ELECTRICAL AND COMPUTER ENGINEERING (ECEN)

ECEN 800 Electronic Instrumentation
Crosslisted with: ECEN 400
Prerequisites: Senior standing in engineering or permission.
Description: Applications of analog and digital devices to electronic instrumentation. Includes transducers, instrumentation amplifiers, mechanical and solid-state switches, data acquisition systems, phase-lock loops, and modulation techniques. Demonstrations with working circuits and systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 806 Power Systems Analysis
Crosslisted with: ECEN 406
Prerequisites: ECEN 338/(UNO) ECEN 3380 or ECEN 838/(UNO) ECEN 8386.
Description: Symmetrical components and fault calculations, power system stability, generator modeling (circuit viewpoint), voltage control system, high voltage DC transmission, and system protection.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 807 Power Systems Planning
Crosslisted with: ECEN 407
Prerequisites: ECEN 305/(UNO) ECEN 3050.
Description: Economic evaluation, load forecasting, generation planning, transmission planning, production simulation, power plant reliability characteristics, and generation system reliability.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 808 Engineering Electromagnetics
Crosslisted with: ECEN 408
Prerequisites: ECEN 306/(UNO) ECEN 3060.
Notes: Laboratory experiments.
Description: Applied electromagnetics: Transmission lines in digital electronics and communication. The quasistatic electric and magnetic fields: electric and magnetic circuits and electromechanical energy conversion. Guided waves: rectangular and cylindrical metallic waveguides and optical fibers. Radiation and antennas: line and aperture antennas and arrays.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 810 Multivariate Random Processes
Crosslisted with: ECEN 410
Prerequisites: ECEN 305/(UNO) ECEN 3050.
Description: Probability space, random vectors, multivariate distributions, moment generating functions, conditional expectations, discrete and continuous-time random processes, random process characterization and representation, linear systems with random inputs.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 911; ECEN 912; ECEN 915; ECEN 946

ECEN 815 Digital Image Processing
Prerequisites: ECEN 424/824 (UNO ECEN 4240/8240) or permission
Description: Topics covering the spatial and spectral analysis of digital image processing systems, the design of multi-dimensional digital filters and systems, and advanced theories and technologies in digital image processing systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 816 Materials and Devices for Computer Memory, Logic, and Display
Crosslisted with: ECEN 416
Prerequisites: PHYS 212/(UNO) PHYS 2120.
Description: Survey of fundamentals and applications of devices used for memory, logic, and display. Magnetic, superconductive, semiconductive, and dielectric materials.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 817 Semiconductor Fundamentals II
Crosslisted with: ECEN 417
Prerequisites: ECEN 421/(UNO) ECEN 4210 or ECEN 821/(UNO) ECEN 8216.
Description: Analysis of BJT's and MOSFET's from a first principle materials viewpoint. Static and dynamic analysis and characterization. Device fabrication processes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 820 Plasma Processing of Semiconductors
Crosslisted with: ECEN 420
Prerequisites: Senior or graduate standing.
Description: Physics of plasmas and gas discharges developed. Includes basic collisional theory, the Boltzman equation and the concept of electron energy distributions. Results are related to specific gas discharge systems used in semiconductor processing, such as sputtering, etching, and deposition systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ECEN 821 Principles of Semiconductor Materials and Devices I  
Crosslisted with: ECEN 421  
Prerequisites: PHYS 213/(UNO) PHYS 2130.  
Description: Introduction to semiconductor fundamentals, charge carrier concentration and carrier transport, energy bands, and recombination. PN junctions, static and dynamic, and special PN junction diode devices.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 822 Introduction to Physics and Chemistry of Solids  
Crosslisted with: PHYS 422, PHYS 822, ECEN 422  
Prerequisites: PHYS 213 or CHEM 481/881, MATH 221/821, or permission.  
Description: Introduction to structural, thermal, electrical, and magnetic properties of solids, based on concepts of atomic structure, chemical bonding in molecules, and electron states in solids. Principles underlying molecular design of materials and solid-state devices.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 824 Digital Signal Processing  
Crosslisted with: ECEN 424  
Prerequisites: ECEN 355 or (UNO) ECEN 3550.  
Description: The temporal and spectral analysis of digital signals and systems, the design of digital filters and systems, and advanced systems including multi-rate digital signal processing techniques.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: ECEN 815; ECEN 926

