DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Liang Cheng, chair
Devinder Kaur, graduate program director

The mission of the Electrical Engineering and Computer Science (EECS) department is to educate future engineers and scientists in the fields of electrical engineering and computer science; to contribute to the body of knowledge in the fields of electrical engineering and computer science; and to conduct research and contribute to the development of innovative solutions to address diverse technological and societal needs.

The EECS department offers advanced studies leading to the M.S. or the Ph.D. degrees as well as a Graduate Certificate in Cybersecurity. EECS Graduate courses and research entail diverse topics across the spectrum of Electrical Engineering (EE), Computer Engineering (CE), and Computer Science (CS). Current topics for EE include communications, control and signal processing, machine vision and imaging, power systems, power electronics, nano-electronic materials and devices, photovoltaic devices, laser-based advanced processing, electromagnetics and plasma science, renewable energy and smart grid, and microelectronics. Current topics in Computer Science and Engineering include artificial intelligence, computer systems design and applications (hardware and software), computer graphics and visualization, computer aided design and simulation, cyber and computer security, hardware oriented security and trust, social networking, and high performance computing.

EECS department faculty members participate in four research tracks, with each track consisting of multiple specialization areas. The research activities of some faculty fall in more than one these tracks and areas. Each specialization area has sets of required and recommended courses for all graduate students pursuing the specialization. The recommended courses needed to complete the degree requirements are selected by the student in consultation with an advisor. The four research tracks include the following:

- **Electrical Engineering Physical Sciences (PS).** Research in the PS track includes the following specialization areas:
  - Materials, Devices, Electromagnetics and Plasma Virtual
  - Power
- **Electrical Engineering System Sciences (SS).** Research in the SS track includes the following specialization areas:
  - Communications
  - Signals, Image Processing and Computer Vision
  - Controls
- **Computer Science (CS).** Research in the CS track includes the following specialization areas:
  - Artificial Intelligence
  - Cybersecurity
- **Computer Engineering (CE).** Research in the CE track includes the following specialization area:
  - Advanced Computing Systems

Degrees Offered

MS in Computer Science & Engineering (https://catalog.utoledo.edu/graduate/engineering/departments/electrical-engineering-computer-science/ms-engineering/)

MS in Electrical Engineering (https://catalog.utoledo.edu/graduate/engineering/departments/electrical-engineering-computer-science/ms-electrical-engineering/)

PhD in Engineering (Electrical Engineering) (https://catalog.utoledo.edu/graduate/engineering/departments/electrical-engineering-computer-science/phd-electrical-engineering/)

PhD in Engineering (Computer Science & Engineering) (https://catalog.utoledo.edu/graduate/engineering/departments/electrical-engineering-computer-science/phd-engineering/)

Graduate Certificate in Cyber Security (https://catalog.utoledo.edu/graduate/engineering/departments/electrical-engineering-computer-science/graduate-certificate-in-cybersecurity/)

COURSES

CYBR 5930 Cyber Security Seminar
[0 credit hours]
All graduate students in the Master of Science in Cyber Security program are expected to attend the seminar each semester and to keep a journal of ideas, questions, and other items that may benefit their research. Students will also present their thesis and project results in the seminar.
Term Offered: Spring, Fall

CYBR 6800 Experiential Learning in Cyber Security
[3 credit hours]
This course will discuss advanced topics in computer and network security. It will revisit the foundation of cyber security, and then discuss recent attacks, analyze attack trends, and on-going activities in a number of emerging areas in cyber security. Students will also have the opportunities to learn real-world attacks and defenses through the UT Cyber Range infrastructure with the guidance from IT security team at UT.
Prerequisites: EECS 5640 with a minimum grade of D- and EECS 5720 with a minimum grade of D- and EECS 5790 with a minimum grade of D-
Term Offered: Fall

CYBR 6920 Cyber Security Project
[1-6 credit hours]
Intensive discipline specific study in cyber security for the project option, may include theoretical and experimental work. This course may be repeated for credit for up to 6 credit hours. The exact topic will be agreed upon mutually after discussion between the instructor and the student.
Term Offered: Spring, Summer, Fall

