ELECTRICAL & COMPUTER ENGINEERING (ECE)

ECE 100. Introduction to Electrical and Computer Engineering. 3 Credit Hours.
Introduction to Electrical and Computer Engineering (ECE) for high school students interested in science and technology. The course covers important thematic units of the discipline: electronics, digital design, computer programming and signal processing. Emphasis on hands-on experience in the use of laboratory instrumentation, circuit construction and computer simulation.
Components: LEC.
Grading: GRD.
Typically Offered: Summer.

ECE 110. Introduction to Engineering I. 3 Credit Hours.
Use of engineering tools and computer techniques for problem solving, data acquisition, analysis, presentation, software design, and computer aided drafting. Development of design skills through several design and building competitions is included as well as an introduction to professional ethics, intellectual property rights, the use of MATLAB, AutoCAD, and programming in C++.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 111. Introduction to Engineering II. 2 Credit Hours.
Course is designed to provide first-year undergraduate students with an introduction to some key electrical and computer engineering concepts and topics by discussing their roles in some of the commonly used electrical and computer engineering systems. Numerical examples, circuit simulations, and computer programming are introduced through the use of MATLAB, microcontroller programming languages, and PSpice. Hands-on experience are provided through a project where the students design, assemble, program, and test a microcontroller-based mobile robot with a variety of sensing devices. Should be taken as a freshman only; otherwise to be replaced by a technical elective.
Prerequisite: ECE 111. Or Requisite: Permission of Instructor.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 118. Introduction to Programming. 3 Credit Hours.
Introduction to computing, problem solving, program design, C++ language fundamentals, and software engineering principles. Software design projects are included.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 201. Electrical Circuit Theory. 3 Credit Hours.
Fundamentals of DC-AC circuit laws, including steady state and transient analysis. Lecture, 3 hours.
Prerequisite: MTH 162.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 205. Principles of Electrical Engineering--I. 3 Credit Hours.
Fundamentals of DC and AC Circuits and a survey of Electrical Machinery and Electronics. Not open to students with credits in ECE 201. Lecture, 3 hours.
Prerequisite: MTH 162.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 206. Circuits, Signals and Systems. 3 Credit Hours.
This course teaches the basics of continuous-time signals and systems with an emphasis on circuits as motivating examples. Topics include signals and linear time-invariant systems, convolution, stability, Laplace Transform, transfer function, poles and zeros, s-domain circuit analysis, feedback control, Fourier Series and Transform, Bode plots, analog filters.
Pre-requisite: ECE 201 And MTH 311.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 207. Engineers Without Borders. 1 Credit Hour.
This course focuses on international engineering projects, and introduces them to students through an extensive study of a particular country or region. The course is a team project that involves travel, and involves the students in an engineering project and the challenges of working in another country.
Pre-requisite: ECE 201.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 208. Design Projects. 2 Credit Hours.
Design projects are included.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 209. Introduction to Biomedical Engineering. 3 Credit Hours.
Provides an introduction to the field of biomedical engineering. The course covers the fundamentals of medical electronics and the basic concepts of medical instrumentation design and the role of engineers in the medical device industry.
Pre-requisite: ECE 201.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 210. Introduction to Biomedical Engineering Laboratory. 1 Credit Hour.
This laboratory course provides hands-on experience with medical electronics and instrumentation. Students will design, build, and test simple medical devices and learn how to use common medical measurement equipment.
Pre-requisite: ECE 201.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 211. Logic Design. 3 Credit Hours.
Introduction to digital logic design and computer programming languages. Emphasis on Boolean algebra and its applications in analysis and design of logic circuits. Introduction to SSI and MSI circuits as building blocks, memory elements, and analysis and synthesis of synchronous and asynchronous sequential systems are discussed.
Pre-requisite: ECE 118 Or CSC 120.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 212. Electronics I. 3 Credit Hours.
Semiconductor physics and devices. Diodes, Bipolar Junction Transistors (BJT). Introduction to field-effect transistors (FETs) and Operational Amplifiers. Emphasis on dc and ac analysis of electronic circuits. Use of CAD tools such as PSpice.
Pre-requisite: ECE 201.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 213. Digital Logic Design. 3 Credit Hours.
This course provides a comprehensive introduction to digital logic design and computer programming languages. Emphasis is placed on Boolean algebra and its applications in analysis and design of logic circuits. Students will design, build, and test simple digital systems and learn how to use computer-aided design tools.
Pre-requisite: ECE 201.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 214. Electronics Laboratory. 1 Credit Hour.
Laboratory work employing the techniques of circuit theory to physical components, devices, and circuits. Use of electronic computing techniques to relate analytical and empirical investigations. Laboratory, 3 hours.
Pre-requisite: ECE 201.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 215. Principles of Electrical Engineering--II. 3 Credit Hours.
Fundamentals of DC and AC Circuits and a survey of Electrical Machinery and Electronics. Not open to students with credits in ECE 205. Lecture, 3 hours.
Prerequisite: MTH 162.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 216. Signals and Systems. 3 Credit Hours.
This course teaches the basics of continuous-time signals and systems with an emphasis on circuits as motivating examples. Topics include signals and linear time-invariant systems, convolution, stability, Laplace Transform, transfer function, poles and zeros, s-domain circuit analysis, feedback control, Fourier Series and Transform, Bode plots, analog filters.