ECEN 828 Power Electronics  
Crosslisted with: ECEN 428  
Prerequisites: ECEN 304/(UNO) ECEN 3040 and ECEN 316/(UNO) ECEN 3160.  
Description: Basic analysis and design of solid-state power electronic devices and converter circuitry.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: ECEN 932

ECEN 830 Wind Energy  
Crosslisted with: ECEN 430  
Prerequisites: Senior standing or permission.  
Description: Engineering principles of both the mechanical/aero dynamical and electrical components and systems, along with economic and environmental considerations for citing and public policy, to appropriately cover the relevant topics associated with all scales of wind energy implementations.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 832 Basic Analytical Techniques in Electrical Engineering  
Crosslisted with: ECEN 442  
Prerequisites: MATH 221/(UNO) MATH 2350.  
Description: Applications of partial differential equations, matrices, vector analysis, complex variables, and infinite series to problems in electrical engineering.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 833 Microprocessor System Design  
Crosslisted with: ECEN 433  
Prerequisites: ECEN 310 or (UNO) ECEN 3100 with a grade of "C" or better; ECEN 332 or (UNO) ECEN 3320 with a grade of "C" or better.  
Description: Microprocessor based systems: architecture, design; and interfacing. Hardware topics: memory design; input/output ports; serial communications; and interrupts. Software topics: generating assembly ROM code; assembly/C firmware generation; and designing device drivers.  
Credit Hours: 4  
Max credits per semester: 4  
Max credits per degree: 4  
Format: LEC  
Offered: FALL/SPR

ECEN 835 Embedded Microcontroller Design  
Crosslisted with: ECEN 435  
Prerequisites: ECEN 433/833 or (UNO) ECEN 4330/8336 with a grade of "C" or better; STAT/MATH 380 or (UNO) STAT 3800.  
Description: Microcontroller architecture: design, programming, and interfacing for embedded systems. Timing issues, memory interfaces, serial and parallel interfacing, and functions for common microcontrollers.  
Credit Hours: 4  
Max credits per semester: 4  
Max credits per degree: 4  
Format: LEC  
Offered: FALL/SPR  
Prerequisite for: ECEN 496

ECEN 836 Electric Machines  
Crosslisted with: ECEN 436  
Prerequisites: PHYS 212/(UNO) PHYS 2120 and ECEN 216/(UNO) ECEN 2160.  
Description: Provides a solid background in electric machine analysis, covering fundamental concepts, techniques, and methods for analysis and design. Discussion of transformers and presentation of some new systems and applications.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  
Prerequisite for: ECEN 932

