

# FBSU DEPARTMENT OF ELECTRICAL ENGINEERING

## Course Descriptions

- ELEE 210 Electric Circuits I** **3(3, 0, 0)**  
A course on fundamentals of electric circuits; basic elements and laws; independent and dependent sources; techniques of circuit analysis: nodal and mesh analysis; circuit theorems: linearity, superposition, source transformation, Thevenin and Norton equivalents; inductors and capacitors. Prerequisite: CSC 101 and 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; introduction to VHDL. Pre-requisite: CSC 101.
- ELEE 230 Programming for Engineers** **3(3, 0, 0)**  
This course introduces the basic concepts and principles of structured and object oriented programming in a high level language. The course also covers basic data types, control structures, methods, arrays, conditional statements, loop statements, functions, classes and objects, recursion, pointers and strings. The course is offered in a computer laboratory. Pre-requisite: CSC 101.
- ELEE 240 Electronics** **3(3, 0, 0)**  
A course on semiconductors; semiconductor devices including PN junctions, diodes, Bipolar junction transistors (BJT), MOS field effect transistors (MOSFET), operational amplifiers (OP-AMPS); device characteristics; diode and transistor circuits. The course covers fundamental skills in analysis of electronic circuits: DC biasing, AC small signal analysis, and circuit simulation. Pre-requisite: ELEE 210.
- ELEE 250 Electric Circuits II** **3(3, 0, 0)**  
A course on analysis of one-phase AC circuits under steady-state; AC power calculations and power factor correction; transient response of RL, RC and RLC circuits; ideal transformers. Prerequisite: ELEE 210.
- ELEE 250L Electric Circuits Laboratory** **1(0, 0, 2)**  
A laboratory course that covers the use of laboratory instruments; passive electronic components; voltage-divider circuits; sources and Thevenin's theorem; RC lead-lag networks, series resonance, and transformers. This lab course also introduces circuit simulation using PSPICE. Co-requisite: ELEE 250.
- ELEE 290 Digital Systems** **3(3, 0, 0)**  
Microprocessor and Microcontroller design and applications: internal architecture, programming, interfacing techniques, and performance evaluation. The course includes a design project. Prerequisite: ELEE 220 and ELEE 230.
- ELEE 290L Digital Systems Lab** **1(0, 0, 2)**  
Logic circuit design: combinational and sequential circuits; computer organization and interfacing techniques; program-controlled and interrupt-driven I/O; memory organization; simple peripheral devices and controllers; bus interfaces; microcontroller-based designs. Co-requisite: ELEE 290.
- ELEE 340 Electronic Circuits** **3(3, 0, 0)**  
A course on BJT amplifiers; MOSFET amplifiers; differential amplifiers; frequency response of amplifiers; negative and positive feedback; operational amplifiers; oscillators; digital CMOS circuits; TTL circuits, SPICE simulations. Prerequisite: ELEE 240.
- ELEE 340L Electronics Lab** **1(0, 0, 2)**  
Single-phase diode rectifier circuits; LEDs; Zener diode regulator; diode clamping and clipping; BJT and MOSFET characteristics; op-amp circuits. Co-requisite: ELEE 240.
- ELEE 350/CEN 240 Signals and Systems** **3(3, 0, 0)**  
Signals and systems: definition, properties, and analysis; the Fourier series; the Fourier transform and its applications; the Laplace transformation and its applications; analysis and design of analog filters, MATLAB for analog signal processing. Prerequisite: MATH 202 and ELEE 250.
- ELEE 360 Electric Machines** **3(3, 0, 0)**  
A course on three-phase circuits and power calculations; magnetic circuits; single-phase and three-phase transformers; DC and AC machines under steady-state: construction, equivalent circuit, testing and performance characteristics. Prerequisite: ELEE 250.