Pre-requisite: ECE 201 And MTH 311.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 217. Design Projects. 2 Credit Hours.
Design projects are included.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 218. Design Projects. 2 Credit Hours.
Design projects are included.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 219. Introduction to Biomedical Engineering Laboratory. 1 Credit Hour.
This laboratory course provides hands-on experience with medical electronics and instrumentation. Students will design, build, and test simple medical devices and learn how to use common medical measurement equipment.
Pre-requisite: ECE 201.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.
ECE 212. Processors: Hardware, Software, And Interfacing. 3 Credit Hours.
Architecture and operation of modern microprocessor based computer systems and microcontrollers. Assembly language and applications with hands on experience. Lecture, 3 hours; laboratory, 3 hours.
Prerequisite: ECE 118 and ECE 211/304.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 218. Data Structures. 3 Credit Hours.
Continuation of Programming with emphasis on C++ and the skills required of a capable programmer. Essential data structures and algorithms, and introducing algorithm analysis. Basic sorting, searching, and data management. Dynamic and static memory management. Object oriented programming.
Prerequisite: ECE 118.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 301. Electromagnetic Field Theory. 3 Credit Hours.
Vector analysis, static and time-varying fields, Maxwell's equations, propagation of electromagnetic waves, and transmission line theory and applications are discussed.
Prerequisite: PHY 207 and MTH 210.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 302. Electronics II. 3 Credit Hours.
Prerequisite: ECE 205 or ECE 202.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 303. Electronics Laboratory. 1 Credit Hour.
Laboratory course in conjunction with courses ECE 202 and 302.
Prerequisite: ECE 203 or 204. Or Pre or Corequisite: ECE 302 or 306.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 304. Logic Design. 3 Credit Hours.
Boolean algebra and its applications in analysis and design of logic circuits. Introduction to SSI and MSI circuits as building blocks, memory elements, and analysis and synthesis of synchronous and asynchronous sequential systems are discussed.
Prerequisite: ECE 118 or CSC 120.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 305. Electronics I. 3 Credit Hours.
Semiconductor physics and devices. Diodes, bipolar-junction transistors (BJT). Introduction to field-effect transistors (FETs) and Operational Amplifiers. Emphasis on dc and ac analysis of electronic circuits. Use of CAD tools such as PSpice.
Prerequisite: ECE 201.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 306. Electronics II. 3 Credit Hours.
Prerequisite: ECE 202 or 305.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 307. Circuits, Signals And Systems. 3 Credit Hours.
This course teaches the basics of continuous-time signals and systems with an emphasis on circuits as motivating examples. Topics include signals and linear time-invariant systems, convolution, stability, Laplace Transform, transfer function, poles and zeros, s-domain circuit analysis, feedback control, Fourier Series and Transform, Bode plots, analog filters.
Prerequisite: ECE 201, MTH 311.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 308. Linear Control Systems. 3 Credit Hours.
Introduction to system theory, transfer function and state variable modeling of linear continuous time systems, root locus, Bode plot, Nyquist criterion, analysis and controller design using root locus and frequency domain techniques, proportional-integral-derivative controllers.
Prerequisite: ECE 206/307 and ECE 303/311 and MTH 210.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 310. Introduction to Engineering Probability. 3 Credit Hours.
Axioms of probability, discrete and continuous random variables, probability density functions. Expectation, conditioning, independence, functions of random variables, characteristic functions, multiple random variables. Sums of random variables, limit theorems, probability bounds, convergence concepts. Introduction to statistical analysis, estimation, and hypothesis testing. Cross-listed with IEN 310.
Prerequisite: MTH 162 or equivalent. Requisite: Junior Status.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 311. Electronics Laboratory. 1 Credit Hour.
Laboratory course in conjunction with courses ECE 205 and 306.
Prerequisite: ECE 203 or 204. Or Pre or Corequisite: ECE 302 or 306.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.
ECE 312. Processors: Hardware, Software, And Interfacing. 3 Credit Hours.
Architecture and operation of modern microprocessor based computer systems and microcontrollers. Assembly language and applications with hands on experience. Lecture, 3 hours; laboratory, 3 hours.
Prerequisite: ECE 118 and ECE 211/304.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 315. Digital Design Laboratory. 1 Credit Hour.
Familiarization with properties and use of logic gates, flip-flops, digital standard components, and programmable logic devices. Design and implementation of combinational and synchronous digital systems and Computer Aided Engineering (CAE) tools for design and simulation of digital systems are also included.
Prerequisite: ECE 304 Or ECE 211.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 316. Structured Digital Design. 1 Credit Hour.
VHDL ((VHSIC (very high speed integrated circuits) hardware description language)) introduction and syntax. Functional and behavioral models of VHDL for design, testing, and simulation of digital circuits and programmable logic devices. Design and implementation of combinational and sequential digital systems using VHDL is also included.
Prerequisite: ECE 315.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 318. Algorithms. 3 Credit Hours.
Continuation of the programming sequence. Object oriented programming with C++, emphasizing the skills required of a professional programmer. Essential data structures and algorithms: trees, graphs, hash tables, parsing and text processing. Advanced sorting and data management algorithms. Advanced features of C++; effective programming with C.
Prerequisite: ECE 218.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 322. Systems Programming. 3 Credit Hours.
Practical hands-on experience with UNIX systems programming and administration. Programming using C and shell scripting languages. File systems features, multiprocessing, inter-process communication, and systems programming fundamentals are discussed.