CYBR 6960 Cyber Security Research and Thesis
[1-9 credit hours]
Intensive discipline specific study in cyber security, including theoretical and experimental work. This course may be repeated for credit with minimum 9 cr hr required for the MS thesis. The exact topic will be agreed upon mutually after discussion between the instructor and the student.
Term Offered: Spring, Summer, Fall

CYBR 6970 Graduate Engineering Internship
[1 credit hour]
Faculty advisor approved industry, government, or agency internship to provide an experiential learning component to the Master's degree program.
Prerequisites: GNEN 5000 with a minimum grade of S
Term Offered: Spring, Summer, Fall

CYBR 6990 Independent Study in Cyber Security
[1-3 credit hours]
Intensive discipline specific study in cyber security up to 3 hours, may include theoretical and experimental work. This course may be repeated for credit. The exact topic will be agreed upon mutually after discussion between the instructor and the student.
Term Offered: Spring, Summer, Fall

EECS 5120 Introduction to Fuzzy Systems and Applications
[3 credit hours]
Introduction to Fuzzy Rule Based Intelligent Systems. Basic concepts of Fuzzy logic, Fuzzy Sets, Fuzzy Arithmetic, Fuzzy Relations, Fuzzy Graphs, Approximate Reasoning and Fuzzy Implication. Applications in Real World Domains.
Term Offered: Spring, Fall

EECS 5200 Feedback Control Systems
[3 credit hours]
Feedback methods for the control of dynamic systems. Topics include characteristics and performance of feedback systems, state variable analysis stability, root locus and frequency response methods and computer simulations.
Term Offered: Spring

EECS 5220 Programmable Logic Controllers
[3 credit hours]
Programmable Logic Controllers (PLCs), programming, sensors, process control algorithms, interfacing of sensors and other I/O devices, simulation and networking.
Term Offered: Spring, Fall

EECS 5240 Power Systems Operation
[3 credit hours]
Single Line Diagrams & Per Unit calculations, Network Matrices & Ybus for systems with uncoupled lines, Load Flow Techniques, Large system Loss Formula using Zbus, Real and Reactive Power Dispatch programming, Power systems relays & protection schemes.
Term Offered: Spring, Fall

EECS 5260 Control Systems Design
[3 credit hours]
A general study of computer-aided design of control systems. Topics include: stability, compensation, pole placement, nonlinear systems and digital systems.
Term Offered: Fall

EECS 5330 Image Analysis And Computer Vision
[3 credit hours]
Imaging geometry, image filtering, segmentation techniques, image representation and description, stereovision and depth measurements, texture analysis, dynamic vision and motion analysis, matching and recognition.
Term Offered: Spring, Fall

EECS 5360 Communication Systems
[3 credit hours]
Fourier transform applications in signal analysis and communication. Signals spectra, filtering, AM and FM modulation, noise and optimum receiver, sampling theorem, multiplexing, PCM, introduction to digital modulators and demodulators.
Prerequisites: EECS 3300 with a minimum grade of D-
Term Offered: Spring, Fall

EECS 5370 Information Theory And Coding
[3 credit hours]
Coding concepts, Huffman code, Entropy analysis, Channel and mutual information, Channel capacity and Shannon's theorems, Algebraic coding theory and application to block code and cyclic code, Introduction to convolutional code.
Term Offered: Spring, Fall

EECS 5380 Digital Signal Processing
[3 credit hours]
Discrete Fourier Transform (DFT), Discrete convolution and correlation, Fast Fourier Transform (FFT) and its applications. Design of IIR and FIR digital filters, Multi-rate/channel digital systems, Decimation and Interpolation.
Term Offered: Spring

EECS 5390 Wireless And Mobile Networks
[3 credit hours]
Mobile radio propagation; traffic engineering; cellular concept; multiple radio access; multiple division techniques; channel allocation; mobile communication systems; existing wireless systems; network protocols; Ad Hoc and sensor networks; wireless LANS and PANS; recent advances.
Term Offered: Spring, Fall

