counters, registers, state machines, memory), integrated circuit issues (operating characteristics, logic voltage levels, propagation delay, fan-out), power dissipation and programmable logic devices. Digital circuits are implemented and tested utilizing both schematic diagram representation and hardware description language (HDL). **Corequisite:** ELEC2250 (4 credits)

ELEC2299 ELECTRICAL CIRCUIT ANALYSIS & DESIGN
Basic electric circuit theory is covered, including direct current (DC), transient, and alternating current (AC) steady state analysis. Specific topics include the concepts of current, voltage, resistance, capacitance, inductance, impedance, power, energy, power factor, Ohm’s Law, series and parallel circuits, Kirchhoff’s Laws, nodal analysis, mesh analysis, Superposition Theorem, Thévenin’s Theorem, Norton’s Theorem, Maximum Power Transfer Theorem, Phasor diagrams, and introduction to the Laplace Transform in circuit analysis. Laboratory work and computer-aided analysis techniques are designed to correlate with circuit analysis theory and design. **Corequisites:** MATH1850 and PHYS1750 (4 credits)

ELEC2499 LOGIC CIRCUITS
This course introduces binary and hexadecimal numbers, Boolean algebra, truth tables, Karnaugh maps, and combination logic using basic gates. Flip-flops, counters, registers, ALUs, encoders, and decoders are also presented. Circuit simulation software is used in both classroom and laboratory work. **Prerequisite:** ELEC1100 (4 credits)

ELEC2599 INTRODUCTION TO MICROPROCESSORS
This course introduces microprocessors and microcomputer systems. Related hardware and software issues will be covered. It will also cover memory systems, input/output devices, and interfacing mechanisms. **Prerequisite:** ELEC2499 (4 credits)

ELEC2600 DIGITAL APPLICATIONS
This course covers the analysis and modeling of high-speed digital systems. It examines the use of programmable CMOS integrated circuits. The student will learn to implement both combination and sequential logic circuits in addition finite state machines. **Prerequisite:** ELEC1500 and ELEC2100; **Corequisite:** MATH1800 (4 credits)

ELEC2699 INTEGRATED ELECTRONICS
This integrated electronics course covers basic analog and digital electronic circuits and devices. The topics include diodes, MOSFETs, FETs, BJTs, operational amplifiers, inverting, non-inverting, integrating, and differentiating op-amps, bioinstrumentation amplifiers, filters, oscillators and signal generators, digital logic, Boolean algebra, Karnaugh maps, logic gates, flip-flops, programmable logic devices, encoders, decoders, counters, registers and A to D converters. Lab experiments will include basic analog and digital devices, practical biomedical applications, and a design project. **Prerequisite:** ELEC2299 (3 credits)

ELEC2700 INTEGRATED CIRCUITS WITH APPLICATIONS
Integrated circuit applications of operational amplifiers and linear integrated circuits are introduced. Topics include the use of linear and non-linear IC’s in open and closed loop (feedback) configurations. **Prerequisite:** ELEC2000; **Corequisite:** MATH1800 (4 credits)

ELEC2750 NETWORK THEORY II
In this continuation of Network Theory I, the concept of complex impedance and admittance is included. Circuits are analyzed using network theorems. Magnetic circuits, transformer concepts and AC power are studied in addition to three-phase balanced circuits. The Laplace Transform analysis and its application to circuit analysis are also studied. **Prerequisites:** ELEC2250 and MATH2500 (4 credits)
ELEC2799 CIRCUIT THEORY AND APPLICATION
Introduction to electrical and electronic circuits, with emphasis on building a foundation for applications involving mechanical systems. Voltage, current and power will be analyzed in DC and AC circuits having components that include resistors, capacitors, inductors, diodes or operational amplifiers. Some of the laboratory exercises will involve applications having sensors of mechanical phenomenon, signal conditioning, data acquisition and basic signal processing on a computer running suitable software. Some of the homework and laboratory exercises will involve building and testing circuits using circuit simulation software. Prerequisites: MATH1750 and PHYS1750 (3 credits)