Prerequisite: ECE 218.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 336. Discrete-Time Signals And Systems. 3 Credit Hours.
This course provides the basics connecting continuous-time (CT) and discrete-time (DT) signal processing, and an introduction to discrete-time signals and systems and applications. Topics include communication, sampling, discrete-time linear time-invariant (LTI) signals and systems, difference equations, z Transform, transform domain analysis of DT systems, DT Fourier transform (DTFT), digital filters, applications to audio, and image processing.
Prerequisite: ECE 307 Or ECE 211.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 368. Internet Computing I. 3 Credit Hours.
Principles and practices used in creating interactive Internet sites. Extensive object oriented programming in Java is taught. Use of eXtensible Markup Language (XML) to provide content description. Use of GUI components and graphics to create web based applications.
Prerequisite: ECE 218.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 395. Undergraduate Research in Electrical and Computer Engineering. 1-3 Credit Hours.
Research and/or design projects consisting of an individual investigation of real-world contemporary problems. Offered by special arrangement and under the supervision of a faculty member.
Components: THI.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 399. Cooperative Education. 1 Credit Hour.
Practical application of classroom theory through alternating semester or summer employment with firms offering positions consistent with the student's field of study. Course may be repeated.
Components: THI.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 404. Communication Systems. 3 Credit Hours.
Introduction to digital communication, including binary and M-ary baseband and bandpass modulation over additive white Gaussian noise channels. Optimal receivers, pulse shaping for bandlimited channels, synchronization, multiple access.
Prerequisite: ECE 336, ECE 310 or IEN 310.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 405. Solid-State Electronics. 3 Credit Hours.
Principles of semiconductor electronics, energy bands of semiconductors, Fermi level, carrier distribution, and transport mechanisms are discussed. Application of semiconductor theory to various junction and field effect devices are included.
Prerequisite: ECE 301, PHY 207.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.
ECE 412. Software Engineering and Architecture. 3 Credit Hours.
Prerequisite: ECE 318.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 413. Software Design and Verification. 3 Credit Hours.
Prerequisite: ECE 412/512.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 414. Computer Organization and Design. 3 Credit Hours.
Hardware structure, organization and design of computers. Design of computer arithmetic and control units, data, and instruction paths. Modern hardware description language (HDL) based design methodology. Register transfer level design of computers and digital systems. Algorithmic state machine (ASM) charts, instruction set architecture, control unit implementation, microprogramming, memory organization, pipelining, I/O system organization and high speed arithmetic units are discussed.
Prerequisite: ECE 312 Or ECE 212.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 415. Senior Project I. 1 Credit Hour.
Topics cover tasks in project planning including scheduling, documentation, communication (written and oral), financial constraints, and ethics. Students are required to present project proposals to serve as the basis for the follow-up course, ECE 416.
Requisite: Senior Status.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 416. Senior Project II. 2 Credit Hours.
The capstone design course for Electrical Engineering majors. An electrical system is designed, implemented, and documented. The purpose of this course is to integrate the student's knowledge in hardware, software, and project management. A major digital system is designed, implemented, debugged, and documented.
Prerequisite: ECE 418.
Components: THI.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 417. Embedded Microprocessor System Design. 3 Credit Hours.
Study of microcomputer system design, scientific methods for quantifying system performance, embedded controller applications using high level languages, and debugging strategies. Lecture, 1 hour; laboratory, 3 hours.
Prerequisite: ECE 218, ECE 315, ECE 414.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 418. Senior Project Planning. 1 Credit Hour.
The creative process of devising a product to meet customers needs including an overview of the design process, analysis of requirements, project planning, scheduling, evaluation, and documentation. Students are required to present project proposals to serve as the basis for the follow-up senior design project.
Requisite: Senior Status.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 419. Senior Project. 2 Credit Hours.
The design and implementation of operating systems. Virtual memory and memory management, resource allocation, device drivers, process creation, control, communications and scheduling, file systems, data protection, security, parallel processing and time-sharing. The class includes a significant operating system implementation project.
Prerequisite: ECE 318.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 421. Computer Operating Systems. 3 Credit Hours.
The design and implementation of operating systems. Virtual memory and memory management, resource allocation, device drivers, process creation, control, communications and scheduling, file systems, data protection, security, parallel processing and time-sharing. The class includes a significant operating system implementation project.
Prerequisite: ECE 318.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 436. Digital Signal Processing. 3 Credit Hours.
Topics include finite length transforms (e.g., discrete Fourier transform, discrete sine and cosine transforms) and their fast computation, finite impulse response (FIR) and infinite impulse response (IIR) digital filter design, digital filter structures, finite wordlength effects on filter performance, and multirate signal processing fundamentals.
Prerequisite: ECE 336.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 437. Real-Time Digital Signal Processing Laboratory. 1 Credit Hour.
Digital signal processing hardware for real-time operation, software development tools, instruction set, and DSP experiments with audio and speech application are discussed.
Prerequisite: ECE 436. Or Corequisite: ECE 436.
Components: LAB.
Grading: GRD.
Typically Offered: Fall.