EECS 5410 Electro-Optics
[3 credit hours]
Laser physics, optics, optical waveguides, optical communication systems and electro-optics. Design of light processing and communication systems will be considered with emphasis on optics and optical communication.
Term Offered: Spring, Fall

EECS 5460 Power Systems Management
[3 credit hours]
An advanced study of the management and operation of today's power system. Included are historical developments, utility and operational costs and economics, power generation alternatives, fuel alternatives, renewable applications, transmission and distribution practices, and a discussion of current power system issues, both in the U.S. and abroad.
Prerequisites: EECS 3220 with a minimum grade of D-
Term Offered: Spring, Summer, Fall

EECS 5480 Power Electronics 1
[3 credit hours]
Basic electronic power switching circuits. Half-wave and full-wave rectification. Characteristics of power semiconductors. Phase-controlled rectifiers and inverters. Isolated and non-isolated dc-dc converters.
Term Offered: Spring, Fall

EECS 5500 Programming for the World Wide Web
[3 credit hours]
Fundamental concepts and programming languages for constructing contempoary websites. Differences and similarities between procedural, object-oriented, and scripting languages. Topics include HTML, Javascript, CSS, XML, Ajax, PHP, ASP.net, Three.js, and related technologies, as well as their impact on the programming process.
Term Offered: Spring

EECS 5520 Advanced Systems Programming
[4 credit hours]
This course examines pertinent concepts of systems programming. Topics covered include: synchronization, distributed programming models, kernel design, peripheral handling, file systems and security history and methods.
Term Offered: Spring, Fall

EECS 5530 Computer Graphics I
[4 credit hours]
An introduction to typical computer graphics systems and their operation. Interactive techniques will be introduced as well as representations and projections of three-dimensional images. Exercises using graphics equipment are assigned.
Term Offered: Spring, Fall

EECS 5560 Database Systems I
[3 credit hours]
The following topics are covered: relational database modeling, query languages, design issues and implementation issued of databases. An appropriate database language is introduced and used to demonstrate principles.
Term Offered: Spring, Fall

EECS 5590 Human Computer Interface Design
[3 credit hours]
This course presents the fundamental theory and practice of design, implementation and evaluation of human-computer interfaces.
Term Offered: Spring

EECS 5600 Solid State Devices
[3 credit hours]
Theory and operation of physical electronic devices. Electrical transport in metals, semiconductors and models of BJT's and FET's. Optoelectronic devices and integrated circuits. Laboratory includes hands-on experimentation with basic semiconductor fabrication processes.
Term Offered: Spring

EECS 5610 Digital Vlsi Design I: Basic Subsystems
[4 credit hours]
CMOS process technologies. CMOS logic families. Custom and semicustom design. Subsystem design; adders, counters, multipliers. System design methods. VLSI design tools.
Prerequisites: EECS 3400 with a minimum grade of D-

EECS 5640 Inside Cryptography
[3 credit hours]
Examines the inner workings of several cryptographic algorithms, including the discrete math behind them. Introduces operations in a Galois Field, and covers some Prime Number Theory. Symmetric algorithms include Feistel (DES) and non-Feistel (AES) designs; Asymmetric algorithms include Merkle-Hellman and RSA. Block and stream modes are explored, as are cryptographic hash functions, and ECB and Chained modes of encryption.
Prerequisites: EECS 2520 with a minimum grade of D- and EECS 3100 with a minimum grade of D-
Term Offered: Spring, Fall

EECS 5720 Fundamentals of Cyber Security
[3 credit hours]
This course introduces cybersecurity concepts and their relevance to national security, businesses, society, and individuals. Concepts that will be discussed include terminologies, blockchain, cryptocurrency, maths/statistics in the domain, review of various cybersecurity domains, forensics, and methods/practices to secure systems. Additional real-world security problems will be introduced through hands-on experiments.
Prerequisites: EECS 2110 with a minimum grade of D-
Term Offered: Spring, Fall

