ELECTRICAL AND COMPUTER ENGINEERING

https://ece.coe.miami.edu/index.html

 Dept. Code: ECE

Introduction

Electrical and Computer Engineering are complementary disciplines that are at the forefront of the continuing development and evolution of our modern technological society. Electrical and computer engineers have initiated and contributed to the development of such important and diverse areas as integrated electronics and photonics, telecommunication systems and computer networks, computer hardware and software, image processing and computer vision, automation and robotics, electrical power generating and transmission systems, as well as participated in the development of significant applications to biotechnology. These technologies have significantly transformed how our evolving society will live, learn, work, communicate and do business in the 21st century and are critical to the development of a sustainable world economy. It is an exciting and challenging discipline offering a variety of rewarding career paths. The Department of Electrical and Computer Engineering offers a number of innovative academic and research programs to help prepare students to achieve a variety of career goals.

The Department offers three undergraduate degree programs as well as three five year BS/MS degree programs:

- Bachelor of Science in Electrical Engineering degree program (B.S.E.E.)
- Bachelor of Science in Computer Engineering degree program (B.S.Cp.E.)
- Bachelor of Science in Software Engineering (B.S.S.E)
- Bachelor of Science in Computer Engineering/Master of Science in Electrical and Computer Engineering (B.S.Cp.E./M.S.E.C.E.)
- Bachelor of Science in Electrical Engineering/Master of Science in Electrical and Computer Engineering (B.S.E.E./M.S.E.C.E.)
- Bachelor of Science in Computer Engineering/Master of Science in Software Engineering(B.S.Cp.E/M.S.S.E)

The Electrical Engineering and the Computer Engineering degree programs are accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org

In addition, the Department offers graduate courses leading to the:

- Degree of Master of Science in Electrical and Computer Engineering (M.S.E.C.E.),
- Master of Science in Software Engineering (M.S.S.E), and the
- Doctor of Philosophy degree (Ph.D.).

For further information see the Bulletin of the Graduate School (http://bulletin.miami.edu/graduate-academic-programs/engineering/).

Bachelor of Science in Electrical Engineering (B.S.E.E.)

This degree program endeavors to achieve its objectives by imparting to its students the fundamental principles underlying modern electrical engineering, along with the necessary skills and experiences to apply standard practices, methodologies and available tools for solving electrical engineering problems. The major areas of Electrical Engineering include electronics, analog and digital circuits, microprocessors, communications and control systems. The design sequence is spread throughout the educational experience curricula, culminating in the two-semester senior design project. Graduates are expected to keep pace with this rapidly evolving discipline. To this end, the faculty stresses the importance of continued education and life-long professional development by trying to instill in their students a sense of excitement for the prospects of this evolving technology, tempered by a strong sense of responsibility and concern for its potential impacts on society.

Degree Program

The Electrical Engineering (http://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/electrical-engineering-bsee-electrical-engineering-option/) degree program has three options:

1. Electrical Engineering Option
2. Audio Engineering Option
3. Electrical Engineering Pre-Med Option

These options require specialized courses as well as the 49 Engineering Credit Hours required in the accredited Electrical Engineering degree program.

Double Degree Program - B.S.E.E. & B.S.B.E.

A BME student who satisfies the requirement of the Bachelor of Science in Biomedical Engineering (B.S.B.E.) degree with electrical orientation as described in this Bulletin may also qualify for the B.S.E.E. degree by taking the following additional courses:

Code	Title	Credit Hours
ECE 218	Data Structures	3
ECE 301	Electromagnetic Field Theory	3
ECE 302	Electronics II	3
ECE 303	Electronics Laboratory	1
ECE 212	Processors: Hardware, Software, and Interfacing	3
ECE 316	Structured Digital Design	1
ECE 336	Discrete-Time Signals and Systems	3
Select one ECE Design Elective		3
Select two EE Core Electives		6
Select three ECE Electives		9
Senior Project (ECE Faculty as co-sponsor)		
Total Credit Hours		**35**

Bachelor of Science in Computer Engineering (B.S.Cp.E.)