ECE 454. Digital System Design and Testing. 3 Credit Hours.
Functional building blocks and concepts of control and timing in digital design. Descriptive techniques for digital systems and design for testability.
Prerequisite: ECE 315 and 316. Corequisite: ECE 455.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.
ECE 455. Design-for-Testability Laboratory. 1 Credit Hour.
Project laboratory demonstrating the techniques necessary to design, implement, and debug and test a large system. The process is carried through from conceptual design, implementation, integration, simulation, and synthesis on a FPGA chip.
Prerequisite: ECE 454. Or Corequisite: ECE 454.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 467. Database Design and Management. 3 Credit Hours.
Database systems design, modeling, implementation, management methodologies, and techniques. Different database systems are addressed including relational, object-oriented, object-relational, and distributed database systems. Internet (WWW) technology, data warehousing, and online analytical processing applications of database management systems and hands-on experience with commercial database systems is also included.
Prerequisite: ECE 322 or CSC 322.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 470. Network Client-Server Programming. 3 Credit Hours.
Introduction to server-client systems and programming. Advanced server-client design and implementation based on distributed component object model in Windows and UNIX.
Prerequisite: ECE 218.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 481. Senior Project I. 1 Credit Hour.
The creative process of devising a product to meet customers' needs including an overview of the design process, analysis of requirements, project planning, scheduling, evaluation, and documentation. Students are required to present project proposals to serve as the basis for the follow-up senior design project.
Requisite: Senior Status.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 482. Senior Project II. 2 Credit Hours.
The capstone design course for Electrical Engineering and Computer Engineering majors. A major electrical and/or computer engineering system is designed, implemented, and documented.
Prerequisite: ECE 481.
Components: THI.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 499. Senior-Junior Cooperative Education. 1-3 Credit Hours.
Analysis and design experience obtained in industry or government. Approved project jointly supervised and assessed by department faculty and external partner. Note: A maximum of three credits could be used to satisfy degree requirement as Technical Elective. See Bulletin for more information.
Components: THI.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 500. 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 502. 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: Fall.