EECS 5740 Artificial Intelligence
[3 credit hours]
This course explores the topic of intelligent software agents with a emphasis on hands-on design of adaptive problem-solving agents for environments of increasing complexity ranging from single-agent computer games to complex real-world mult-agent environments.
Term Offered: Spring

EECS 5750 Machine Learning
[3 credit hours]
This course emphasizes learning algorithms and theory including concept, decision tree, neural network, comprtational, Bayesian, evolutionary, and reinforcement learning.
Prerequisites: (MIME 4000 with a minimum grade of D- and MATH 2890 with a minimum grade of D- and EECS 2110 with a minimum grade of D-)
Term Offered: Spring, Fall

EECS 5760 Computer Security
[3 credit hours]
Survey of computer security concepts: ethics and responsibility, OS vulnerabilities and intrusion detection, viruses and worms, defensive strategies including secret/public key cryptosystems, firewalls and decoys.
Prerequisites: EECS 2110 with a minimum grade of C- and EECS 3540 with a minimum grade of C-
Term Offered: Fall

EECS 5770 Computer Hacking and Forensic Analysis
[3 credit hours]
This course is an introduction to discovering vulnerabilities, attacking/defending systems, responding to attacks, and identifying/designing controls for attack prevention. Topics include the evolution of hacking, penetration testing; cryptology; footprinting; vulnerability scanning and exploit; wireless, web, and database attacks; traffic analysis; incident response; and defensive technologies and controls.
Prerequisites: (EECS 2110 with a minimum grade of C- and EECS 4720 with a minimum grade of C-) or (EECS 5720 with a minimum grade of C)
Term Offered: Spring

EECS 5790 Network Security
[4 credit hours]
Theory and practice of network security. Topics include firewalls, Windows, UNIX and TCP/IP network security. Security auditing, attacks, viruses, intrusion detection and threat analysis will also be covered.
Prerequisites: EECS 4720 with a minimum grade of D- or EECS 5720 with a minimum grade of C
Term Offered: Spring

EECS 5920 Projects
[1-6 credit hours]
Independent research project with intensive investigation into an area of practical interest to the student and the instructor. Students will make progress in a project of an advanced nature in Electrical Engineering/Computer Science and Engineering. The project will culminate in a submission of a written report. Course may be repeated.
Term Offered: Spring, Summer, Fall

EECS 5930 Electrical Engineering & Computer Science Seminar
[1 credit hour]
Seminar talk series by invited speakers from academia, industry, research corporations, private or federal research labs, and funding agencies. 1 cr. hr. seminar.
Term Offered: Spring, Fall

EECS 5980 Special Topics in EECS
[1-4 credit hours]
Pilot offerings of new courses involving emerging topics of interest are introduced using this number. One credit per lecture hour or 2.5 lab hours per week.
Term Offered: Spring, Fall

EECS 6110 Advanced Computer Architecture
[3 credit hours]
Architectural development in computer systems and scability. Processors and arithmetic algorithms. Memory hierarchy, shared memory and cache architecture. Pipeline, superscaler and vector organization.
Term Offered: Fall

EECS 6180 Biologically Inspired Computing
[3 credit hours]
Introduction to Computational Techniques inspired from Biology for Self Learning Adaptive Systems. Evolutionary Computations, Binary and Real coded Genetic Algorithms. Neural Networks, Swarm Intelligence, DNA Computing and Artificial Immune Systems. Hybrid systems such as Evolutionary Fuzzy Systems and Evolutionary Neural Systems, Swarm Neural Systems. Emerging Topics in Computing inspired by nature.
Term Offered: Spring, Fall

EECS 6190 Renewable Energy and Smart Grid
[3 credit hours]
Electric power systems nowadays are undergoing significant changes worldwide in order to become cleaner, smarter, and more reliable. This course examines a broad spectrum of topics relevant to theses changes.
Term Offered: Fall