Computer engineering is a rapidly changing and evolving discipline driven by new technological developments and marketplace conditions. To adequately train students to meet the challenges of the future and to assume leadership roles in the practice of computer engineering, the department offers an up-to-date curriculum that reflects new technological developments that have the potential for significantly impacting professional practice in the industry. The curriculum is constantly updated to incorporate new technological, scientific and economic developments.

Alternatively, students can earn a Bachelor of Science in Computer Engineering under the Software Engineering option, which is primarily focused on the systematic and disciplined development of software systems. This option focuses on the application of computer engineering and computer science principles and practices to the creation, operation, and maintenance of software applications and systems.

Degree Program

This degree program endeavors to achieve its objectives by imparting to its students the fundamental principles underlying modern computer engineering, along with the necessary skills and experiences to apply standard practices, methodologies and modern tools for solving computer engineering problems.

The computer engineering design sequence is spread throughout the curriculum, culminating in a two semester senior design project.

Graduates are expected to keep pace with this rapidly-evolving discipline. To this end, the faculty stress the importance of continued education and life-long professional development, by trying to instill in the students a sense of excitement for the prospects of this evolving technology, tempered by a strong sense of responsibility and concern for its potential impacts on society.

The Computer Engineering (http://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/computer-engineering-bscpe-computer-engineering-option/) degree program has three options:

1. Computer Engineering Option
2. Software Engineering Option
3. Computer Engineering Pre-Med Option

These options require a common engineering core, which is followed by specialized courses in each area along with elective courses.

Bachelor of Science in Software Engineering

Software Engineering is concerned primarily with the systematic and disciplined approach to developing software systems. It requires the application of both computer engineering and computer science principles and practices to the creation, operation, and maintenance of software systems and applications. Software systems are becoming increasingly complex, and emerging technologies are pushing the boundaries of reusable components and software quality assurance. The growth of software use in all areas and aspects of everyday life has increased over the past decades and has now become an integral part of society. The reliance on software in critical areas including infrastructure, transportation, utilities, national security, and defense has resulted in the need for properly trained and motivated individuals.

This Program prepares students for successful careers in various software related jobs such as Software Developers, Quality Assurance Analysts, Computer Programmers, Web Developers, Database Administrators, Information Security Analyst and Testers. This program will not satisfy the licensure requirements for professional engineering registration.

Degree Program

To prepare students to meet these challenges, the Software Engineering (http://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/software-engineering-bs/) program establishes a solid foundation of software system fundamentals, coupled with strong hands-on experience and an understanding of professional practice and conduct. In addition to the core curriculum in software engineering,

students are introduced to the paradigms of real-time, adaptive, and collaborative software systems, through a wide range of technical elective courses from the Department of Electrical and Computer Engineering. Students may also use courses from other departments with academic advisor approval. The technical electives allow students to apply the knowledge they have gained to different application areas. This provides valuable hands-on experience in contemporary application areas, which enhances the students' potential career development opportunities.

Accelerated Program

This Accelerated Software Engineering (http://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/accelerated-software-engineering-bs/) program is targeted to individuals who want to develop expertise in the latest software engineering tools and practices. The program is meant for practicing professionals who are interested in developing advanced competency in software development, software process management and programming. The applicant should have a BS degree and preferably some work experience. Applicants must meet specific admission requirements including prerequisites in Math (Calculus, Linear Algebra, Discrete Math, Probability and Statistics), Basic Science with Lab, and Computing (Engineering and Technology, Basic Computer Programming, Digital Logic with Lab). Applicants may have already taken or plan to take these courses as part of an existing BS degree.

Dual Majors

Computer Engineering or Electrical Engineering students who want to do additional majors or minors must meet with their academic advisor to plan out their course work.