**ELEE 380      Linear 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 presents a review of vector analysis and covers the study of static electric fields in vacuum and dielectrics, conductors, capacitance, the study of magnetic fields in magnetic and non-magnetic media, and inductance. The concepts of electrostatic and magnetic potentials, energy and forces are introduced. The course also covers the basic concepts of time-varying fields (Maxwell's equation). Prerequisites: PHYS 102 and MATH 215.

**ELEE 399L      MATLAB for Engineers      1(0, 0, 2)**

Introduction to the MATLAB programming environment: Desktop, command window, graph window; application of MATLAB in engineering problems, especially numerical computing techniques. Prerequisites: MATH 225.

**ELEE 400      Internship for ELEE 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: Senior standing and ENGL 206.

**ELEE 470      Communication Systems      3(3, 0, 0)**

This is an introductory course on modern communication systems. The course covers the following main topics: fundamentals of analog and digital modulation methods; analog to digital conversion and pulse coded modulation; transmission and reception of digital signals; introduction to noise modeling and the effects of channel noise on the performance of analog and digital communication systems. Prerequisites: ELEE 350 and STAT 230.

**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. Pre-requisite: 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: Senior standing and ENGL 206.

**ELEE 499      Final Year Project II      3(0, 3, 0)**

Students work in groups to complete the project initiated in ELEE 401 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

### Elective Laboratories

**ELEE 440L      Electronic Circuits Lab      1(0, 0, 2)**

PSpice simulation of electronic circuits; linear applications of op-amp; Wein-bridge oscillator; active filters: LPF and HPF; Schmitt trigger and astable multi-vibrator; differential amplifier using BJT; CMOS inverter characteristics; TTL inverter characteristics. Prerequisite: ELEE 340.

**ELEE 460L      Machines Lab      1(0, 0, 2)**

Transformers: open circuit, short circuit, and load test; unbalanced loading and parallel operation of transformers; speed control and load characteristics of shunt, series and compound dc machines; induction machines: blocked rotor, no-load, and loading tests; operation of single-phase induction motors; operation of a synchronous machine connected to a large external source. Prerequisite: ELEE 260.

**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 370.

**ELEE 490L    Radio Frequency Lab** **1(0, 0, 2)**

Transmission line parameters; attenuation, magnitude and phase of voltage and current on lines; reflected waves; waveguide characteristics and techniques; antenna patterns and impedances; optical devices. Prerequisite: ELEE 390.

**Electives - General**

**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 421    Computer Graphics** **3(3, 0, 0)**

A course on interactive graphics; graphics hardware; graphical input devices; windowing; clipping; viewports; zooming, geometrical transformations (2D and 3D); data structures; advanced raster display architectures; raster algorithms; special graphics techniques; applications. Prerequisite: Senior standing.

**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. Prerequisites: ELEE 290.

**ELEE 431/CEN 340/CSC 384    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. Prerequisites: ELEE 350 and STAT 230.

**ELEE 441    Analog Integrated Circuits** **3(3, 0, 0)**

A course on the design of analog integrated circuits with an emphasis on MOS circuits; op-amp design; feedback and stability; applications of analog integrated circuits such as filtering and A/D conversion; comparison with bipolar circuits; extensive use of SPICE for circuit simulation. Prerequisite: ELEE 340.

**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 451    Digital Signal Processing** **3(3, 0, 0)**

Review of signals, systems, and transforms; design of Digital Filters: FIR and IIR; sampling and reconstruction of signals; multi-rate signal processing with applications; effects of finite word length; discrete random signals and Spectral Estimation; introduction to 2D signal and image processing. Prerequisite: ELEE 350.

**ELEE 454    Digital Image Processing** **3(3, 0, 0)**

A course on two-dimensional signals and systems; image formation and perception; representation, coding, filtering restoration, and enhancements; feature extraction and scene analysis; introduction to computer vision. Prerequisite: ELEE 350.