ELEC2850 MICROCONTROLLERS USING C PROGRAMS
Students learn to develop both computer programs and microcontroller systems. Based on the C language, fundamental programming concepts are explored, including types, operators (Boolean, binary, numeric), expressions, control flow, functions, pointers, arrays, structures and input/output mechanisms. Microcontroller concepts are explored, including hardware architecture, programming model, timers, interrupts, data acquisition, signal output and serial communication. Peripheral circuits for microcontrollers are developed for signal conditioning of sensor input and for controlling of actuators. Prerequisite: ELEC2275 (4 credits)

ELEC2950 EMBEDDED COMPUTER SYSTEMS
Students will design embedded data acquisition systems to monitor and record data from a variety of electromechanical systems. This course includes the study and use of sensors for measurement of physical parameters, signal conditioning for input interfacing, semiconductor devices for output control. Both hardware and software designs are implemented to solve a variety of engineering applications. Prerequisite: ELEC2275 (3 credits)

ELEC3000 OBJECT ORIENTED PROGRAMMING ELECTRONICS
This course is an introduction to object oriented programming topics useful for electronics. Topics include I/O file streams and data files, introduction to classes, class functions, and conversions. Prerequisite: ELEC2850 (4 credits)

ELEC3025 INTERNET OF THINGS
Explore technology and development for the internet of things (IoT), including the IoT aspects of 1) nodes of embedded processors connected to sensors or actuators, 2) communication between nodes, gateways and the cloud using communication protocols, and 3) cloud for data storage and analytics. Prerequisite: ENGR1800; Corequisite: ELEC2275 or ELEC2299 or ELEC2799 or BIOE2500 (4 credits)

ELEC3100 DATA COMMUNICATIONS
This course introduces the concepts of digital transmission, metallic cable and fiber transmission media, transmission lines, public telephone network and data communications. Prerequisite: ELEC2100 (4 credits)

ELEC3150 OBJECT ORIENTED PROGRAMMING FOR ENGINEERS
This course introduces students to a set of tools and methods that enables engineers to build reliable, user-friendly, maintainable, well documented, reusable software systems. This course teaches these fundamental ideas through the object-oriented approach to programming using C++ and Java. Prerequisite: ELEC2850 (4 credits)

ELEC3160 DIGITAL IMAGE PROCESSING
This course introduces the student to digital image processing. Topics considered are image capture, computer processing of digital images, and display. Applications include image enhancement, noise filtering, special effects, edge detection algorithms, compression methods like JPEG, and image analysis. Laboratory and class work demonstrate some of the underlying mathematical principles including transform techniques like FFT, DCT, Haar and wavelets. Prerequisite: MATH1500 (3 credits)

ELEC3200 ADVANCED DIGITAL CIRCUIT DESIGN
Students learn the approach to designing complex digital systems described using schematic entry or hardware description languages. Circuits are synthesized, simulated and tested on programmable logic hardware circuits. Prerequisite: ELEC2275 (4 credits)

ELEC3225 APPLIED PROGRAMMING CONCEPTS
This course will introduce engineers to applied programming concepts and large-scale programming projects. Topics include design patterns, data structures, database management, advanced user’s interfaces, algorithm design, and version control and regression testing. The course will focus on hands-on programming, with both small and large projects. Prerequisites: ELEC3150 or instructor permission (3 credits) summer

ELEC3250 ANALOG CIRCUIT DESIGN
This course covers the concepts of design, analysis, simulation, implementation and evaluation of analog electronic circuits and systems. Topics include semiconductor physics, BJT, MOS, and FET devices and linear integrated circuits. Prerequisite: ELEC2750 (4 credits)

ELEC3300 ELECTRIC MACHINES & TRANSFORMERS
This course concentrates on single-phase and three-phase systems, magnetic systems, transformers, electromechanical conversion principles, three-phase and single-phase induction motors, synchronous motors and generators, DC generators and motors, and stepper motors as applied to electric power and control systems. Laboratory work parallels classroom theory. Prerequisite: ELEC1500 (4 credits)

