

ELECTRICAL AND COMPUTER ENGINEERING

<https://ece.coe.miami.edu/>

The Department of Electrical and Computer Engineering offers graduate programs leading to the degrees of Master of Science (thesis or non-thesis option) and Doctor of Philosophy in Electrical and Computer Engineering. Five-year BS and MS dual degree programs are available for qualified undergraduate students enrolled within the Department.

Current research interests of the faculty include:

- Statistical signal processing.
- Image and video processing, pattern recognition, computer vision, automation of visual tasks.
- Machine learning and big data analytics.
- Bioinformatics, computational biology, and genomics.
- Nano-photonics, plasmonics, micro/nano-electronic devices, nano-materials and structures.
- Fusion and learning in networks.
- Data mining, multimedia information systems, multimedia networking and security.
- Intelligent sensor microchips and MEMS, BioMEMS, implantable medical devices, VLSI, ASICs, system-on-a-chip, FPGAs.
- Integrated optics, holography, lithography, spectral imaging, optical coherence tomography.
- Game theory, multi-agent systems.

Master of Science in Electrical and Computer Engineering (MSECE)

Must complete either a thesis option (consisting 24 course credits + 06 thesis credits) or a non-thesis option (30 course credits). Thesis option requirements include the submission and oral defense of a thesis supervised by a Research Supervisor.

Doctor of Philosophy (PhD)

Must complete 30 credits (18 course credits + 12 dissertation credits). Requirements include successful completion of a Qualifying Examination, an oral defense of a research proposal, and submission and oral defense of a dissertation supervised by a Research Supervisor.

Masters Programs in Electrical and Computer Engineering

- M.S. in Electrical and Computer Engineering (<http://bulletin.miami.edu/graduate-academic-programs/engineering/electrical-computer-engineering/electrical-computer-engineering-ms/>)
- M.S. in Software Engineering (<http://bulletin.miami.edu/graduate-academic-programs/engineering/electrical-computer-engineering/software-engineering-ms/>)
- Five-Year B.S.E.E.-M.S.E.C.E. Dual Degree (<http://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/five-year-bsee-msece-dual-degree-electrical-engineering-option/>)
- Five-Year B.S.Cp.E.-M.S.E.C.E. Dual Degree (<http://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/five-year-bscpe-msece-dual-degree-computer-engineering-option/>)
- Five-Year B.S.C.p.E.-MS in Software Engineering Dual Degree (<http://bulletin.miami.edu/graduate-academic-programs/engineering/electrical-computer-engineering/computer-engineering-bs-software-engineering-ms/>)

Doctoral Program in Electrical and Computer Engineering

- Ph.D. in Electrical and Computer Engineering (<http://bulletin.miami.edu/graduate-academic-programs/engineering/electrical-computer-engineering/electrical-computer-engineering-phd/>)

ECE 600. Engineering Analytical Techniques. 3 Credit Hours.

Complex variables, analytic functions, power series, residue theorem, conformal mappings, series solution, Bessel functions, Legendre polynomials. singular value decomposition, vector, and matrix norms are discussed.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 602. Engineering Acoustics. 3 Credit Hours.

Introduction to basic principles of acoustics, methods of sound measurement, physiological, psychological acoustics, the acoustics of the major classes of musical instruments and speech, fundamentals of transducers, architectural acoustics, and the effects and control of noise are covered.

Prerequisite: ECE 336.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 603. Laser Communications. 3 Credit Hours.

Principles of optics, optical fibers, electro-optics, light wave propagation in free space and anisotropic media, and waveguides are discussed. Communication devices including lasers, detectors, electro-optic modulators, optical fiber communication links are covered. The course includes seven hands-on experiments.

Prerequisite: PHY 222 and PHY 223 and ECE 301 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 604. Fundamentals of Optical Imaging. 3 Credit Hours.

Introduction to optical imaging, optical coherence tomography imaging, fiber endoscope imaging, and spectral imaging. Learn grating diffraction, interferometer, and optical spectrometer. The course includes ten hands-on experiments. Gain system level understanding of optical coherence tomography and spectral imaging.

