# ENGINEERING, ELECTRICAL (ENEE)

## Courses

**ENEE 3011 Physical Electronics (4 Credits)**
The basic physical concepts of electronics, electrons and holes in semiconductors, transport and optical processes. Concentration on device concepts, including material synthesis and device processing, P-N junction diodes, junctions with other materials, bipolar transistors, field effect transistors (JFET, MESFET, MOSFET) and optoelectronic effect transistors (JFET, MESFET, MOSFET) and optoelectronic devices (lasers, detectors). Prerequisites: CHEM 1010, CHEM 1610, PHYS 1213, PHYS 1214 or permission of instructor.

**ENEE 3111 Signals & Systems (4 Credits)**
Introduces continuous time and discrete time linear system analysis, Fourier series, Fourier transforms and Laplace transforms. Specific engineering tools for discrete time linear system analysis include discrete time convolution, Z-transform techniques, discrete Fourier transform and fast Fourier transform (DFT/FFT), and the design and analysis of analog and digital filters for real-world signal processing applications. Prerequisites: ENEE 2021, MATH 2070.

**ENEE 3141 Digital Communications (3 Credits)**
Introductory course on modern digital communication systems. The basic communication system theory, probability and random processes, baseband digital data transmission, coherent and non-coherent digital modulation techniques and analysis of bit error probability. Bandwidth efficiency and transmission of digital data through band-limited channels. Prerequisites: ENEE 3111, ENGR 3610 or permission of instructor.

**ENEE 3611 Analysis and Design of Antennas and Antenna Arrays (4 Credits)**
Maxwell's equations applied to antenna analysis and design. Topics include fundamental parameters of antennas, radiation integrals and auxiliary potential functions, analysis and design of linear wire antennas, loop antennas, arrays, broadband antennas, frequency independent antennas, aperture antennas and horns. Integrated lab included. Prerequisite: ENEE 2611.

**ENEE 3620 Optical Fiber Communications (4 Credits)**
A comprehensive treatment of the theory and behavior of basic constituents, such as optical fibers, light sources, photodetectors, connecting and coupling devices, and optical amplifiers. The basic design principles of digital and analog optical fiber transmission links. The operating principles of wavelength-division multiplexing (WDM) and the components needed for its realization. Descriptions of the architectures and performance characteristics of complex optical networks for connecting users with a wide range of transmission needs (SONET/SDH). Discussions of advanced optical communication techniques, such as soliton transmission, optical code-division multiplexing (optical CDMA) and ultra-fast optical time-division multiplexing (OTDM). Laboratory. Cross listed with ENEE 4620. Prerequisite: ENEE 3030 or permission of instructor.

**ENEE 3641 Introduction to Electromagnetic Compatibility (4 Credits)**
The study of the design of electronic systems so that they operate compatibly with other electronic systems and also comply with various governmental regulations on radiated and conducted emissions. Topics may include Electromagnetic Compatibility (EMC) requirements for electronic systems; non-ideal behavior of components; radiated emissions and susceptibility; conducted emissions and susceptibility; shielding and system design for EMC. Cross listed with ENEE 4640. Prerequisites: ENEE 3111, ENEE 2611 and ENEE 2223.

**ENEE 3670 Introduction to Digital Signal Processing (4 Credits)**
Introduction to the theory and applications of Digital Signal Processing. Special attention is paid to the fast Fourier transform and convolution and to the design and implementation of both FIR and IIR digital filters. Prerequisite: ENEE 3111.

**ENEE 4030 Optoelectronics (4 Credits)**
Optical fibers: structures, waveguiding, and fabrication; attenuation and dispersion; optical sources (LED, LASER, Fiber laser); power launching and coupling; photodetectors (APD, PIN, MSM); and practical optical transmitter and receivers. Cross listed with ENEE 3030.

**ENEE 4035 Nanophotonics (4 Credits)**
Nanophotonics provides high-speed, high-bandwidth, and ultra-small optoelectronic components. This course covers nanoscale processes, devices and their applications for harnessing and manipulating light on the nanoscale.

**ENEE 4141 Digital Communications (4 Credits)**
Introductory course on modern digital communication systems. The basic communication system theory, probability and random processes, baseband digital data transmission, coherent and non-coherent digital modulation techniques and analysis of bit error probability. Bandwidth efficiency and transmission of digital data through band-limited channels.