ECEN 837 Parallel and Distributed Processing  
Crosslisted with: ECEN 437  
Prerequisites: ECEN 435/835 or (UNO) ECEN 4350/8356.  
Description: Parallel and distributed processing concepts, principles, techniques, and machines.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 842 Introduction to Electronic Design Automation (EDA)  
Crosslisted with: ECEN 442  
Prerequisites: None.  
Description: Introduction to electronic design automation techniques, including logic and circuit design, layout, and verification.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC
ECEN 844 Linear Control Systems
Crosslisted with: ECEN 444
Prerequisites: ECEN 304/(UNO) ECEN 3040.
Description: Classical (transfer function) and modern (state variable) control techniques. Both time domain and frequency domain techniques are studied. Traditional proportional, lead, lag, and PID compensators are examined, as well as state variable feedback.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 848 Decision Analysis
Crosslisted with: ECEN 448
Prerequisites: ECEN 305/(UNO) ECEN 3050 or STAT 380/(UNO) STAT 3800.
Description: Principles of engineering economy including time value of money, net present value and internal rate of return. Use of influence diagram and decision tree to structure and analyze decision situations under uncertainty including use of stochastic dominance, value of information, and utility theory. Fundamentals of two-person matrix games including Nash equilibrium.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 850 Bioinformatics
Crosslisted with: ECEN 450
Prerequisites: Computer programming language and ECEN 305/(UNO) ECEN 3050 or IMSE 321 or STAT 380/(UNO) STAT 3800 or equivalent.
Description: Examination of how information is organized in biological sequences such as DNA and proteins and computational techniques which make use of this structure. Various biochemical processes that involve these sequences are studied to understand how these processes affect the structure of these sequences. In the process bioinformatics algorithms, tools, and techniques which are used to explore genomic and amino acid sequences are also introduced.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 851 Introduction to VLSI System Design
Crosslisted with: ECEN 451
Prerequisites: ECEN 310 or (UNO) ECEN 3100.
Description: The concepts, principles, and methodology at all levels of digital VLSI system design and focused on gate-level VLSI implementation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 852 Introduction to Computer-Aided Digital Design
Crosslisted with: ECEN 452
Prerequisites: ECEN 310 or (UNO) ECEN 3100.
Description: The concepts, simulation techniques and methodology in computer-aided digital design at system and logic levels.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 854 Power Systems Operation and Control
Crosslisted with: ECEN 454
Prerequisites: ECEN 338/(UNO) ECEN 3380.
Description: Characteristics and generating units. Control of generation, economic dispatch, transmission losses, unit commitment, generation with limited supply, hydrothermal coordination, and interchange evaluation and power pool.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 860 Labview Programming
Crosslisted with: ECEN 460
Prerequisites: Prior programming experience
Description: Labview as a programming language and for applications to acquire and analyze data, to access the network, control lab instruments, and for video and sound applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 861 Digital Communications Media
Crosslisted with: ECEN 461
Prerequisites: ECEN 325 or (UNO) 3250 or ECEN 462 or (UNO) ECEN 4620
Description: Topics related to the transport of bit streams from one geographical location to another over various physical media such as wire pairs, coaxial cable, optical fiber, and radio waves. Transmission characteristics, media interfacing, delay, distortion, noise, and error detection and correction techniques.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Offered: FALL/SPR
Prerequisite for: ECEN 479, ECEN 879; ECEN 885; ECEN 977

ECEN 862 Communication Systems
Crosslisted with: ECEN 462
Prerequisites: ECEN 304/(UNO) ECEN 3040 and ECEN 305/(UNO) ECEN 3050.
Description: Mathematical descriptions of signals in communication systems. Principles of analog modulation and demodulation. Performance analysis of analog communication systems in the presence of noise.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 911

ECEN 863 Digital Signal Processing
Crosslisted with: ECEN 463
Prerequisites: ECEN 304/(UNO) ECEN 3040.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 915
ECEN 864 Digital Communication Systems
Crosslisted with: ECEN 464
Description: Principals of digital transmission of information in the presence of noise. Design and analysis of baseband PAM transmission systems and various carrier systems including ASK, FSK, PSK.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 911; ECEN 912; ECEN 959

ECEN 865 Introduction to Data Compression
Crosslisted with: ECEN 465
Prerequisites: ECEN 305/(UNO) ECEN 3050.
Description: Introduction to the concepts of Information Theory and Redundancy removal. Simulation of various data compression schemes such as Delta Modulation, Differential Pulse Code Modulation, Transform Coding and Runlength Coding.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 866 Telecommunications Engineering I
Crosslisted with: ECEN 466
Prerequisites: ECEN 362 or (UNO) ECEN 3620; ECEN 461/861 or (UNO) ECEN 4610/8610, or parallel.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: ECEN 496

ECEN 867 Electromagnetic Theory and Applications
Crosslisted with: ECEN 467
Prerequisites: ECEN 306/(UNO) ECEN 3060.
Description: Engineering application of Maxwell’s equations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 965

ECEN 868 Microwave Engineering
Crosslisted with: ECEN 468
Prerequisites: ECEN 306/(UNO) ECEN 3060.
Description: Applications of active and passive devices to microwave systems. Includes impedance matching, resonators, and microwave antennas.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 965