Prerequisites: ECE 301 or BME 545.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ECE 605. Semiconductor Photonic Devices. 3 Credit Hours.

Principles of operation, properties semiconductor based optoelectronic devices. Details of applications such as LED, CCD and CMOS imagers, Laser Diodes, Solar cell, Organic devices and Display devices.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 606. Microfabrication. 3 Credit Hours.

Understand the standard microfabrication processes and related equipment technologies. Device design and hands-on microfabrication lab in the cleanroom. Understand various electrooptic device characterization.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 610. Software Requirements and Interaction Design. 3 Credit Hours.

Understanding user requirements is the foremost step in the software engineering process. The course discusses various requirements management techniques, processes involved in requirements engineering, and designing requirements specifications for both Agile and Waterfall methods of software development. Interaction Design (IxD) is the design of interactive products and services in which a designer's focus goes beyond the item in development to include the way users will interact with it. Interaction Design includes User Experience Design (UX) and User Interaction design. (UI).

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 612. Software Architecture and Design. 3 Credit Hours.

The software architecture of a system represents the design decisions related to overall system structure and behavior. The course discusses the design of software architectures in a systematic, predictable, repeatable, and cost-effective way. The course focuses on practical methodology for architecture and design principles that any professional software engineer can use, provides structured methods supported by reusable chunks of design knowledge. The course includes rich case studies that demonstrate how to use the methods. Building an effective architecture that enables rapid product delivery for today's needs while also addressing the long-term adaptability and maintainability of software.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 613. Software Verification and Testing. 3 Credit Hours.

The course reviews the software testing techniques that are applicable to any software product, as well as covers techniques for behavior-driven development and testing. The agile development paradigm of test-driven development is discussed. Concepts covered include test cycles, testing objectives, testing in the software development process, types of software errors, reporting and analyzing software errors, problem tracking systems, test case design, testing tools, test planning, test documentation, and managing a test group. The course also discusses how to build testing and quality into every stage of the development process and deliver a multitude of releases in an agile development environment.

Pre-Requisite: ECE 612.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 618. Software Engineering and Operations. 3 Credit Hours.

This course is designed for engineers and professionals in software who want to understand software development life cycle process. Topics such as Waterfall model, Rapid Applications Development, and Agile software development concepts are discussed with rich case studies. Operations ensure that features are running smoothly and that there are no interruptions in service - by making sure the network, storage, platform, compute, and security posture of the software after deployment in a production environment. The course also reviews DevOps lifecycle (sometimes called the continuous delivery pipeline, when portrayed in a linear fashion) is a series of iterative, automated development processes, or workflows, executed within a larger, automated, and iterative development lifecycle designed to optimize the rapid delivery of high-quality software.

Pre-Requisite: ECE 610.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 632. VLSI Systems. 3 Credit Hours.

Fundamentals of MOS Technology in VLSI. System data, control flow, structures, design, layout, maskmaking, fabrication, packaging, and testing of VLSI chips are discussed. Highly concurrent Very Large Scale Integration computational systems are also covered. * For students who are taking it as ECE 632 there will be a separate advanced final project that will include the use of all digital circuit library that will be developed in the lab exercises and in addition include an analog component to achieve a mixed signal system integration. This will require additional research study as well as comprehension of more advanced topics in VLSI. Supplemental material and additional project instruction will be delivered in the lab.

Prerequisite: ECE 202. Or ECE 305. And ECE 211. Or ECE 304.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 633. Random Signals and Noise. 3 Credit Hours.

Probability models, Bayes' theorem, Limit theorems of Laplace and Poisson, functions of random variables, Central limit theorem, conditional expectation and estimation, Stochastic processes, stationarity and ergodicity, cross-spectral analysis, filtering, and prediction are discussed.

Prerequisite: ECE 310. Or IEN 310.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 634. Communication Networks. 3 Credit Hours.

Principles of digital communications, Local Area Networks (LANs), Wide Area Networks(WANs), Open systems Intercommunication (OSI), Internet reference models, internet architecture and protocols, packet switching a3nd routing, and network performance are discussed. * For students who are taking it as ECE 634 there will be a separate requirement.