Computer Engineering students wanting to do Computer Science as a second major must:

1. Have an additional 6 advisor-approved technical credit hours beyond that required for the CE major,
2. Complete an approved two semester sequence of courses with laboratory in Biology, Chemistry, Physics, or Geological Sciences (may also count towards Basic Science requirements),
3. Take PHI 115 (may also count towards Cognate requirements).

Five-Year Dual B.S./M.S. Degrees

Purpose

Intended for exceptional students to acquire both a Bachelor of Science and a Master of Science degree simultaneously, in five years rather than the 4 plus 2 years (approximately) it normally requires.

Requirements

You must be an undergraduate student in the College of Engineering (CoE). A master's degree is considered the first professional degree in engineering. The Admission Committee will carefully review academic credentials for admission into our M.S. program. Students should discuss the program and possibility of entering with an academic adviser. Completed applications are due prior to the beginning of the final exams in your junior year.

Get the application form (it is different for US students and International students) from the CoE Office of Research and Graduate Studies, fill it out and then return it to the same office. The application fee is waived for currently enrolled students in the CoE.

Take the GRE Examination before the end of your senior year and attain a combined score of more than 1000 on the Verbal and Quantitative portions. You must have a cumulative GPA of at least 3.0 at the time of application.

For further information about admission into the graduate school see the Bulletin of the Graduate School (http://bulletin.miami.edu/graduate-academic-programs/engineering/).

For more detailed information about the CoE Five-Year programs, please refer to the College of Engineering Bulletin section (http://bulletin.miami.edu/undergraduate-academic-programs/engineering/#fiveyearbsmsprogramtext). The Department of Electrical and Computer Engineering has two Five-Year degree programs, B.S.Cp.E./M.S.E.C.E., B.S.E.E./M.S.E.C.E, and B.S.Cp.E/M.S.S.E. Each of first two programs has two options as listed below.

The B.S.Cp.E./M.S.E.C.E. (http://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/five-year-bscpe-msece-dual-degree-computer-engineering-option/) program has two options:

1. Computer Engineering Option
2. Software Engineering Option

The B.S.E.E./M.S.E.C.E. (http://bulletin.miami.edu/undergraduate-academic-programs/engineering/electrical-computer-engineering/five-year-bscpe-msece-dual-degree-computer-engineering-option/) program has two options:

1. Audio Engineering Option
2. Electrical Engineering Option

Departmental Laboratories

The Department maintains a variety of well-equipped laboratories and computers adequate for undergraduate instruction and graduate research. The laboratories and computer facilities include:

- Computer Vision and Image Processing Laboratory
- Digital Audio and Speech Processing Laboratory
- Digital Signal Processing Laboratory
- Digital Systems Design Laboratory
- Electronics Laboratory
- Electro-Optics and Micro-Devices Laboratory
- Embedded Systems Laboratory
- Fortinet Cyber Security Laboratory
- Information Technology Laboratory
- Microprocessor Laboratory
- Multimedia Laboratory (Arnold Center for Confluent Media Studies)
- Networks Laboratory
- Optics and Fiber Communications Laboratory
- Underwater Imaging Laboratory