- ELEE 455 Adaptive Filtering** **3(3, 0, 0)**  
 A course that examines the fundamentals of adaptive filter analysis and design, with emphasis on applications in linear and decision-feedback equalization, beam forming, channel estimation and tracking, noise and echo cancellation, source separation, and blind equalization; stochastic gradient algorithms (LMS-type) and recursive least-squares algorithms (RLS-type). Prerequisite: ELEE 350.
- 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 370.
- ELEE 472 Information Theory** **3(3, 0, 0)**  
 This course introduces the field of information theory and its applications to communications theory, computer science, statistics, and probability theory. Covering all the essential topics in information theory, we introduce the basic quantities of entropy, relative entropy, and mutual information, and show how they arise as natural answers to questions of data compression, channel capacity, rate distortion, and hypothesis testing. Prerequisite: Senior standing.
- ELEE 473 Coding Theory** **3(3, 0, 0)**  
 This course introduces the theory of error-correcting codes. The course will focus on results of asymptotic or algorithmic significance. Topics include: construction and existence results for error-correcting codes; limitations on the combinatorial performance of error-correcting codes; low density parity check codes; algebraic geometric codes; Turbo codes; and decoding algorithms. Prerequisite: Senior standing.
- ELEE 475 Stochastic Processes, Detection, and Estimation** **3(3, 0, 0)**  
 This is a course on types of random processes, series representation, and filtering; hypothesis testing and parameter estimation from a probabilistic point of view; extension to detection and estimation of known signals in white and non-white noise; prediction and filtering problems. Prerequisites: STAT 230 and ELEE 350.
- ELEE 481 Control System Analysis and Design** **3(3, 0, 0)**  
 This course outlines state-space models of discrete and continuous, linear and nonlinear systems; controllability; observability; minimality; Eigenvector and transforms analysis of linear time invariant multi-input multi-output systems; pole shifting; computer control; design of state feedback controllers and observers. Prerequisite: ELEE 380.
- ELEE 482 Robotics** **3(3, 0, 0)**  
 A course that examines robot manipulators: kinematics, control, programming, task planning, and effect of load; design of robot controllers: path tracking, force feedback control, real-time computation issues; a set of laboratory experiments and a design project. Prerequisite: ELEE 380.
- ELEE 483 Optimal Control** **3(3, 0, 0)**  
 A course on optimization theory and performance measures; calculus of variations; the maximum principle; dynamic programming; numerical techniques; LQR control systems. Prerequisite: ELEE 380.
- ELEE 484 System Identification** **3(3, 0, 0)**  
 This course provides an introduction to time series; auto regressive moving average models and their characteristics; modeling; forecasting; stochastic trends and seasonality; multiple series and optimal control; and applications. Prerequisite: Senior standing.
- 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 486 Intelligent Control Systems** **3(3, 0, 0)**  
 Introduction to artificial intelligence concept and techniques; fuzzy control systems: fuzzy logic; fuzzy sets; fuzzification and defuzzification; fuzzy inference and control; neural network control: single-layer and multi-layer perceptrons, self-organizing networks, feedforward networks, training techniques; considerations of practical implementation of intelligent control. Prerequisite: Senior standing.

## **Electives - Electric Machines and Power Systems**

### **ELEE 461 Fundamentals of Power Systems Analysis 3(3, 0, 0)**

Basic concepts and modeling of generation, transmission, and distribution systems; load flow analysis; economic load dispatch problem; symmetrical and asymmetrical short circuit studies; simplified power system stability analysis; introduction to power system operation and control problems. Prerequisite: ELEE 360.

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

A course on diodes; diode circuits and rectifiers; thyristors; controlled rectifiers; power transistors; DC choppers; pulse width modulated inverters; introduction to gate and base drive circuits; switching power supplies. Prerequisite: ELEE 340 and ELEE 360.

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

A course that covers steady-state analysis of dc and poly-phase induction motors, starting, and control; AC drives: solid-state control, dc link in adjustable speed drives, voltage and frequency controls, braking and plugging; DC drives: rectifier and chopper drives, dynamic and regenerative braking, plugging. Stepper motors: types, operational characteristics, control algorithms, power drive configurations. Special-purpose motors. Prerequisite: ELEE 360.