Prerequisite: ECE 212. Or ECE 312. And ECE 310. Or IEN 310.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 636. Adaptive Filters and Signal Processing. 3 Credit Hours.

Topics include linear models and estimation, orthogonality principle, Wiener filters, stochastic gradient methods, LMS and RLS algorithms, mean square error and tracking performance and applications.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 637. Principles of Artificial Intelligence. 3 Credit Hours.

Search techniques, game trees, use of heuristics, logic, representation of knowledge, algorithms for automated reasoning including automated reasoning under imperfect information, some advanced approaches to AI-Problems such as planning.

Prerequisite: ECE 218.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 638. Introduction to Digital Image Processing. 3 Credit Hours.

Digital image representation. Image smoothing, sharpening, and transformations. Color image processing. Encoding of digital images. High level image segmentation and description techniques. Processing of image sequences.

Prerequisite: ECE 206. Or ECE 307. And MTH 210.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 639. Digital Communications. 3 Credit Hours.

Principles for the analysis and design of digital communications systems. Nyquist sampling, signal space representation, digital modulation techniques and optimal receiver design, ISI channels, error control coding, convolutional codes, Viterbi decoder, and wireless applications.

Prerequisite: ECE 404.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 640. Digital Speech and Audio Processing. 3 Credit Hours.

Introduction to human speech production, hearing, and perception. Digital speech and audio signal analysis in time and frequency, speech and audio coding, speech synthesis and recognition, language modeling, design of systems for human-machine interaction are also covered.

Prerequisite: ECE 336.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 642. MEMS: Sensors and Electronics. 3 Credit Hours.

This course will introduce the fundamentals of Microelectromechanical Systems (MEMS). An introductory foundation of MEMS concepts will be established through lectures on sensors, actuators, readout electronics, and noise. Physical principles of electromechanical, piezoresistive, capacitive, and piezoelectric sensing will be introduced. Based on these design and analysis principles the course will focus on commercial applications such as accelometers, biochemical sensors, RF components, microfluidics, and optical devices. Sensor electronics will be discussed with a focus on integration with Complementary Metal Oxide Semiconductor (CMOS) technology.

Prerequisite: Permission of Instructor OR ECE 532.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 643. BioNanotechnology. 3 Credit Hours.

Introduction on the fundamentals of nanotechnology with a focus on Biomedical Applications. A foundation of nanotechnology concepts will be established through lectures on nanometrology with quantum physics basics, nano manufacturing tools, physical, chemical properties of nanomaterials. Application of these principles in electronics, magnetics, mechanics and optics will be discussed. Use of these nanoengineering principles and concepts to focus on biomedical technology applications such as biosensors, biomaterials, biomimetics and therapeutics

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 646. Reliable Digital System Design. 3 Credit Hours.

Topics include descriptive technique for digital systems, synchronizer failure and metastability estimation, design for testability, and estimating digital system reliability. Computer-Aided Engineering (CAE) tools are also covered. Not open to students with credit in ECE 454. Offered only for Graduate students.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 648. Machine Learning. 3 Credit Hours.

Fundamentals of intelligent system design and strategies of learning capability simulation. Selected case studies of learning systems for engineering applications are included.

Prerequisite: ECE 218. Or MTH 309.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ECE 653. Neural Networks. 3 Credit Hours.

Artificial neural network algorithms and structures, learning process, perceptron, least-mean-square algorithms, multilayer perceptron, error back-propagation, radial-basis function networks, the Hopfield network, and self-organizing systems are discussed.

Prerequisite: ECE 218. Or MTH 309.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 662. Wireless and Cellular Communication. 3 Credit Hours.

Wireless Channel Characterization: path loss, shadowing, fading, frequency-selective channels, Doppler spread, and delay spread. Diversity techniques: frequency, time and space diversity. Multiple Antenna Systems: space-time coding, beamforming and layered space-time system. Digital Modulation: adaptive modulations and Orthogonal Frequency Division Multiplexing (OFDM). Cellular Concept: frequency reuse, co-channel interference and handoff. Multiple Access Methods: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and random access. CDMA: spreading codes, RAKE receiver, multiuser detection and power control.