EECS 6230 Optimal Control Theory
[3 credit hours]
Optimization of dynamic systems by the calculus of variations and Pontryagin's Maximum Principle. Solution of optimal control problems using direct and indirect computational methods. Applications include constrained state and/or control parameters.
Prerequisites: EECS 4200 with a minimum grade of D-

EECS 6250 Advanced Digital Signal Processing
[3 credit hours]
Documentation/interpolation filter design, wavelet transforms, spectral estimation, multirate, adaptive, radar and array signal processing techniques, beamforming, simulation of signal processing algorithms via MATLAB or equivalent.
Term Offered: Spring

EECS 6300 Random Signals And Optimal Filters
[3 credit hours]
Description and properties of random signals and their processing by optimal filters. Correlation and power spectra. GRP. Narrowband noise. Signal detection (matched filter) and estimation (Wiener and Kalman filters).
Term Offered: Fall

EECS 6320 Data Compression For Multimedia Communication
[3 credit hours]
Multimedia information representation, Huffman, run length and arithmetic coding, predictive, transform, pyramid coding; vector quantization and subband coding; wavelet-based coding, data packetization, error resilience coding, mutimedia compression standards, JPEG, MPEG coding.
Term Offered: Spring

EECS 6340 Modern Communications Engineering I
[3 credit hours]
Introduction to detection and estimation and applications to the bandpass signals, Bibary and M-ary digital modulation techniques, Error-control convolutional coding, Trellis Coded Modulation (TCM), Spread Spectrum (SS) communication techniques.
Term Offered: Fall

EECS 6350 Modern Communications Engineering II
[3 credit hours]
Digital transmission over Gaussian/non-Faussian channels, Satellite systems (GEO and LEO) and multiple accesses, Cellular and satellite communication network, Mobile/wireless Personal communication services (PCS) and its networking.
Term Offered: Spring, Fall

EECS 6410 Advanced Electromagnetic Components
[3 credit hours]
Maxwell's equations, transmission line theory, technology CAD, circuit modeling of magnetics, antenna design, electromagnetic interference (EMI), signal integrity.
Term Offered: Fall

EECS 6420 Computer-Aided Modeling and Design of Circuits
[3 credit hours]
Introduction to computer aided design, classification of CAD operations, modified nodal admittance matrix, frequency-domain analysis, time-domain analysis of nonlinear circuits, sensitivity analysis, high-frequency modeling and design.
Term Offered: Fall

EECS 6450 Advanced Power Electronics
[3 credit hours]
Dynamic analysis of DC-DC power conversion circuits. State space and converter transfer functions. Analytical semiconductor device modeling techniques. Sinusoidal pulse width modulation in inverter circuits. Isolated DC-DC converters.
Prerequisites: EECS 5480 with a minimum grade of D-
Term Offered: Spring

EECS 6550 Software Specification And Design
[3 credit hours]
This course covers the software development steps of specification, requirements analysis and design in depth. Computer-human interfaces are also discussed.
Term Offered: Spring, Fall

EECS 6570 Intelligent Systems
[3 credit hours]
Heuristic search, game playing, constraint satisfaction, knowledge representation and reasoning with first order logic, planning, probabilistic modeling and reasoning, and learning.
Term Offered: Fall

EECS 6580 Wireless Sensor Networks
[3 credit hours]
Single node and network architecture, design principles, medium access control, naming and addressing, synchronization, localization and positioning, topology control, routing protocols, data-centric networking, and information and data aggregation.
Term Offered: Spring

EECS 6610 Principles of CMOS Devices
[3 credit hours]
MOSFET Device Physics, CMOS Fabrication, Scaling Trends, Characterization, Technology CAD, Digital Analog and RF Applications, Advanced Device Concepts, Nanoelectronics.
Term Offered: Spring

EECS 6630 Digital and VLSI System Testing
[3 credit hours]
In depth study of testing techniques for digital and VLSI circuit including memory and logic, field programmable gate arrays, system on chips, and quantum dot cellular automata circuits.
Term Offered: Spring