ELEC3350 SOLID STATE DEVICES
The primary goal of this course is to provide students with the essential background on semiconductor materials and devices including a basic understanding of crystal structure, energy bands, charge carriers and junctions. Prerequisites: ELEC3250 and MATH2025 (3 credits)

ELEC3450 MICROCONTROLLERS & EMBEDDED COMMUNICATION
This course will introduce the students to microcontroller principles, both hardware and software. Students will write assembly language programs using programming techniques and use sensor signal conditioning for interfacing and software design. Prerequisite: ELEC2100 (4 credits)

ELEC3500 ELECTRONICS II
This course, the second in a two-course sequence, covers the concepts of design, analysis, simulation, implementation and evaluation of electronic circuits and systems. Topics include diodes, MOSFETs, BJTs, building blocks of integrated circuit amplifiers, differential and multi-stage amplifiers, and output stages and power amplifiers. Prerequisites: ELEC3350 (4 credits)

ELEC3550 COMPUTER NETWORKS FOR ENGINEERS
This course focuses on the Internet and a modern treatment of computer networking. Topics include network services, application, transport and network layers, local area networks, wireless and mobile networks, multimedia networking and network security. Prerequisite: ELEC3150; Corequisite: ELEC3725 (4 credits)
ELEC3575 COMPUTER COMMUNICATION & NETWORK
This course covers local (LAN), metropolitan (MAN) and wide area (WAN) networks, topologies and transmission media, network interface and management, congestion/flow/error control, routing and addressing. Laboratory exercises include simulation and installation of small network. **Prerequisite:** ELEC3100 (4 credits)

ELEC3600 SIGNALS AND SYSTEMS
This course introduces students to signals and systems and to linear algebra. Topics include: matrix operations, determinants, vector spaces, linear transformations, orthogonality, eigenvalues, signal operations, classifications of signals and systems, continuous-time LTI system analysis (impulse response, convolution, Laplace transform and its applications), continuous-time signal analysis (Fourier series, Fourier transform and its applications). **Prerequisites:** MATH2025 and MATH2500 (4 credits)

ELEC3650 EMBEDDED SENSOR NETWORK
This course focuses on the embedded processor nodes with sensors and actuators that are on the edge of the Internet of Things (IoT), interacting with the physical world. Theory and methods of IoT, microcontrollers, electronic interfaces, sensor input, actuator output, and communication to other embedded nodes, gateways and the cloud are investigated. Students develop systems by programming software and assembling hardware components for IoT applications. **Prerequisite:** ELEC3025 (4 credits)

ELEC3675 LINEAR NETWORK ANALYSIS
This course introduces first and second order differential equations, initial condition problems, Laplace Transforms with partial fraction expansion, pole/zero analysis, and Fourier Transforms. Associated laboratory experiments parallel the theory and help demonstrate the practical usefulness of the topics as they apply to electronic and computer engineering technology problems. **Prerequisite:** MATH2000 (4 credits)

ELEC3725 COMPUTER ARCHITECTURE
This course introduces engineering students with the design of computer systems and components; processor design, instruction set design, and addressing; control structures and microprogramming; memory management, caches, and memory hierarchy; interrupts and I/O structures. **Prerequisite:** ELEC2275; **Corequisite:** ELEC3550 (3 credits)

ELEC3750 COMPUTER SYSTEMS ARCHITECTURE
This course examines the operation of a computer system including microprocessor, I/O, mass storage, monitors, and memory. Introduces machine language and compilers as applied to current and state-of-the-art systems. Interfacing with stepper motors and sensors are also introduced. **Prerequisite:** ELEC2100 (4 credits)

ELEC3775 DISCRETE SIGNALS & SYSTEMS
Discrete signals and systems are identified and studied. The use of difference equations, convolution techniques, and z-transforms are included. The need for anti-aliasing filters, sample-and-hold circuitry as well as limitations of ADCs are emphasized. Laboratory exercises address practical solutions to problems. **Prerequisite:** Junior status; **Corequisite:** ELEC3675 (4 credits)