**ENEE 4310 Information Theory and Coding (3 Credits)**
Information and entropy; coding theory; error detection, correction codes; channel capacity; application to communications engineering.

**ENEE 4416 Advanced Digitial Signal Processing Topics (4 Credits)**
Study of linear discrete-time systems used to perform operation on random processes for the purposes of signal detection, estimation, spectral estimation, enhancement and parametric modeling of signals and systems, linear difference equations, Z-transforms, random sequences, state variables, matched filtering, Wiener filtering. Prerequisite: ENEE 3670.

**ENEE 4460 Real-Time Digital Signal Processing (4 Credits)**
Digitial signal processing algorithms and processing of discrete data, finite word length effects on filters, fixed point arithmetic and floating-point arithmetic. Overview of different architectures of digital signal processors. Programming of the DSP processor, implementation of DSP algorithms on DSP hardware in labs. Prerequisite: ENEE 3111, ENEE 3670, or ENCE 3210.

**ENEE 4620 Adv Optical Fiber Comm (4 Credits)**
A comprehensive treatment of the theory and behavior of basic constituents, such as optical fibers, light sources, photodetectors, connecting and coupling devices, and optical amplifiers. The basic design principles of digital and analog optical fiber transmission links. The operating principles of wavelength-division multiplexing (WDM) and the components needed for its realization. Descriptions of the architectures and performance characteristics of complex optical networks for connecting users who have a wide range of transmission needs (SONET/SDH). Discussions of advanced optical communication techniques, such as soliton transmission, optical code-division multiplexing (optical CDMA), and ultra-fast optical time division multiplexing (OTDM). Advanced Project. Cross listed with ENEE 3620. Prerequisite: instructor permission.

**ENEE 4625 Radio over Fiber Comms. (4 Credits)**
This course provides comprehensive and technical foundation in Microwave photonic Applications: Radio over optical fiber communications (RoF) is a novel technology in the field of short-range communication applications. The main goal is to enable range extension of 1 to 3 orders of magnitude over a typical ultra wide wideband radio signal in the range of 3.1-10.6 GHz. This technology allows separation of low cost Base-Station (BS)s from the Central-Station (CS). In the RoF technology is targeting the Personal Area Network (PAN) market that is characterized by very low cost and low power (10 uW) access point. In RoF, the optical fiber is used to carry extremely wide RF signals (several GHz).

**ENEE 4630 Optical Networking (4 Credits)**
This course provides a technical overview of optical networking. It gives students a solid understanding of optical networking field principles and practice. Underlying principles are reviewed along with common optical solutions and practices. It explains and provides practical tips on how to design and implement Networks. Examples are used to demonstrate key concepts of ATM, SONET/SDH and DWDM implementation. Prerequisite: ENEE 3011 or instructor approval.

**ENEE 4635 Optical Wireless Communications (OWC) (4 Credits)**
This course addresses describing important issues in optical wireless theory, including coding and modulation techniques for optical wireless, wireless optical CDMA communication systems, Optical MIMO systems and optical wireless technology such as visible light communications, IR links and sensor networks. Project in OWC. No prerequisite.

**ENEE 4640 Electromagnetic Compatibility (4 Credits)**
The study of the design of electronic systems so that they operate compatibly with other electronic systems and also comply with various governmental regulations on radiated and conducted emissions. Topics may include: Electromagnetic Compatibility (EMC) requirements for electronic systems; non-ideal behavior of components; radiated emissions and susceptibility; conducted emissions and susceptibility; shielding and system design for EMC. Final Project. Cross listed with ENEE 3641.

**ENEE 4650 Radio Frequency Design in the Wireless World (4 Credits)**
Topics include the following: basic concepts in Radio Frequency deign and communications, transceiver architectures, low-noise amplifiers, mixers, oscillators, phase-locked loops, power amplifiers, and transceiver design examples. Final Project. Prerequisites: ENEE 2611, ENEE 2222, and ENEE 3111 or equivalents.

**ENEE 4800 Advanced Topics (EE) (1-5 Credits)**
Various advanced topics in electrical engineering as announced. May be taken more than once. Cross-listed with ENEE 3035.

**ENEE 4991 Independent Study (1-10 Credits)**

**ENEE 4992 Directed Study (1-10 Credits)**

**ENEE 4995 Independent Research (1-16 Credits)**

**ENEE 6991 Ph.D Independent Study (1-10 Credits)**

**ENEE 6995 Ph.D Independent Research (1-16 Credits)**