# ELECTRICAL ENGINEERING

## Courses

**ELCT 510 - Photovoltaic Materials and Devices (3 Credits)**
Fundamentals of photovoltaic solar cell technologies. Design and operation of solar cells, including efficiency analysis and cost benefit. Applications to green and sustainable energy systems.
**Prerequisites:** C or better in ELCT 363.

**ELCT 521 - Introduction to Microwave Engineering (3 Credits)**
Introduction to plane electromagnetic wave propagation, reflection, transmission, antennas and antenna arrays, wireless link margin; noise, noise figure, noise temperature; switches and phase shifters; microwave modeling.
**Prerequisites:** D or better in ELCT 361 or PHYS 504.

**ELCT 531 - Digital Control Systems (3 Credits)**
Analysis and design of discrete-time control systems, implementation of control systems using digital electronic systems. Applications to electrical systems.
**Prerequisites:** ELCT 331.

**ELCT 533 - System Health Management (3 Credits)**
Sensing, data acquisition, and data processing for evaluation of performance and system health. Integration and implementation of health management systems.
**Prerequisites:** ELCT 321 or equivalent.

**ELCT 541 - Sensors for Biomedicine (3 Credits)**
Operating principles and design of bioelectric sensors and sensor systems for medical applications.
**Prerequisites:** C or better in ELCT 361, ELCT 363 and ELCT 371.

**ELCT 553 - Electromechanical Energy Conversion (3 Credits)**
Analysis and design of electromechanical energy conversion systems, including electrical machines and electronic drives.
**Prerequisites:** D or better in ELCT 331, ELCT 361 and ELCT 451.

**ELCT 554 - Integration of Photovoltaics in Modern Power Systems (3 Credits)**
Analysis and design of power systems in presence of photovoltaic generation with focus on protection systems, control, power quality.
**Prerequisites:** ELCT 551.

**ELCT 559 - Special Topics in Distributed Energy Resources for Electric Energy Systems (3 Credits)**
Special topics in distributed energy resources for modern electrical energy systems. Course content varies and will be announced in the schedule of classes by title. May be repeated as topics vary.
**Prerequisite or Corequisite:** D or better in ELCT 451.

**ELCT 562 - Wireless Communications (3 Credits)**
Fourier techniques and stochastic processes review, multiple access & cellular techniques, signal space representations for signals and noise, baseband modulations and optimal receivers in additive white Gaussian noise, bandpass and higher-order modulations, mobile & wireless propagation channel characteristics, effects of bandlimiting & distortion mitigation, diversity techniques.
**Prerequisites:** ELCT 332, ELCT 361.

**ELCT 563 - Semiconductor Devices for Power, Communications and Lighting (3 Credits)**
Operational principles and characteristics of electronic and optoelectronic semiconductor devices including MOSFETs and high electron mobility transistors (HEMTs) for power electronics, electric cars and high-speed communications, light emitting diodes and lasers for solid state lighting, displays and optical communication, solar cells for green power generation.
**Prerequisites:** D or better in ELCT 363.

**ELCT 564 - RF Circuit Design for Wireless Communications (3 Credits)**
RF design fundamentals, lumped elements, transmission line theory, transmission lines and waveguides, S-parameters, impedance matching, microwave resonators.
**Prerequisites:** ELCT 361.

**ELCT 572 - Power Electronics (3 Credits)**
Basic analysis and design of solid-state power electronic devices and circuitry.
**Prerequisites:** D or better in ELCT 371.

**Prerequisite or Corequisite:** D or better in ELCT 331.

**ELCT 574 - Semiconductor Materials and Device Characterization (3 Credits)**
Semiconductor material and device characterization; resistivity, carrier and doping density, contact resistance, Schottky barriers, series resistance, defects, trapped charges, and carrier lifetime.
**Prerequisites:** ELCT 363 or equivalent.

**ELCT 582 - Semiconductor Laboratory (3 Credits)**
Prerequisite: ELCT 363.

**ELCT 732 - Radio Propagation & Wireless Channel Modeling (3 Credits)**
Plane wave propagation and effects of various media. Distinct propagation mechanism descriptions. Mathematics for computing field strengths and powers for different propagation mechanisms. Antenna/noise principles. Wireless channel effects on signaling. Channel modeling as linear, time-varying filter. Delay/Doppler spreads. Empirical & statistical wireless channel models. Multi-antenna channel characteristics.
**Prerequisites:** ELCT 562 or successful completion of undergraduate courses in electromagnetics, probability/statistics, and linear system theory.

**ELCT 751 - Advanced Power Systems Analysis (3 Credits)**
Network analysis methods suitable for computer implementation. System studies, including load-flow analysis, short-circuit analysis, and state estimation.
**Prerequisites:** ELCT 551.

**ELCT 753 - Electrical Drives (3 Credits)**
Dynamics of electrical machine and space phasor theory. Analysis and design of control architecture for electrical motors.
**Prerequisites:** ELCT 553.

**ELCT 761 - Fundamental Electromagnetics (3 Credits)**
Theorems and principles of EM theory, Maxwell's equations, vector and scalar potentials. Solution to Maxwell's equation in one-, two-, and three-dimensions. Green's functions and theorems with applications to radiation and guided-wave propagation.
**Prerequisites:** ELCT 361.