ECE 503. Laser Communications. 3 Credit Hours.
Principles of optics, optical fibers, electro-optics, light wave propagation in anisotropic and periodic media, guided waves, and integrated optics are discussed. Electro-optic devices including sources and detectors, optical fiber communication, and optics for medical and biomedical applications are also covered.
Prerequisites: PHY 206, PHY 207, ECE 301, or Permission of Instructor.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 504. Fundamentals of Optical. 3 Credit Hours.
Introduction to optics and fiber communication, light propagation in free space and waveguides, imaging, wave phenomena and diffraction, interferometer, spectrometer, holography, fiber coupling, and fiber communication are covered.
Prerequisites: ECE 301 or BME 545.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 505. Semiconductor Photonic Devices. 3 Credit Hours.
Principles of semiconductor electronics: energy bands of semiconductors; Fermi level; carrier distribution and transport mechanisms. Application of semiconductor theory to various junction and field effect devices.
Prerequisite: ECE 302, 306, 405.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 506. Microfabrication. 3 Credit Hours.
Principles of operation, properties and applications of semiconductor devices, junction, metal-semiconductor, metal-oxide-semiconductor, optoelectronic, bulk-effect, and charge-coupled are covered.
Prerequisite: ECE 505.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.
ECE 511. Computability, Complexity, And Algorithms. 3 Credit Hours.
Advanced programming techniques: dynamic programming, fast data retrieval and sorting, enumerators, data structures, and data management. The limits of software engineering, computability and models of computation, complexity analysis.
Prerequisite: ECE 318.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 512. Software Engineering and Architecture. 3 Credit Hours.
Prerequisite: ECE 318.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 513. Software Design and Verification. 3 Credit Hours.
Prerequisite: ECE 412/512.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 514. Computer Architecture. 3 Credit Hours.
Computer data and instruction types, survey of existing architectures, and the interaction between hardware and software sub-systems are discussed. Advanced topics in computer architecture.
Prerequisite: ECE 414.
Components: LEC.
Grading: GRD.
Typically Offered: Spring & Summer.