EECS 6650 Hardware Oriented Security and Trust
[3 credit hours]
The course covers the following topics: Hardware Security Basics, Physical Unclonable Function (PUF), Metrics for Evaluating PUFs, Split Manufacturing, Hardware Trojans, Detection of Hardware Trojans, Built-In Self-Repair Hardware Circuits, Security of FPGAs, Machine Learning Attack Models, Testing of Digital/VLSI Circuits.
Term Offered: Spring, Fall

EECS 6660 Field Programmable Gate Arrays
[3 credit hours]
Introduction to FPGA's. Programming technology. Logic block architectures. Routing architectures. FPGA based VLSI design. Design tools.
Term Offered: Spring, Fall

EECS 6830 Power Semiconductor Device Engineering
[3 credit hours]
Semiconductor material physics, electrical transport physics, power switching, power amplification characteristics, power diodes, power MOSFETs, power MOS-bipolar devices, thyristors, and emerging devices.
Term Offered: Fall

EECS 6840 Compound Semiconductors and Devices
[3 credit hours]
This course will cover the fundamentals of various compound-semiconductor materials and devices, including materials and device physics, diodes, GaAs MESFETS, optoelectronic and photovoltaic devices and structures.
Term Offered: Fall

EECS 6860 RF Integrated Circuits
[3 credit hours]
Wireless principles, Passive RLC networks, Passive IC component characteristics, MOS Device Physics, Distributed Systems, Smith Chart and s-parameters, Bandwidth estimation, high frequency amplifier design, voltage references, noise, LNA design, mixers, feedback systems, RF power amplifiers, PLLs, Oscillators and Synthesizers, Phase Noise, Transceiver architectures.
Term Offered: Spring

EECS 6870 Advanced Analog Integrated Circuits
[3 credit hours]
Integrated Circuit Technology, Device Modeling, MOS Switches, Current Sinks and Sources, Bandgap References, Amplifiers, Operational Amplifiers, Comparators, Switched-Capacitor Circuits, Data Converters
Term Offered: Fall

EECS 6900 Independent Research
[1-6 credit hours]
Selected topics from current EE and CSE research with intensive investigation into recent literature in an area of mutual interest to the student and the instructor.
Term Offered: Spring, Summer, Fall

EECS 6910 EECS Graduate Seminar
[1 credit hour]
Students will attend seminars and prepare a report reflecting their learning, questions and the impact of the seminar series. Students will also present their thesis or project plan and initial research results.
Term Offered: Spring, Fall

EECS 6960 Master's Graduate Research And Thesis
[1-9 credit hours]
Graduate research towards the completion of a Master's degree. Students will make progress in a project of an advanced nature in Electrical Engineering/Computer Science and Engineering. The project will culminate in submission and a public defense a master's thesis. Course may be repeated.
Term Offered: Spring, Summer, Fall

EECS 6970 Graduate Engineering Internship
[1 credit hour]
Faculty advisor approved industry, government, or agency full-time internship to provide an experiential learning component to the Master's/ Doctoral degree program.
Prerequisites: GNEN 5000 with a minimum grade of S
Term Offered: Spring, Summer, Fall

EECS 6980 Special Topics In Electrical Engineering & Computer Science
[1-5 credit hours]
Selected topics in the field of Electrical Engineering and Computer Science in areas of special interest to the class and the professor.
Term Offered: Spring, Summer, Fall

EECS 6990 Independent Study
[1-3 credit hours]
In depth study of a selected topic of mutual interest to the student and the instructor.
Term Offered: Spring, Summer, Fall

EECS 8110 Advanced Computer Architecture
[3 credit hours]
Architectural development in computer systems and scability. Processors and arithmetic algorithms. Memory hierarchy, shared memory and cache architecture. Pipeline, superscaler and vector organization.
Term Offered: Fall

EECS 8180 Biologically Inspired Computing
[3 credit hours]
Introduction to Computational Techniques inspired from Biology for Self Learning Adaptive Systems. Evolutionary Computations, Binary and Real coded Genetic Algorithms. Neural Networks, Swarm Intelligence, DNA Computing and Artificial Immune Systems. Hybrid systems such as Evolutionary Fuzzy Systems and Evolutionary Neural Systems, Swarm Neural Systems. Emerging Topics in Computing inspired by nature.
Term Offered: Spring, Fall