ELEC3800 SPECIAL TOPICS IN ELECTRONICS
Presents topics that are not covered by existing courses and are likely to change from semester to semester. Refer to the Class Schedule for a specific semester for details of offerings for the semester. (1 - 4 credits)

ELEC3900 INTRODUCTION TO NANOTECHNOLOGY
The ongoing impact of nanotechnology on the current state of science and engineering will be explored here. Various deposition techniques and applications are also studied. (3 credits)

ELEC3920 ENGINEERING SIGNALS & SYSTEMS
Continuous and discrete-time signals and systems will be studied. Time domain analysis of linear systems will include convolution (discrete and continuous), time-invariance, causality, and stability of systems. Time domain analysis of signals using the Fourier series and Fourier integral will be covered as well as frequency domain analysis of signals using the Fourier transform. Laplace transform analysis of linear systems including pole-zero plots and z-transform analysis of discrete systems will be studied. Laboratory exercises will use computer software to strengthen important course concepts. **Prerequisites:** ELEC2750 and MATH2500 (4 credits)

ELEC3950 ADVANCED SENSORS & INTERFACING SYSTEMS
Topics include linear and nonlinear sensors, high-performance instrumentation amplifiers for signal conditioning, temperature sensors, analog computational units with application of linear regression techniques, and design of multiplier circuits. Modern sensors and interfacing with microcontrollers are introduced. **Prerequisite:** ELEC2700 (4 credits)

ELEC4000 DIGITAL SIGNAL PROCESSING
This course presents the basic digital signal processing (DSP) principles used in the design and analysis of sampled signals. Topics include but are not limited to design of finite impulse response (FIR) filters and infinite impulse response (IIR) filters. The Fast Fourier Transform (FFT) is studied in order to compute the Discrete Fourier Transform (DFT). Laboratory experiments emphasize hardware and software solutions to practical problems. **Prerequisites:** ELEC3775 (4 credits)

ELEC4025 HARDWARE SECURITY
This course will introduce students to the hardware and related software aspects of modern computing devices. Students will learn about confidentiality, data integrity, availability, general methods of data/information protection, and study existing exploitations, in order to design more secure systems/devices. Students will also study the ethics of hacking and security. **Prerequisites:** ELEC2850 or instructor permission (3 credits) summer

ELEC4050 MOTORS AND CONTROLS
This course reviews the topic of magnetic, DC, AC (single and 3-phase) and special motors are considered. Applications of different types of motors will be discussed. Electromechanical control equipment as well as the solid state control equipment will be covered. The course will use the knowledge learned in previous courses in the curriculum to build a working model for a particular application. **Prerequisites:** ELEC3250 and MATH2025 (4 credits)

ELEC4075 ENGINEERING OPERATING SYSTEMS
Students will learn the fundamentals of operating systems concepts and architectures for various platforms such as personal computers, mobile, networked and real-time embedded systems. Coverage shall include operating systems architecture, concepts and methods for managing processes and threads, main memory, file systems, I/O management and real-time systems. Detailed examples are taken from several operating systems, emphasizing the techniques used in UNIX variants. Concepts and techniques will be demonstrated using lab experiments using UNIX-like system such as Linux or QNX. **Prerequisite:** ELEC3150 (4 credits) spring

ELEC4100 ELECTROMAGNETICS
Static electric and magnetic fields are studied in this course. Maxwell’s equations are presented and time-varying fields are introduced. Laboratory applications include transmission of electromagnetic waves in air and on transmission lines. **Prerequisite:** MATH2000 (4 credits)
ELEC4200  DIGITAL CONTROL & SYSTEMS
This course will use velocity and position feedback to control servos. PID and other types of systems will be analyzed through software packages employing BODE, Nyquist and Root locus techniques. **Prerequisite:** ELEC3675; **Corequisite:** ELEC4225 (4 credits)

ELEC4225  INTRODUCTION TO DIGITAL SIGNAL PROCESS
This course introduces sampling, aliasing, ADCs and z-transforms. DSP applications including digital filtering (both FIR and IIR) are analyzed and designed. Fast Fourier Transform (FFT) is studied in order to compute the Discrete Fourier Transform (DFT). Laboratory experiments emphasize hardware and software solutions to practical problems. **Prerequisites:** ELEC3450 and ELEC3675 (4 credits)