ECE 519. Design of Computing Languages. 3 Credit Hours.
Major features of modern programming languages with emphasis on design and software efficiency. Interaction between language design and the design of its compiler are included.
Prerequisite: ECE 218.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 521. Computer Operating Systems. 3 Credit Hours.
The design and implementation of operating systems. Virtual memory and memory management, resource allocation, device drivers, process creation, control, communications and scheduling, file systems, data protection, security, parallel processing and time-sharing. The class includes a significant operating system implementation project.
Prerequisite: ECE 318.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 532. 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.
Prerequisite: ECE 202. Or ECE 305. And ECE 211. Or ECE 304.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 533. 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 534. 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 and routing, and network performance are discussed.
Prerequisite: ECE 212. Or ECE 312. And ECE 310. Or IEN 310.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 537. 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 538. Introduction to Digital Image Processing. 3 Credit Hours.
Prerequisite: ECE 206. Or ECE 307. And MTH 210.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 539. 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 540. 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: Spring.

ECE 542. Artificial 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. Use of these nanoengineering principles and concepts to focus on biomedical technology applications such as biosensors, biomaterials, biomimetics and therapeutics.
Components: LAB.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 543. 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 nanotechnology and design of systems for human-machine interaction are also covered.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 544. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 545. Database Design and Management. 3 Credit Hours.
Database systems design, modeling, implementation, management methodologies, and techniques. Different database systems are addressed including relational, object-oriented, object-relational, and distributed database systems. Internet (WWW) technology, data warehousing, and online analytical processing applications of database management systems and hands-on experience with commercial database systems is also included.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 546. Wireless Communication Lab. 1 Credit Hour.
Computer simulation of path loss, shadowing and fading in wireless channels, performance of various digital modulation methods in both Gaussian and wireless channels, diversity methods, equalization methods including zero-forcing, minimum mean-square error (MMSE) and detection-feedback equalization (DFE), co-channel interfacing in cellular systems, space-time coding. Orthogonal Frequency Division Multiplexing (OFDM) systems, spreading codes for Code Division Multiple Access (CDMA) systems, and matched-filter receiver and multiuser detector for CDMA systems. Measurement of wireless signals in various environments.
Components: LAB.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 547. Network Client-Server Programming. 3 Credit Hours.
Introduction to server-client systems and programming. Advanced server-client design and implementation based on distributed component object model in Windows and UNIX.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 548. Machine Learning. 3 Credit Hours.
Fundamentals approaches to classifier induction, probabilistic and instance-based approaches, linear and polynomial classifiers, neural networks, decision trees, boosting techniques, performance evaluation, cluster analysis, reinforcement learning, fundamentals of computational learning theory.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 549. Digital Speech and Audio Processing. 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 systems. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 550. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 551. Digital Speech and Audio Processing. 3 Credit Hours.
Computer simulation of path loss, shadowing and fading in wireless channels, performance of various digital modulation methods in both Gaussian and wireless channels, diversity methods, equalization methods including zero-forcing, minimum mean-square error (MMSE) and detection-feedback equalization (DFE), co-channel interfacing in cellular systems, space-time coding. Orthogonal Frequency Division Multiplexing (OFDM) systems, spreading codes for Code Division Multiple Access (CDMA) systems, and matched-filter receiver and multiuser detector for CDMA systems. Measurement of wireless signals in various environments.
Components: LAB.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 552. Wireless Communication Lab. 1 Credit Hour.
Computer simulation of path loss, shadowing and fading in wireless channels, performance of various digital modulation methods in both Gaussian and wireless channels, diversity methods, equalization methods including zero-forcing, minimum mean-square error (MMSE) and decision-feedback equalization (DFE), co-channel interfacing in cellular systems, space-time coding. Orthogonal Frequency Division Multiplexing (OFDM) systems, spreading codes for Code Division Multiple Access (CDMA) systems, and matched-filter receiver and multiuser detector for CDMA systems. Measurement of wireless signals in various environments.
Components: LAB.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 553. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 554. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 555. Database Design and Management. 3 Credit Hours.
Database systems design, modeling, implementation, management methodologies, and techniques. Different database systems are addressed including relational, object-oriented, object-relational, and distributed database systems. Internet (WWW) technology, data warehousing, and online analytical processing applications of database management systems and hands-on experience with commercial database systems is also included.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 556. Wireless Communication Lab. 1 Credit Hour.
Computer simulation of path loss, shadowing and fading in wireless channels, performance of various digital modulation methods in both Gaussian and wireless channels, diversity methods, equalization methods including zero-forcing, minimum mean-square error (MMSE) and decision-feedback equalization (DFE), co-channel interfacing in cellular systems, space-time coding. Orthogonal Frequency Division Multiplexing (OFDM) systems, spreading codes for Code Division Multiple Access (CDMA) systems, and matched-filter receiver and multiuser detector for CDMA systems. Measurement of wireless signals in various environments.
Components: LAB.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 557. Network Client-Server Programming. 3 Credit Hours.
Introduction to server-client systems and programming. Advanced server-client design and implementation based on distributed component object model in Windows and UNIX.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 558. Digital Speech and Audio Processing. 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 systems. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 559. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 560. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 561. Database Design and Management. 3 Credit Hours.
Database systems design, modeling, implementation, management methodologies, and techniques. Different database systems are addressed including relational, object-oriented, object-relational, and distributed database systems. Internet (WWW) technology, data warehousing, and online analytical processing applications of database management systems and hands-on experience with commercial database systems is also included.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 562. 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 systems. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.
ECE 574. 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 age nts, 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 576. 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 368.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 577. 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.
Prerequisite: ECE 467 Or ECE 567.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 579. Mobile Computing. 3 Credit Hours.
Mobile computing and proxy architectures, mobile web protocols, mobile user interfaces, applications, systems-ware adaptations, mobile databases, transactions, data synchronization, privacy, authentication, and security are covered.
Prerequisite: ECE 368.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 581. 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: Offered by Announcement Only.