**ELCT 762 - Signal Integrity for High Speed Circuits (3 Credits)**
The concept of signal integrity for high speed circuits, signal parameters, transmission lines, I/O buffer models, clock schemes, serial data, package/die/connector modeling, I/O power delivery, and measurement.
**Prerequisites:** ELCT 561 or equivalent.

**ELCT 763 - Semiconductor Device Modeling and Simulation (3 Credits)**
Computer-aided semiconductor device modeling and simulation; Technology Computer-Aided Design (TCAD) tools for modern semiconductor devices.

**ELCT 766 - Solid-State Lighting (3 Credits)**
Solid-state light sources converting electricity directly into light and their societal impacts. Includes principles, fabrication, and applications of solid-state lamps and lighting systems.
**Prerequisites:** ELCT 566.

**ELCT 771 - Optical Communications: Devices and Systems (3 Credits)**
Principles of optical communications, optical signal modulation, optoelectronic devices for optical communications.
**Prerequisites:** ELCT 361, ELCT 363, and ELCT 581.

**ELCT 772 - Advanced Power Electronics (3 Credits)**
Advanced topics in power electronics to include rectifiers, inverters, resonant and soft switching converters, power converter system stability issues.
**Prerequisites:** ELCT 572.

**ELCT 774 - Advanced Semiconductor Characterization (3 Credits)**
Advanced semiconductor material characterization; Hall effect and mobility measurements, optical characterization, scanning probe microscopy, electron microscopy, X-Ray diffraction techniques; nanoscale characterization techniques.
**Prerequisites:** ELCT 574.

**ELCT 782 - Power Semiconductor Devices (3 Credits)**
The function and theory of operation of power semiconductor devices.
**Prerequisites:** ELCT 363.

**ELCT 797 - Research (1-12 Credits)**
Individual research to be arranged with the instructor.

**ELCT 799 - Thesis Preparation (1-12 Credits)**

**ELCT 837 - Modern Control Theory (3 Credits)**
The analysis and synthesis of linear, nonlinear, and discrete control systems employing the state space approach.
**Prerequisites:** ELCT 331.

**ELCT 838 - Optimal Control and Estimation (3 Credits)**
Optimal filtering, prediction, and smoothing in the presence of uncertainty.
**Prerequisites:** ELCT 331.

**ELCT 839 - Robust Adaptive Control (3 Credits)**
Theory and rigorous mathematical foundation for synthesis and analysis of robust adaptive controls for systems with uncertain dynamics. Lyapunov stability theory, robust control analysis, methods for model reference adaptive control with emphasis on L1 adaptive control.
**Prerequisites:** ELCT 331.

**ELCT 861 - Special Topics in Communications and Electromagnetics (3 Credits)**
Special topics of current interest in Communications and Electromagnetics. Content varies by semester and will be identified by a specific subtitle.

**ELCT 862 - Antennas and Radiation (3 Credits)**
Radiation mechanism and fundamental parameters. Dipoles, monopoles, and loop antennas. Antenna arrays. Microstrip, helical, biconical, sleeve, spiral, and log-periodic dipole antennas. Horn and reflector antennas. Antenna measurement and modeling.
**Prerequisites:** ELCT 561.

**ELCT 863 - Computational Electromagnetics (3 Credits)**
Electric and magnetic field integral equations, the moment method (MM). Finite element method (FEM), discretization and interpolation, system of equations. Finite difference time domain (FDTD) method, stability, dispersion, incident wave, absorbing boundary conditions (ABCs).
**Prerequisites:** ELCT 761 or PHYS 703.

**ELCT 864 - Microwave Devices and Circuits (3 Credits)**
Microwave semiconductor diodes and transistors; active and passive microwave circuits.
**Prerequisites:** ELCT 521 and ELCT 581.

**ELCT 870 - Computing Methods for System Simulation (3 Credits)**
Use and development of computer software applications for modeling and simulation of energy systems.
**Prerequisites:** ELCT 761, ELCT 766, ELCT 771, ELCT 775.

**ELCT 871 - Advances in Semiconductor Devices (3 Credits)**
Current topics in semiconductor devices.
**Prerequisites:** ELCT 771.

**ELCT 874 - Advanced Semiconductor Materials (3 Credits)**
Principles and technology involved in the growth of both bulk and thin films of advanced semiconductor materials used in the fabrication of next generation electronic devices. Topics include principles of crystal growth, types of defects, and defect generation mechanisms.
**Prerequisites:** ELCT 563.

**ELCT 881 - Advances in Pulsed Power (3 Credits)**
Current topics in pulsed power.
**Prerequisites:** ELCT 781

**ELCT 882 - High-Speed Semiconductor Devices (3 Credits)**
Physics of Negative Differential Resistance devices, 2D-electron gas and quantum wells; principles and characteristics of heterostructure field-effect transistors and bipolar transistors, heterostructure light-emitting diodes, lasers, and photodetectors.
**Prerequisites:** ELCT 581 or PHYS 512.

**ELCT 883 - Power Systems Stability and Control (3 Credits)**
Power system transient and dynamic stability analysis. Power system control, including excitation systems, automatic generation control and boiler-turbine-generator models.
**Prerequisites:** ELCT 751.

**ELCT 891 - Selected Topics in Electrical Engineering (3 Credits)**

**ELCT 897 - Directed Individual Study (1-3 Credits)**
Approved plan of study must be filed.

**ELCT 899 - Dissertation Preparation (1-12 Credits)**