EECS 8190 Renewable Energy and Smart Grid
[3 credit hours]
Electric power systems nowadays are undergoing significant changes worldwide in order to become cleaner, smarter, and more reliable. This course examines a broad spectrum of topics relevant to theses changes.
Term Offered: Fall

EECS 8230 Optimal Control Theory
[3 credit hours]
Optimization of dynamic systems by the calculus of variations and Pontryagin's Maximum Principle. Solution of optimal control problems using direct and indirect computational methods. Applications include constrained state and/or control parameters.
Prerequisites: EECS 4200 with a minimum grade of D-

EECS 8250 Advanced Digital Signal Processing
[3 credit hours]
Documentation/interpolation filter design, wavelet transforms, spectral estimation, multirate, adaptive, radar and array signal processing techniques, beamforming, simulation of signal processing algorithms via MATLAB or equivalent.
Term Offered: Spring

EECS 8300 Random Signals And Optimal Filters
[3 credit hours]
Description and properties of random signals and their processing by optimal filters. Correlation and power spectra. GRP. Narrowband noise. Signal detection (matched filter) and estimation (Wiener and Kalman filters).
Term Offered: Fall

EECS 8320 Data Compression For Multimedia Communication
[3 credit hours]
Multimedia information representation, Huffman, run length and arithmetic coding, predictive, transform, pyramid coding; vector quantization and subband coding; wavelet-based coding, data packetization, error resilience coding, mutimedia compression standards, JPEG, MPEG coding.
Term Offered: Spring

EECS 8340 Modern Communications Engineering I
[3 credit hours]
Introduction to detection and estimation and applications to the bandpass signals, Binary and M-ary digital modulation techniques, Error-control convolutional coding, Trellis Coded Modulation (TCM), Spread Spectrum (SS) communication techniques.
Term Offered: Fall

EECS 8350 Modern Communications Engineering II
[3 credit hours]
Digital transmission over Gaussian/non-Faussian channels, Satellite systems (GEO and LEO) and multiple accesses, Cellular and satellite communication network, Mobile/wireless Personal communication services (PCS) and its networking.
Term Offered: Spring, Fall

EECS 8410 Advanced Electromagnetic Components
[3 credit hours]
Maxwell's equations, transmission line theory, technology CAD, circuit modeling of magnetics, antenna design, electromagnetic interference (EMI), signal integrity.
Term Offered: Fall

EECS 8420 Computer-Aided Modeling and Design of Circuits
[3 credit hours]
Introduction to computer aided design, classification of CAD operations, modified nodal admittance matrix, frequency-domain analysis, time-domain analysis of nonlinear circuits, sensitivity analysis, high-frequency modeling and design.
Term Offered: Fall

EECS 8450 Advanced Power Electronics
[3 credit hours]
Dynamic analysis of DC-DC power conversion circuits. State space and converter transfer functions. Analytical semiconductor device modeling techniques. Sinusoidal pulse width modulation in inverter circuits. Isolated DC-DC converters.
Prerequisites: EECS 5480 with a minimum grade of D-
Term Offered: Spring

EECS 8550 Software Specification And Design
[3 credit hours]
This course covers the software development steps of specification, requirements analysis and design in depth. Computer-human interfaces are also discussed.
Term Offered: Spring, Fall

EECS 8570 Intelligent Systems
[3 credit hours]
Heuristic search, game playing, constraint satisfaction, knowledge representation and reasoning with first order logic, planning, probabilistic modeling and reasoning, and learning.
Term Offered: Fall

EECS 8580 Wireless Sensor Networks
[3 credit hours]
Single node and network architecture, design principles, medium access control, naming and addressing, synchronization, localization and positioning, topology control, routing protocols, data-centric networking, and information and data aggregation.
Term Offered: Spring