ECE 582. 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 583. 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 584. 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 590. Special Topics in Information Technology. 1-3 Credit Hours.
Lecture courses in selected areas of specialization within Information Technology.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 591. Special Topics in Information Technology. 1-3 Credit Hours.
Lecture courses in selected areas of specialization within Information Technology.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 594. 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 595. 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 596. 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 597. 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 598. 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 599. Special Topics in Electrical Engineering. 1-3 Credit Hours.
Lecture courses in selected areas of specialization within Electrical Engineering.
Components: LEC.
Typically Offered: Offered by Announcement Only.
Grading: GRD.

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.
Typically Offered: Offered by Announcement Only.
Grading: GRD.

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.
Typically Offered: Fall.
Grading: GRD.

ECE 603. Laser Communications. 3 Credit Hours.
Prerequisites: PHY 206, PHY 207, ECE 301, or Permission of Instructor.
Components: LEC.
Typically Offered: Fall.
Grading: GRD.

ECE 604. Fundamentals of Optical. 3 Credit Hours.
Prerequisites: ECE 301 or BME 545.
Components: LEC.
Typically Offered: Spring.
Grading: GRD.

ECE 605. Semiconductor Photonic Devices. 3 Credit Hours.
Principles of semiconductor electronics: energy bands of semiconductors; Fermi level; carrier distribution and transport mechanisms. Application of semiconductor theory to various junction and field effect devices.
Prerequisite: ECE 302, 306, 405.
Components: LEC.
Typically Offered: Fall.
Grading: GRD.

ECE 606. Microfabrication. 3 Credit Hours.
Principles of operation, properties and applications of semiconductor devices, junction, metal-semiconductor, metal-oxide-semiconductor, optoelectronic, bulk-effect, and charge-coupled are covered.
Components: LEC.
Typically Offered: Spring.
Grading: GRD.

ECE 632. VLSI Systems. 3 Credit Hours.
Fundamentals of MOS Technology in VLSI. System data, control flow, structures, design, layout, masking, 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, 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 635. 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 636. 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: Offered by Announcement Only.

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

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: 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 nanoeengineering 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: Offered by Announcement Only.

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: Offered by Announcement Only.

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.
Prerequisite: ECE 467 Or ECE 567.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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.
Prerequisite: ECE 634.
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.*For students who are taking it as ECE 676 there will be a separate requirement.
Prerequisite: ECE 368.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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.
Prerequisite: ECE 467 or ECE 567.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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 673 and 676.
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: LEC.
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 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 685. 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 686. 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 687. 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 688. 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 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.

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.

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: Offered by Announcement Only.

ECE 755. 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 current problems. Offered by special arrangement only.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 783. 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 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.
Prerequisite: ECE 678.
Components: LEC.
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: MOD.
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.

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.

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: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

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.