ECEN 869 Analog Integrated Circuits
Crosslisted with: ECEN 469
Prerequisites: ECEN 361/(UNO) ECEN 3610.
Description: Analysis and design of analog integrated circuits both bipolar and MOS. Basic circuit elements such as differential pairs, current sources, active loads, output drivers used in the design of more complex analog integrated circuits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 913

ECEN 870 Digital and Analog VLSI Design
Crosslisted with: ECEN 470
Prerequisites: ECEN 316/(UNO) ECEN 3160.
Description: Introduction to VLSI design techniques for analog and digital circuits. Fabrication technology and device modelling. Design rules for integrated circuit layout. LSI design options with emphasis on the standard cell approach of digital and analog circuits. Lab experiments, computer simulation and layout exercises.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 871 Computer Communication Networks
Crosslisted with: ECEN 471
Prerequisites: ECEN 325 or (UNO) ECEN 3250.
Description: High-speed access control protocols, routing protocols, traffic management, and network topologies. Giga-bit Ethernet, ATM, and TCP/IP. Performance modeling and simulation techniques.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 873 Mobile and Personal Communications
Crosslisted with: ECEN 473
Prerequisites: ECEN 325 or (UNO) ECEN 3250.
Description: Concepts on mobile and personal communications. Modulation techniques for mobile radio, equalization, diversity, channel coding, and speech coding.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 874 Digital Systems
Crosslisted with: ECEN 474
Prerequisites: ECEN 370/(UNO) ECEN 3700.
Description: Synthesis using state machines; design of digital systems; micro programming in small controller design; hardware description language for design and timing analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 477, ECEN 877
### ECEN 875 Satellite Communications
**Crosslisted with:** ECEN 475  
**Prerequisites:** ECEN 325 OR (UNO) ECEN 3250.  
**Description:** The fundamental concepts of satellite communications. Orbits, launching satellites, modulation and multiplexing, multiple access, earth stations, coding, interference and special problems in satellite communications.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC

### ECEN 876 Wireless Communications
**Crosslisted with:** ECEN 476  
**Prerequisites:** Permission.  
**Description:** The fundamental concepts of wireless communications. Basic communications concepts such as multiple access and spectrum. Propagation, radio standards and internetworking. Current issues in wireless communications.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** ECEN 926; ECEN 977

### ECEN 877 Digital Systems Organization and Design
**Crosslisted with:** ECEN 477  
**Prerequisites:** ECEN 474/(UNO) ECEN 4740 or ECEN 874/(UNO) ECEN 8746  
**Description:** Hardware development languages, hardware organization and realization, microprogramming, interrupt, intersystem communication, and peripheral interfacing.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

### ECEN 879 Optical Fiber Communications
**Crosslisted with:** ECEN 479  
**Prerequisites:** ECEN 461/861 or (UNO) ECEN 4610/8616  
**Description:** Fundamentals of lightwave communication in optical fiber waveguides, physical description of fiber optic systems. Properties of the optical fiber and fiber components. Electro-optic devices: light sources and modulators, detectors and amplifiers; optical transmitter and receiver systems. Fiber optic link design and specification; fiber optic networks.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC  
**Prerequisite for:** ECEN 979

### ECEN 880 Introduction to Lasers and Laser Applications
**Crosslisted with:** ECEN 480, PHYS 480, PHYS 880  
**Prerequisites:** PHYS 213/(UNO) PHYS 2130.  
**Description:** Physics of electronic transition production stimulated emission of radiation. Threshold conditions for laser oscillation. Types of lasers and their applications in engineering.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

### ECEN 882 Antennas and Radio Propagation for Wireless Communications
**Crosslisted with:** ECEN 482  
**Prerequisites:** ECEN 328 or (UNO) ECEN 3280.  
**Description:** Fundamental theory of antennas and radio propagation for wireless communications. Basic antenna characteristics and various antennas and antenna arrays. Basic propagation mechanisms and various channel models, such as Friis free space model, Hata model, lognormal distribution, and multipath model. Includes practical antenna design for high radio frequency (RF) with modeling software tools such as Numerical Electromagnetic Code (NEC) and Advanced Design System (ADS). Design projects will be assigned as the main part of course.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC

### ECEN 883 Random Processes in Engineering
**Prerequisites:** STAT 380 (UNO STAT 3800)  
**Description:** Topics related to the concept of random variables, functions of random variables and random processes.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** ECEN 926

### ECEN 884 Network Security
**Crosslisted with:** ECEN 484  
**Prerequisites:** ECEN 325 or (UNO) ECEN 3250.  
**Description:** Network security and cryptographic protocols. Classical encryption techniques, block ciphers and stream cyphers, public-key cryptography, authentications digital signatures, key management and distributions, network vulnerabilities, transport-level security, IP security.  
**Credit Hours:** 4  
**Max credits per semester:** 4  
**Max credits per degree:** 4  
**Format:** LEC

### ECEN 885 Spread Spectrum Communications
**Prerequisites:** ECEN 461/861 (UNO ECEN 4610/8616)  
**Description:** Introduction to the theory of spread spectrum communications: direct sequence, frequency and time hopping techniques. Topics include properties of pseudo-random binary sequences, low-probability-of-intercept (LPI) and anti-jamming (AJ) methods, performance of spread spectrum systems, applications of spread spectrum techniques in radio frequency and optical code-division multiple access (CDMA) systems.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

### ECEN 886 Applied Photonics
**Crosslisted with:** ECEN 486  
**Prerequisites:** ECEN 306/(UNO) ECEN 3060 or permission.  
**Description:** Introduction to the use of electromagnetic radiation for performing optical measurements in engineering applications. Basic electromagnetic theory and light interaction with matter are covered with corresponding laboratory experiments conducted.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** ECEN 986
ECEN 888 Wireless Security
Crosslisted with: ECEN 488
Prerequisites: ECEN 325 or (UNO) ECEN 3250.
Description: A comprehensive overview on the recent advances in wireless network and system security. Covers security issues and solutions in emerging wireless access networks and systems as well as multihop wireless networks.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 891 Special Topics in Computer and Electronics Engineering IV
Crosslisted with: ECEN 491
Prerequisites: Senior standing.
Description: Special topics in the emerging areas of electrical and computer engineering which may not be covered in other courses in the Electrical and Computer Engineering curriculum.
Credit Hours: 1-4
Min credits per semester: 1
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 892 Individual Study in Computer and Electronics Engineering IV
Crosslisted with: ECEN 492
Prerequisites: Senior standing.
Notes: ECEN 492 (UNO - ECEN 4920) requires a ECE departmentally approved proposal.
Description: Individual study in selected electrical and computer engineering area under the supervision and guidance of an Electrical & Computer Engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 893 Independent Study in Computer and Electronics Engineering
Prerequisites: Departmentally approved proposal.
Description: Individual study at the graduate level in a selected electrical or computer engineering area under the supervision and guidance of an Electrical & Computer Engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: IND

ECEN 895 Special Topics
Description: Special topics in the newly emerging areas of computer and electronics engineering not covered in the other courses in the electrical and computer engineering curriculum.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 898 Special Topics in Electrical Engineering IV
Crosslisted with: ECEN 498
Prerequisites: Permission.
Notes: ECEN 498/898 (UNO ECEN 4980/8986) is offered as the need arises for electrical engineering topics for fourth-year and graduate students not covered in other courses.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 18
Format: LEC

ECEN 899 Masters Thesis
Prerequisites: Admission to masters degree program and permission of major adviser.
Description: Masters thesis work.
Credit Hours: 1-10
Min credits per semester: 1
Max credits per semester: 10
Max credits per degree: 99
Format: IND