Prerequisite: ECE 404.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 664. Wireless Networks. 3 Credit Hours.

Introduction of wireless channels and network. Introduction of medium access control: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and Carrier Sense Multiple Access. Wireless data networks: IEEE 802.11 (WiFi), IEEE 802.16 (WiMax) and Bluetooth. Wireless network layer: mobile IP and mobile ad-hoc networks. Wireless transport layer: mobile TCP. Wireless Cellular systems: network structure and call processing of GSM and CDMA systems.

Pre or Corequisite: ECE 634.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 672. Object-Oriented and Distributed Database Management Systems. 3 Credit Hours.

Object-Oriented modeling concepts in languages and database systems. Object-Oriented database systems. Semantic data models, nested-relational, object-relational databases. Distributed database system. Federated Databases. Application to engineering design problems.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 673. Information Assurance. 3 Credit Hours.

Assurance as the basis for believing an information system will behave as expected. Security design fundamentals that help create systems that are fit for their purpose and worthy of being trusted. The concepts of information assurance fundamentals. Vulnerabilities and Risk Management assessment. Security Life-Cycle, Mechanisms, Frameworks and Emerging Threats.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 674. Agent Technology. 3 Credit Hours.

Agent definition and applications, agent modeling, theories, agent representation using KIF (Knowledge Interchange Format), agent behavior, ethical and emotional agents, agent communication languages (KQML (Knowledge Query and Manipulation Language)), agent development environments and tools, agent systems (cooperative agents, interface agents, information agents, learning agents, believable agents, agents for workgroups, mobile agents), and agent case studies are covered.

Prerequisite: ECE 537 Or ECE 637.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 675. Digital Forensics. 3 Credit Hours.

The techniques and skills to apply forensics techniques throughout an investigation life cycle while complying with legal requirements. Preservation, identification, extraction and documentation of computer evidence stored on a computer. Application of forensics techniques to investigate and analyze a host in a network, devices including mobile, and techniques to investigate and analyze network traffic.

Prerequisite: ECE 634.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 676. Internet and Intranet Security. 3 Credit Hours.

Security issues and applications for securing internet and Intranet-based information exchange. Secure information models, security tools, security services, security protocols, electronic commerce, virtual private networks, firewalls, and security versus cost tradeoffs are covered.

Prerequisite: ECE 218 or CSC 322 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 677. Data Mining. 3 Credit Hours.

Introduction to the general principles of inferring useful knowledge from large data sets. Data mining algorithms, including inferring rules, linear regression, decision trees, association rules, and predictive models. Evaluation of data mining algorithms, including training, testing, prediction, comparison, cost, and cross-validation. Data mining applications.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 678. Network Security. 3 Credit Hours.

Information about the threats that may be present in the cyber realm and the techniques that can be taken to protect a network and communication assets from cyber threats. Threat examination and application of security measures. Implementation of network defense measures and adjustments for cloud and hybrid applications.

Prerequisite: ECE 634.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 680. Electrical and Computer Engineering Internship. 1-3 Credit Hours.

Analysis, design, and research experience obtained at an operating and recognized industry. Approved project jointly supervised and assessed by departmental faculty and industrial partner.

Components: THI.

Grading: GRD.

Typically Offered: Fall & Spring.

ECE 681. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Fall.

ECE 682. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Spring.

ECE 683. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: LEC.

Grading: GRD.

Typically Offered: Summer.

ECE 684. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: LEC.

Grading: GRD.

Typically Offered: Summer.

ECE 694. Special Topics in Computer Engineering. 1-3 Credit Hours.

Lecture courses in selected areas of specialization within Computer Engineering.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 695. Special Topics in Computer Engineering. 1-3 Credit Hours.

Lecture courses in selected areas of specialization within Computer Engineering.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 696. Special Topics in Computer Engineering. 1-3 Credit Hours.

Lecture courses in selected areas of specialization within Computer Engineering.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 697. Special Topics in Electrical Engineering. 1-3 Credit Hours.

Lecture courses in selected areas of specialization within Electrical Engineering.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 698. Special Topics in Electrical Engineering. 1-3 Credit Hours.