### **ELEE 464 Industrial Electrification 3(3, 0, 0)**

A course on medium and low voltage installations; lighting; practical applications of electric machines; motor control centers; emergency power supplies; auxiliary systems. Prerequisite: ELEE 360.

### **ELEE 465 Power System Planning 3(3, 1, 0)**

A course that investigates energy and peak load forecasts, weather-sensitive forecasts, generation reliability, load duration curves, loss-of-load expectation, capacity reserve evaluation, generation and transmission expansion, power flow analysis, reliability of bulk supply, and cost-benefit analysis. Prerequisite: ELEE 461.

### **ELEE 466 Environmental Aspects of Energy Systems 3(3, 0, 0)**

A course that examines world energy resources and classifications; sources and effects of air pollution; air quality modeling, Gaussian dispersion models for pollution estimation; motor vehicle emissions and noise pollution; environmental impacts of electricity generation, pollution control systems, electromagnetic radiation, production and impacts in high-voltage applications; environmental impact assessment; basic concepts. Prerequisite: Senior standing.

### **ELEE 467 Energy Planning and Policy 3(3, 0, 0)**

This course focuses on features of modern energy planning and policy. Topics covered include the interaction among the technological, economic, environmental, and sociopolitical aspects of energy supply and use; electricity, oil, and gas industries, and their market structures; elements of energy planning on the sectoral and national levels; energy decision making under uncertainties, risk management in energy planning; liberalization of energy markets; case studies. Prerequisite: Senior standing.

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

A course that covers wind, solar, hydro, biomass, and geothermal resources; resource assessment, electric drive options, control problems, environmental aspects of electricity generation, and stand-alone and utility applications; institutional and policy issues, and integrated energy systems. Prerequisite: Senior standing.

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

This course introduces the concept of power system protection, objectives, requirements, components; instrument transformers; protective relays; overcurrent and distance protection of networks; differential protection of generator; bus and transformer; digital protection. Prerequisite ELEE 461.

## **Electives - Electromagnetism**

### **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 microstrip 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. Prerequisites: ELEE 340 and ELEE 390.

**ELEE 474 RF and Microwave Communication Systems 3(3, 0, 0)**

A course that introduces students to hardware components, system parameters, and architectures of RF and microwave wireless systems; focus on the design of a radio system for transmission and reception of information: types of receivers and transmitters, matching techniques, antenna types in wireless systems, RF and microwave radio components, receiver and transmitter RF system parameters, and radio links; basic modulation and demodulation schemes and multiple-access techniques used in present RF systems, including an overview of different RF and microwave point-to-point, mobile, and satellite communications systems. Prerequisites: ELEE 340 and ELEE 390.

**ELEE 491 Antenna Theory and Design 3(3, 0, 0)**

This course covers radiation systems, wire antennas, aperture antennas, arrays, input impedance, microstrip antennas, dielectric antennas, antennas in material layers. Prerequisite: ELEE 390.

**Electives - Biomedical Engineering**

**ELEE 411 Biomedical Instrumentation 3(3, 0, 0)**

This course introduces general instrumentation configuration, living cells, and performance of instrumentation systems; types and characteristics of transducers; sources and characteristics of bioelectric signals and electrodes; cardiovascular system, measurements, and diagnostic equipment; patient care and monitoring.

**ELEE 412 Biomedical Signal and Image Processing 3(3, 0, 0)**

A course that introduces the fundamentals of digital signal processing as implemented in biomedical applications. It provides a concise treatment of the tools utilized to describe deterministic and random signals as the basis of analyzing biological signals: data acquisition; imaging; de-noising and filtering; feature extraction; modeling. The course is tightly coupled with a practical component as it looks at and assigns several laboratory projects. Examples include the auditory system, speech generation, electrocardiogram, neuronal circuits, and medical imaging. Students should have reasonable software skills in Matlab. Prerequisite: ELEE 350.