Departmental Electives

Code	Title	Credit Hours
Humanities and Arts/People and Society Cognates		
Humanities and Arts (HA) Cognates, and People and Society (PS) Cognates can be selected from the appropriate University list, the link of which can be found in the Engineering section.		
CE Core Electives		
ECE 302	Electronics II	3
ECE 412	Software Engineering and Architecture	3
ECE 454	Digital System Design and Testing	3
EE Core Electives		
ECE 308	Linear Control Systems	3
ECE 404	Communication Systems	3
ECE 405	Solid-State Electronics	3
ECE 436	Digital Signal Processing	3
ECE Electives		
Select any 300-level or above ECE elective course		
Technical Electives		
Select any 200-level or above course from either ECE, BME, CAE, CET, ISE, MAE, Math, Physics, Chemistry, Biology, Computer Science or other science subject to the approval of the academic advisor.		
Audio Engineering Electives		
Select from the following set of courses:		
MMI 361	Acoustics	3
MMI 502	Digital Audio Theory	3
MMI 504	Audio Software Development II	3
MMI 505	Current Trends in Music Engineering I	3
MMI 506	Current Trends in Music Engineering II	3
MMI 508	Current Trends in Music Engineering III	3
MMI 510	Computational Psychoacoustics	3
MTC 506	Digital Editing and Sequencing	3
EE Design Elective		
Select one of the following:		
ECE 417	Embedded Microprocessor System Design	3
ECE 454	Digital System Design and Testing	3
ECE 505	Semiconductor Photonic Devices	3

ECE 532	VLSI Systems	3
or any ECE course approved by the Academic Advisor		
Basic Science (/Lab) Electives		
Basic Science (/Lab) Electives are selected in consultation with the Academic Advisor from courses in Biology, Chemistry, Environmental Science, Geological Science, Marine Science, or Physics.		
Computer Engineering (CE) Technical Electives		
Select any 300-level or above ECE course in consultation with, and with the approval of, the academic advisor. Additionally, one elective course may be selected from the following computer science courses:		
CSC 315	Introduction to Python for Scientists	3
CSC 317	Data Structures and Algorithm Analysis	3
CSC 427	Theory of Computing	3
CSC 518	Interpreters and Compiler Theory	3
CSC 529	Introduction to Computer Graphics	3
CSC 540	Algorithm Design and Analysis	3
CSC 555	Multimedia Systems	3
Software Engineering (SE) Technical Electives		
Select any 300-level or above ECE course in consultation with, and with the approval of, the academic advisor. Additionally, one elective course may be selected from the following computer science courses:		
CSC 315	Introduction to Python for Scientists	3
CSC 329	Introduction to Game Programming	3
CSC 424	Computer Networks	3
CSC 427	Theory of Computing	3
CSC 507	Data Security and Cryptography	3
CSC 529	Introduction to Computer Graphics	3
CSC 540	Algorithm Design and Analysis	3
CSC 545	Introduction to Artificial Intelligence	3
CSC 547	Computational Geometry	3
CSC 555	Multimedia Systems	3

Advanced Writing and Communication Skills

Electrical and Computer Engineering students satisfy the University's Advanced Writing and Communication Skills requirement by completing a set of classroom, laboratory, and design procedures where they learn effective oral, graphical and technical writing skills. Electrical and Computer Engineering students acquire Advanced Writing and Communication skills in the following core courses: ECE 212, ECE 481 and ECE 482.

Internship Program

The Department of Electrical and Computer Engineering encourages its students to take advantage of the College of Engineering Internship Cooperative Program with Industry.

Students may pursue an internship either on a part-time or a full-time arrangement. Students who wish to intern full-time for one semester or for twelve weeks in the summer may apply to earn as much as 3 credit hours that could be applied to their degree requirement as a Technical Elective. Students interested in such a possibility need to submit a proposal to the ECE Department describing the type of work they expect to accomplish approved by the industrial supervisor. If the proposal is approved the student will be assigned a Faculty Supervisor and will be able to register under ECE 499. At the end of the Internship Program, the student is expected to submit to the ECE Department a technical report with comments from the student industrial supervisor. The Faculty advisor will review the report and submit the appropriate grade for ECE 499.

NOTE: All ECE courses at the 300 level or above must be taken at UM.

Departmental Honors

See College of Engineering (http://bulletin.miami.edu/undergraduate-academic-programs/engineering/) section.