ECEN 911 Communication Theory
Prerequisites: ECEN 862/(UNO) ECEN 8626, and ECEN 864/(UNO) ECEN 8646 or ECEN 810/(UNO) ECEN 8106
Description: Applications of probability and statistics to signals and noise; correlation; sampling; shot noise; spectral analysis; Gaussian processes; filtering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 912 Error Control Coding
Prerequisites: ECEN 410/(UNO) ECEN 4100 or ECEN 810/(UNO) ECEN 8106; and ECEN 464/(UNO) ECEN 4640 or ECEN 864/(UNO) ECEN 8646; or permission.
Description: Fundamentals of error correction and detection in digital communication and storage systems. Linear and algebraic block codes; Hamming, BCH and Reed-Solomon codes; algebraic decoding techniques; structure and performance of convolutional codes, turbo codes, and trellis coded modulation; MAP, Viterbi, and sequential decoding techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 913 Advanced Analog and Mixed-Signal Integrated Circuits
Prerequisites: ECEN 869/(UNO) ECEN 8696 and permission
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ECEN 915 Adaptive Signal Processing  
**Prerequisites:** ECEN 410/(UNO) ECEN 4100 or ECEN 810/(UNO) ECEN 8106; and ECEN 463/(UNO) ECEN 4630 or ECEN 863/(UNO) ECEN 8636; and permission  
**Description:** Adaptive filtering algorithms, frequency and transform domain adaptive filters, and simulation and critical evaluation of adaptive signal processing for real world applications.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 926 Statistical Signal Processing for Wireless Communications  
**Prerequisites:** ECEN 424/824/(UNO) ECEN 4240/8246; ECEN 476/876/(UNO) ECEN 4760/8760; and ECEN 883/(UNO) ECEN 8830  
**Description:** Statistical signal processing and applications for wireless communications: the characteristics of random signals; optimum linear filters; statistical parameter estimation using maximum likelihood (ML) and minimum mean-square error (MMSE) methods; adaptive signal processing using least-mean-square (LMS) and recursive least-square (RLS) approaches; Kalman filtering; and eigenanalysis.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 932 Advanced Power Electronics and Applications  
**Prerequisites:** ECEN 428/(UNO) ECEN 4280 or ECEN 828/(UNO) ECEN 8286; and ECEN 426/(UNO) ECEN 4260 or ECEN 836/(UNO) ECEN 8366.  
**Description:** Analysis and design of power electronic circuits and their applications, including: snubber circuits, resonant converters and soft switching techniques, pulse-width modulation techniques, control of power electronic circuits, power electronics and control for electric machines and wind energy systems, flexible AC-transmission system (FACTS) devices, and high-voltage DC (HVDC) transmission.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 935 Computational Intelligence  
**Prerequisites:** MATH 208/(UNO) MATH 1970, MATH 221/(UNO) MATH 2350, MATH 314/(UNO) MATH 2050, and good skills using MATLAB  
**Description:** Computational intelligence paradigms and their applications, including: artificial neural networks, fuzzy logic systems, swarm intelligence, evolutionary computation (e.g., genetic algorithms), machine learning (e.g., supervised learning, unsupervised learning, and reinforcement learning), neurocontrol and adaptive critic designs, and applications of computational intelligence for system identification, state estimation, time series prediction, signal processing, adaptive control, optimization, diagnostics, prognostics, etc.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 946 Optimal Filtering, Estimation and Prediction  
**Prerequisites:** ECEN 810/(UNO) ECEN 8106; and permission  
**Description:** Techniques for optimally extracting information about the past, present, or future status of a dynamic system from noise-corrupted measurements on that system.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 957 Advanced Computer Methods in Power System Analysis  
**Prerequisites:** ECEN 806/(UNO) ECEN 8066  
**Description:** Power system matrices, sparsity techniques, network equivalents, contingency analysis, power flow optimization, state estimation, and power system restructuring examined via computer methods.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 959 Wireless Communications  
**Prerequisites:** ECEN 864/(UNO) ECEN 8646 and permission  
**Description:** Principles of wireless communications, including: description of the wireless channel characteristics; ultimate performance limits of wireless systems; performance analysis of digital modulation techniques over wireless channels; diversity techniques; adaptive modulation; multiple-antenna communications; multi-carrier modulation; and multi-user wireless communications.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 960 Solid-State Devices  
**Prerequisites:** ECEN 315/(UNO) ECEN 3150 or equivalent  
**Description:** Gallium arsenide and silicon devices. Device properties based on structure and physical properties of the materials.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 965 Passive Microwave Components  
**Prerequisites:** ECEN 867/(UNO) ECEN 8676 or ECEN 868/(UNO) ECEN 8686  
**Description:** Application of Maxwell’s Equations to the analysis of waveguides, resonant cavities, filters and other passive microwave devices.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