EECS 8610 Principles of CMOS Devices
[3 credit hours]
MOSFET Device Physics, CMOS Fabrication, Scaling Trends, Characterization, Technology CAD, Digital Analog and RF Applications, Advanced Device Concepts, Nanoelectronics.
Term Offered: Spring

EECS 8630 Digital and VLSI System Testing
[3 credit hours]
In depth study of testing techniques for digital and VLSI circuit including memory and logic, field programmable gate arrays, system on chips, and quantum dot cellular automata circuits
Term Offered: Spring

EECS 8660 Field Programmable Gate Arrays
[3 credit hours]
Introduction to FPGA's. Programming technology. Logic block architectures. Routing architectures. FPGA based VLSI design. Design tools.
Term Offered: Spring, Fall

EECS 8670 Hardware Oriented Security and Trust
[3 credit hours]
The course covers the following topics: Hardware Security Basics, Physical Unclonable Function (PUF), Metrics for Evaluating PUFs, Split Manufacturing, Hardware Trojans, Detection of Hardware Trojans, Built-In Self-Repair Hardware Circuits, Security of FPGAs, Machine Learning Attack Models, and Testing of Digital/VLSI Circuits.
Term Offered: Spring, Fall

EECS 8830 Power Semiconductor Device Engineering
[3 credit hours]
Semiconductor material physics, electrical transport physics, power switching, power amplification characteristics, power diodes, power MOSFETs, power MOS-bipolar devices, thyristors, and emerging devices.
Term Offered: Fall

EECS 8840 Compound Semiconductors and Devices
[3 credit hours]
This course will cover the fundamentals of various compound-semiconductor materials and devices, including materials and device physics, diodes, GaAs MESFETS, optoelectronic and photovoltaic devices and structures.
Term Offered: Spring, Fall

EECS 8860 RF Integrated Circuits
[3 credit hours]
Wireless principles, Passive RLC networks, Passive IC component characteristics, MOS Device Physics, Distributed Systems, Smith Chart and s-parameters, Bandwidth estimation, high frequency amplifier design, voltage references, noise, LNA design, mixers, feedback systems, RF power amplifiers, PLLs, Oscillators and Synthesizers, Phase Noise, Transceiver architectures.
Term Offered: Fall

EECS 8870 Advanced Analog Integrated Circuits
[3 credit hours]
Integrated Circuit Technology, Device Modeling, MOS Switches, Current Sinks and Sources, Bandgap References, Amplifiers, Operational Amplifiers, Comparators, Switched-Capacitor Circuits, Data Converters
Term Offered: Fall

EECS 8900 Independent Research
[1-6 credit hours]
Selected topics from current EE and CSE research with intensive investigation into recent literature in an area of mutual interest to the student and the instructor.
Term Offered: Spring, Summer, Fall

EECS 8910 EECS Graduate Seminar
[1 credit hour]
Students will attend seminars and prepare a report reflecting their learning, questions and the impact of the seminar series. Students will also present their thesis or project plan and initial research results.
Term Offered: Spring, Fall

EECS 8960 Dissertation
[1-9 credit hours]
Graduate research towards the completion of a Doctoral Degree. Course may be repeated.
Term Offered: Spring, Summer, Fall

EECS 8970 Graduate Engineering Internship
[1 credit hour]
Faculty advisor approved industry, government, or agency full-time internship to provide an experiential learning component to the Master's/Doctoral degree program.
Prerequisites: GNEN 5000 with a minimum grade of U
Term Offered: Spring, Summer, Fall

EECS 8980 Current Topics In Electrical Engineering & Computer Science
[1-5 credit hours]
Current topics in the field of Electrical Engineering and Computer Science in areas of special interest to the class and the professor. Students will be expected to complete a written project based on a review of the research literature of the area covered in this course.
Term Offered: Spring, Summer, Fall

EECS 8990 Independent Study
[1-3 credit hours]
In depth study of a selected topic of mutual interest to the student and the instructor.
Term Offered: Spring, Summer, Fall