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 101. Introduction to Mobile Computing. 3 Credit Hours.
Introduction to Mobile Computing for high school students interested in application development for mobile systems. The course provides a hands-on approach to the design, development and testing of mobile applications using the latest modern tools. Students start with the basic components used to build applications and continue to more advanced features of mobile devices such as digital cameras, location services, multimedia and more. A strong emphasis is placed on hands-on experience to demonstrate the concepts, culminating in a working mobile application.
Requisite: Summer Scholars Program.
Components: LEC.
Grading: GRD.
Typically Offered: Summer.

ECE 102. Python Programming for FinTech. 3 Credit Hours.
This course covers the fundamentals of programming logic and structured programming principles including problem-solving, algorithm design, and program development using Python with a focus on financial programming applications. The course introduces the student to object-oriented programming through a study of the concepts of program specification and design, algorithm development, and coding and testing using a modern software development environment. Students learn how to write programs in an object-oriented high-level programming language (Python).
Components: LEC.
Grading: GRD.
Typically Offered: Summer.

ECE 103. Foundation of FinTech and Blockchain Technologies. 3 Credit Hours.
This course is an introduction to Blockchain technology and the application of technology in Finance (FinTech). The course is an overview course covering multiple disciplines of technology and how they are individually and collectively applied in financial systems, transactions, payments, and data lifecycles. The course aims to develop a student's understanding of key technological components such as cloud computing, Internet of Things(IoT), Big Data and Machine Learning, Artificial Intelligence, Blockchain technologies, and data security and privacy as they relate to financial transactions, financial institutions, public and private business entities, governments, regulations and an overall monetary system. The course will specifically focus on Blockchain technologies and cryptocurrencies as they relate to financial transactions, financial institutions, public and private business entities, governments, regulations, and an overall monetary system. The course will explore the use of cryptocurrencies and NFTs around the world and in the metaverse and their impact on world financial environments. The topics will include strategies for using cryptocurrencies in payment systems and mobile payment platforms, banking systems, and discussions of trading systems, smart contracts, international payment, and remittance systems, and metaverse asset creation and acquisitions. The course will also attach importance to the regulatory frameworks and constraints governing financial systems and transactions and how such regulatory schemes protect consumers and monetary systems and how they could affect or even dictate aspects of technical architectures and platforms.
Components: LEC.
Grading: GRD.
Typically Offered: Summer.

ECE 110. Introduction to Innovation: Learning About Innovation by Innovating. 3 Credit Hours.
Introduction to diverse methods and tools that promote and nurture student creativity, entrepreneurship, team-work, and skills for creating business plans that consider ethical, global and financial issues. Students will learn to use the Maker Space facility to implement their design ideas.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 111. 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 112. 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.
Components: LEC.
Grading: GRD.
Typically Offered: 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 123. Explorations in Engineering. 3 Credit Hours.
Introduction to engineering for non-engineers with emphasis on real-world engineering systems and services which are changing the way we live, communicate, learn, play, and care for ourselves, our communities and our planet. Students will learn how to use modern tools to observe and design simple engineering systems.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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 202. 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 203. Electrical Circuits 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.
Prerequisite: ECE 201.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

ECE 204. Electrical Circuits 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.
Prerequisite: ECE 201.
Components: LAB.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

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.

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 211. 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.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

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.

ECE 218. Data Structures. 3 Credit Hours.
Continuation of Programming with emphasis on C++ and the skills required of a c apable programmer. Essential data structures and algorithms, and introducing al gorithm analysis. Basic sorting, searching, and data management. Dynamic and st atic 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, propagati on of electromagnetic waves, and transmission line theory and applications are discussed.
Prerequisite: PHY 223 and MTH 210.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 302. Electronics II. 3 Credit Hours.
Continuation of ECE 202. Emphasis on integrated circuits. Field-effect transistors (FETs). Application of operational amplifiers and other integrated circuits. Frequency response of amplifiers. Use of CAD tools as PSpice.
Prerequisite: ECE 305 Or ECE 202.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 303. Electronics Laboratory. 1 Credit Hour.
Laboratory course in conjunction with courses ECE 202 and 302.
Prerequisite: ECE 203 or 204. Or Pre/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.
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.
Continuation of ECE 305. Emphasis on integrated circuits. Field-effect transistors (FETs). Application of operational amplifiers and other integrated circuits. Frequency response of amplifiers. Use of CAD tools as PSpice.
Prerequisite: ECE 202 or 305.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

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 and MTH 311.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

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 & Spring.