Lecture courses in selected areas of specialization within Electrical Engineering.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 699. Special Topics in Electrical Engineering. 1-3 Credit Hours.

Lecture courses in selected areas of specialization within Electrical Engineering.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 703. Graduate Research Seminar. 1-3 Credit Hours.

Attendance and active participation in a designated semester seminar series.

Requisite: Graduate Standing.

Components: SEM.

Grading: SUS.

Typically Offered: Fall & Spring.

ECE 704. Graduate Teaching. 1-3 Credit Hours.

Teaching or assisting in a course with a substantial level of instructional responsibility. Only open to doctoral students.

Requisite: Graduate Standing.

Components: SEM.

Grading: SUS.

Typically Offered: Fall & Spring.

ECE 715. M.S. Design Project I. 3 Credit Hours.

Comprehensive M.S. design project in electrical or computer engineering. Open only to students in the BS/MS dual-degree program.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ECE 716. M.S. Design Project II. 3 Credit Hours.

Continuation of ECE 715. Open only to students in the BS/MS dual-degree program.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ECE 720. Convex Optimization. 3 Credit Hours.

This course aims to give students the tools and training to recognize convex optimization problems that arise in scientific and engineering applications, presenting the basic theory, and concentrating on modeling aspects and results that are useful in applications. Topics include convex sets, convex functions, optimization problems, optimality condition and duality, and algorithms. Applications to signal processing, machine learning and wireless communications are presented.

Prerequisite: MTH 210.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 721. Quantum Computing. 3 Credit Hours.

The field of Quantum Computing (QC) cuts across several disciplines including engineering, physics, and computer science. This course will introduce engineering students to the basics of QC including quantum bits (qubits), quantum gates, quantum decoherence, and quantum entanglement. It will discuss emerging applications of QC for quantum error correction, quantum encryption, quantum Fourier transform, and others. The course, intended for graduate students majoring in Electrical and Computer Engineering (ECE) and other engineering disciplines as well as computer science and physics, can serve as a stepping stone towards continuing research in the emerging highly impactful field.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 722. Magnetic Devices and Materials. 3 Credit Hours.

Students will be introduced to fundamental concepts of magnetism/spintronics and electromagnetism necessary to conduct state-of-the-art research and develop next-generation applications in the emerging interdisciplinary field of Advanced Materials with a focus on intelligent magnetics-based devices and materials. An emphasis will be placed to design nanomagnetic/spintronic and hybrid nano-magneto-electronic and other multifunctional nanodevices and circuits. Future applications of intelligent materials spanning from energy-efficient information processing to renewable energy and medicine will be discussed. By the end of the course, students will be fluent in solving engineering problems related to any magnetic and electromagnetic field application with a focus on the nanoscale.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 725. Statistical Signal Processing. 3 Credit Hours.

Fundamentals of statistical signal processing, focusing on detection and estimation. Detection: hypothesis testing, Neyman-Pearson criterion, Bayes risk, generalized likelihood ratio tests. Estimation: minimum variance, maximum likelihood, maximum a-posteriori, and minimum mean squared error methods, Cramer-Rao and Bayesian bounds, expectation maximization, least squares, Kalman filter, sparse solutions, applications. Students should have completed basic courses on linear algebra and probability prior to taking this course.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 730. Statistical Learning. 3 Credit Hours.

Statistical learning theory, high-dimensional data models, regression, classification, sparse kernel machines, mixture models, graphical models, Markov chain Monte Carlo simulation, model assessment and selection, model inference and combining.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 735. Fundamentals of Network Science. 3 Credit Hours.

Mathematics of networks; network measures and metrics; power laws and scale-free networks; Erdos-Renyi random networks; random networks with general degree distributions; models of network formation, including preferential attachment models.

Prerequisite: MTH 210.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ECE 738. Computer Vision. 3 Credit Hours.

Principles of computer vision. Segmentation, shape and texture analysis, 3D scene analysis, polyhedral scenes, time-varying image analysis, parallel processing algorithms, matching, and recognition are covered.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 753. Pattern Recognition and Neural Networks. 3 Credit Hours.