ELEC4300  ENGINEERING COMMUNICATION SYSTEMS
This course serves as an introductory course in analog and digital communication systems. Topics covered include amplitude, frequency, pulse and pulse-code modulation and signal-to-noise ratios for various modulation schemes and sampling, quantization and coding. The laboratory would augment the course materials. **Prerequisite:** MATH2100 (4 credits)

ELEC4350  FEEDBACK CONTROL SYSTEMS
Analysis and design of linear control systems will be accomplished using Root locus, Bode and Nyquist techniques. The laboratory experiments will include servo trainers and employing 4 software packages. Digital systems will be introduced as well as state variables. PID controllers will be covered. **Prerequisites:** ELEC3675 and ELEC3775 (4 credits)

ELEC4400  ENGINEERING DIGITAL SIGNAL PROCESSING
This course presents the theory and practice of digital signal processing. Topics include review of discrete-time signals, systems and the Z-transform; sampling and quantization; Fourier transforms (DTFT, DFT and FFT) with applications to fast convolution; design techniques for FIR and IIR digital filters; realization structures for digital filters and finite precision effects; fundamentals of multirate signal processing and filter-banks; and DSP applications. **Prerequisites:** ELEC3600 and MATH2300 (4 credits)

ELEC4425  ADVANCED PROGRAMMABLE LOGIC
The objective of this course is to build a RISC processor core. The emphasis will be on implementing MSI circuits using VHDL language. Students utilize top-down methodology to design complex logic circuits using programmable logic abstractions. They synthesize hierarchical architecture structures in building a processor core. **Prerequisites:** ELEC2100 and ELEC3750 (3 credits)

ELEC4450  DIGITAL COMMUNICATION SYSTEMS
This course studies sampling, coding, decoding, pulse code modulation, digital multiplexing, digital carrier systems, frequency shift keying, data compression, as well as bandwidth considerations. Laboratory work parallels classroom theory. **Prerequisite:** ELEC3775 or ELEC4425 (4 credits)

ELEC4475  FEEDBACK AND CONTROL
The definition of an analog feedback control system will be the introduction of the course. The course proceeds with the time-domain and frequency-domain analysis of closed loop feedback control systems. The relationship between the time-domain and frequency-domain is discussed. The stability methods are explained. The course provides an introduction to the state-space method and an introduction to discrete control systems. **Prerequisites:** MATH2500; **Corequisite:** ELEC4050 (4 credits)

ELEC4500  ELECTRONICS DESIGN PROJECT I
The first of a two course sequence, this course concentrates on the selection of an appropriate engineering project for design, the development of time and financial budgets, and milestone graphs. The majority of work is spent in the laboratory researching, designing, prototyping, debugging, and acquiring data on the students’ individual designs. Engineering notebook is required. **Prerequisites:** ELEC3450 and ELEC3950; senior status (3 credits)

ELEC4725  ADVANCED COMPUTER ARCHITECTURE
We will discuss various concepts behind the designs of current microprocessors. In particular, the topics that will be covered in the course are but not limited to: performance simulators and evaluation, static and dynamic scheduling, instruction-level parallelism, advanced pipelining, speculative execution, memory hierarchy and organization, multi-processing. **Prerequisite:** ELEC3725 (3 credits) spring

ELEC5000  SENIOR DESIGN PROJECT I
This course is for BCOT senior students to pursue project-oriented work. Students may work in their curriculum or become involved in an interdisciplinary problem. Course requirements include oral and written progress reports throughout the semester plus a final technical report documenting the semester’s work. **Prerequisite:** Senior status (4 credits)

ELEC5500  SENIOR DESIGN PROJECT II
The second of a two course sequence, Senior Design Project II focuses on implementing the design developed in Senior Design Project I. Emphasis is placed on both oral and written presentation skills as well as packaging and fabrication of an “engineering prototype”. **Prerequisites:** ELEC4500 (3 credits)