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 and Requisite: Junior Standing.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

ECE 311. Electronics Laboratory. 1 Credit Hour.
Laboratory course in conjunction with courses ECE 305 and 306.
Prerequisite: ECE 203 or 204. Or Pre/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: Fall & 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 languag e)) introduction and syntax. Functional and behavioral models of VHDL for desig n, 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 206.
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: Offered by Announcement Only.

ECE 376. Introduction to Cybersecurity. 3 Credit Hours.
This course will give an overview of the basic concepts of information security, various types of attacks and protections, and recovery actions. Cybersecurity concepts and case studies, Lab exercises to provide exposure to various cybersecurity monitoring tools.
Pre-Requisite: ECE 218 Or CSC 220.
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 re al-world contemporary problems. Offered by special arrangement and under the s upervision 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 and ECE 310 or IEN 310.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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 and PHY 223.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

ECE 412. Software Engineering and Architecture. 3 Credit Hours.
Examination of the building blocks of software systems. Requirements and specifications. Model driven architecture. Architectural and design patterns. Design and analysis for functionality and quality. Computer aided software engineering tools.
Prerequisite: ECE 318.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 413. Software Design and Verification. 3 Credit Hours.
Design for testability. Software testing methods and tools. Formal review techniques. Functional and structured testing methods and test generation.Unit-level testing. Integration, acceptance, regression, performance and stress testing. Verification methods.
Prerequisite: ECE 412/512.
Components: LEC.
Grading: GRD.
Typically Offered: 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.
Senior Standing.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 416. Senior Project II. 2 Credit Hours.
The capstone design course for Electrical Engineering majors. An electrical sys tem is designed, implemented, and documented.
Prerequisite: ECE 415.
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. And ECE 315. And 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.
Senior Standing.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 419. Senior Project. 2 Credit Hours.
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 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: Spring.

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: Spring.

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: Offered by Announcement Only.

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: 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: Junior or Senior Standing.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

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.
Pre-requisite: 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: Offered by Announcement Only.

ECE 503. 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 504. 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 505. Semiconductor Photonic Devices. 3 Credit Hours.
Operation principles and properties of semiconductor-based optoelectronic devices. Details of applications such as LED, CCD, and CMOS imagers, Laser Diodes, Solar cell, Organic devices, and Display devices.
Prerequisite: PHY 223 And ECE 302.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 506. 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 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.
Examination of the building blocks of software systems. Requirements and speci fications. Model driven Architecture. Architectural and Design Patterns. Design and analysis for functionality and quality. Computer Aided Software Engineerin g tools.
Prerequisite: ECE 318.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

ECE 513. Software Design and Verification. 3 Credit Hours.
Design for testability. Software testing methods and tools. Formal review techn iques. Functional and structured testing methods and test generation.Unit-level testing. Integration, acceptance, regression, performance and stress testing. Verification methods.
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: Offered by Announcement Only.

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 memoriy 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: Offered by Announcement Only.

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: Spring.

ECE 538. 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 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: Offered by Announcement Only.

ECE 542. 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 acceloremeters, biochemical sensors, RF components, microfludics, 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 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 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 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.
Prerequisite: ECE 218. Or MTH 309.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

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.
Prerequisite: ECE 218. Or MTH 309.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

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 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 Acess (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: Offered by Announcement Only.

ECE 563. 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 celluar 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.
Prerequisite: ECE 562.
Components: LAB.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 564. 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 networksL 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 534.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

ECE 567. 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 570. 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 572. 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 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 infor mation 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 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.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

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: Fall.

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