ECEN 967 Introduction to Quantum Electronics  
**Description:** Introduction to the quantum aspects of electron devices.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** ECEN 968, ECEN 975
ECEN 968 Electron Theory of Solids I  
**Prerequisites:** ECEN 967/(UNO) ECEN 9670 or permission  
**Description:** Quantitative development of the fundamentals of the quantum-mechanical theory of electrons in solids.  
**Credit Hours:** 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 971 Seminar  
**Credit Hours:** 1-12  
Min credits per semester: 1  
Max credits per semester: 12  
Max credits per degree: 12  
Format: LEC

ECEN 975 Optical Properties of Materials  
**Prerequisites:** ECEN 967/(UNO) ECEN 9670 or equivalent, or permission  
**Description:** Quantum mechanical description of the optical properties of solids (complex refractive index and its dispersion, effects of electric and magnetic fields, temperature, stress; additional special topics as desired).  
**Credit Hours:** 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 977 Space-time Wireless Communications  
**Prerequisites:** ECEN 461/861/(UNO) ECEN 4630/8636; ECEN 476/876/(UNO) ECEN 4760/8766  
**Description:** Theory of space-time (ST) wireless communication systems. Spatial diversity, smart antenna systems, MIMO capacity of multi-antenna fading channels, space-time signaling, space-time receivers, and interference mitigation. Overview of more advanced topics such as MIMO-OFDM. Current trends in research and in the industry.  
**Credit Hours:** 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 979 Non-Linear Fiber Optic Systems  
**Prerequisites:** ECEN 479/879 (UNO) ECEN 4790/8796 or permission  
**Description:** Linear and non-linear propagations in optical fibers. Topics include fiber non-linearity, fundamentals of optical amplifiers, semiconductor and fiber amplifiers, soliton communications. Applications include high capacity and long distance transmissions, all-optical networks.  
**Credit Hours:** 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 986 Optoelectronics  
**Prerequisites:** ECEN 886/(UNO) ECEN 8866  
**Description:** Modern phenomena associated with optoelectronics. Electro-optical effect such as Pockel effect, Kerr effect, and nonlinear optical phenomena. Material and devices used in modern communications, femtosecond lasers, and optical computer systems.  
**Credit Hours:** 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 991 Independent Study  
**Prerequisites:** Permission  
**Description:** Selected topic under the direction and guidance of a faculty member.  
**Credit Hours:** 1-24  
Min credits per semester: 1  
Max credits per semester: 24  
Max credits per degree: 24  
Format: IND

ECEN 992 Research Other Than Thesis  
**Prerequisites:** Permission and graduate standing.  
**Description:** Supervised non-thesis research and independent study.  
**Credit Hours:** 1-6  
Min credits per semester: 1  
Max credits per semester: 6  
Max credits per degree: 6  
Format: IND

ECEN 996 Topics in Electrical Engineering  
**Prerequisites:** Permission  
**Description:** Selected topics in electrical engineering.  
**Credit Hours:** 3  
Max credits per semester: 3  
Max credits per degree: 24  
Format: LEC

ECEN 998 Advanced Special Topics  
**Prerequisites:** Permission  
**Description:** Advanced topics in computer and electronics engineering.  
**Credit Hours:** 1-3  
Min credits per semester: 1  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC

ECEN 999 Doctoral Dissertation  
**Prerequisites:** Admission to doctoral degree program and permission of supervisory committee chair.  
**Description:** Dissertation research.  
**Credit Hours:** 1-24  
Min credits per semester: 1  
Max credits per semester: 24  
Max credits per degree: 99  
Format: IND