Statistical pattern classification, feature extraction, cluster analysis, neural net models, Hopfield net, competitive learning, multi-layer perceptron, and the Boltzmann machine are discussed.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ECE 756. Information Theory. 3 Credit Hours.

Measure of uncertainty and entropy, two dimensional sources, noisy channels, mutual and transinformation, equivocation, efficiency and channel capacity, minimum redundancy coding, error-detecting, error-correcting codes, continuous channel without memory. Gaussian additive noise, sampling theorem, and vector space are covered.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 781. Advanced Problems. 1-3 Credit Hours.

Research and/or design projects through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Fall.

ECE 782. Advanced Problems. 1-3 Credit Hours.

Research and/or design projects through an individual investigation of of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Spring.

ECE 783. Advanced Problems. 1-3 Credit Hours.

Research and/or design projects through an individual investigation of of current problems. Offered by special arrangement only.

Components: LEC.

Grading: GRD.

Typically Offered: Summer.

ECE 784. Advanced Problems. 1-3 Credit Hours.

Research and/or design projects through an individual investigation of current problems. Offered by special arrangement only.

Components: LEC.

Grading: GRD.

Typically Offered: Summer.

ECE 785. Advanced Problems in CyberSecurity. 3 Credit Hours.

Comprehensive M.S. capstone project in CyberSecurity.

Components: THI.

Grading: GRD.

Typically Offered: Spring.

ECE 792. Professional Communications Skills for Engineering Grad Students. 0 Credit Hours.

This course covers fundamental areas in professional communication for Engineering graduate students. Topic areas include: presenting research at conferences, writing manuscripts for publication, preparing the dissertation, the PhD comprehensive exams, effective teaching and mentoring, and obtaining positions in academia. Through interactive workshops, in- class exercises, brief presentations and assignments, students will have an opportunity to practice and strengthen necessary communication skills, developing collaborations, and developing effective presentation skills.

Components: LEC.

Grading: SUS.

Typically Offered: Fall & Spring.

ECE 795. Advanced Topics in Computer Engineering. 1-3 Credit Hours.

Subject matter offerings in computer engineering based upon student demand and availability of faculty. Subtitles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Advanced Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 796. Advanced Topics in Computer Engineering. 1-3 Credit Hours.

Subject matter offerings in computer engineering based upon student demand and availability of faculty. Subtitles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Advanced Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 797. Advanced Topics in Electrical Engineering. 1-3 Credit Hours.

Subject matter offerings in electrical engineering based upon student demand and availability of faculty. Subtitles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Advanced Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 798. Advanced Topics in Electrical Engineering. 1-3 Credit Hours.

Subject matter offerings in electrical engineering based upon student demand and availability of faculty. Subtitles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Advanced Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 799. Advanced Topics. 1-3 Credit Hours.

Subject matter offerings based upon student demand and availability of faculty. Subtitles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Advanced Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ECE 810. Master's Thesis. 1-6 Credit Hours.

The student working on his/her master's thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.

ECE 820. Research in Residence. 1 Credit Hour.

Used to establish research in residence for the thesis for the master's degree after the student has enrolled for the permissible cumulative total in ECE 810 (usually six credits). Credit not granted. May be regarded as full time residence.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ECE 825. Continuous Registration--Master's Study. 1 Credit Hour.

To establish residence for non-thesis master's students who are preparing for major examinations. Credit not granted. Regarded as full time residence.

Components: DIL.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ECE 830. Pre-Candidacy Doctoral Dissertation. 1-12 Credit Hours.

Doctoral dissertation credits taken prior to Ph.D. student's candidacy. The student will enroll for credit as determined by his/her advisor. No more than 12 hours of ECE 830 may be taken in a regular semester; no more than six in a summer session.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.

ECE 840. Post-Candidacy Doctoral Dissertation. 1-12 Credit Hours.

Doctoral dissertation credits taken after Ph.D. student has been admitted to candidacy. The student will enroll for credit as determined by his/her advisor. No more than 12 credits in ECE 840 may be taken in a regular semester; no more than six credits in a summer session.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.

ECE 850. Research in Residence. 1 Credit Hour.

Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.