ECE 115. Introduction to Electrical and Computer Engineering. 4 hours.
Concepts of electrical and computer engineering including: circuit analysis, fundamental electromagnetics, electronic devices, sensors, communication, digital logic, programming, numerous practical applications; laboratory. Course Information: Much MATLAB programming, which is taught in the course, is required. Prerequisite(s): Credit or concurrent registration in MATH 180; or Grade of C or better in MATH 165. Natural World - With Lab course.

ECE 194. Special Topics in Electrical and Computer Engineering. 1-4 hours.
Multidisciplinary electrical and computer engineering topics at first-year level that vary from term to term depending on current student and instructor interests. Course Information: May be repeated.

ECE 210. Electrical Circuit Analysis. 3 hours.
Linear circuit analysis: networks, network theorems, dependent sources, operational amplifiers, energy storage elements, transient analysis, sinusoidal analysis, frequency response, filters. Laboratory. Course Information: Prerequisite(s): Credit or concurrent registration in MATH 180. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 225. Circuit Analysis. 4 hours.
Electric circuit elements; Ohm's Law; Kirchhoff's laws; transient and steady-state analysis of circuits; Laplace transform methods; network theorems. Laboratory. Course Information: Credit is not given for ECE 225 if the student has credit for ECE 210. Prerequisite(s): Credit or concurrent registration in MATH 220; and a Grade of C or better in PHYS 142; and Grade of C or better in ECE 115. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 265. Introduction to Logic Design. 4 hours.
Number Systems; Binary arithmetic; Boolean/Logic functions; Boolean Algebra; logic gates, their CMOS design; function minimization, analysis and synthesis of combinational and sequential circuits. Course Information: Credit is not given for ECE 265 if the student has credit for CS 266 or CS 366. Laboratory. Prerequisite(s): MATH 180 and grade of C or better in ECE 115. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 266. Introduction to Embedded Systems. 4 hours.
Introduction to embedded systems and microcontroller; instruction set; data representations; assembly programming; mixed C/assembly programming; memory organization; interrupt processing; I/O devices and interfacing; programming laboratory. Course Information: Credit is not given for ECE 266 if the student has credit in CS 261. Extensive computer use required. Prerequisite(s): CS 107; and Credit or concurrent registration in ECE 265. Class Schedule Information: To be properly registered, students must enroll in one Lecture and one Laboratory.

ECE 267. Computer Organization I. 3 hours.
Introduction to computer organization and assembly language programming. Memory, CPU, and I/O organization. Programming techniques and tools. Course Information: Credit is not given for ECE 267 if the student has credit for CS 266 or CS 366. Prerequisite(s): CS 107; and credit or concurrent registration in ECE 265.

ECE 294. Special Topics in Electrical and Computer Engineering. 1-4 hours.
Multidisciplinary electrical and computer engineering topics at second-year level that vary from term to term depending on current student and instructor interests. Course Information: May be repeated if topics vary.

ECE 310. Discrete and Continuous Signals and Systems. 3 hours.
Signals; systems; convolution; discrete and continuous Fourier series and transforms; Z-transforms; Laplace transforms; sampling; frequency response; applications; computer simulations. Course Information: Prerequisite(s): MATH 220 and credit or concurrent registration in ECE 225; or credit or concurrent registration in ECE 210 for non-ECE students.

ECE 311. Communication Engineering. 4 hours.
Continuous-time signals and spectra; amplitude and angle modulation, sampling and quantization theory; digital pulse modulation, error probability, commercial broadcasting practices. Course Information: Prerequisite(s): Grade of C or better in ECE 310; and Credit or concurrent registration in ECE 341. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 317. Digital Signal Processing I. 4 hours.
Sampling theorem; discrete signals and systems; discrete time Fourier transform; DFT; FFT; IIR and FIR digital filter design; stability; DSP applications. Laboratory. Course Information: Prerequisite(s): Grade of C or better in ECE 310. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 322. Introduction to Electromagnetics and Applications. 4 hours.
Transmission lines. Plane waves in various media. Polarization and Stoke's parameters. Scalar and vector potentials. Guided wave propagation. Radiation. Linear antennas and antenna parameters. Course Information: Prerequisite(s): ECE 225. Class Schedule Information: To be properly registered, students must enroll in one Lecture-Discussion and one Laboratory.

ECE 333. Computer Communication Networks I. 4 hours.
A balanced presentation focuses on the internet as a specific motivating example of a network and also introduces internet protocols in a more theoretical context. Course Information: Credit is not given for ECE 333 if the student has credit for CS 450. Prerequisite(s): ECE 341 and CS 107. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 340. Electronics I. 4 hours.
Operational amplifiers. Semiconductor junctions. Bipolar and field-effect transistors. Simple transistor amplifier and switching applications. Introduction to digital logic circuits. Laboratory experience. Course Information: Prerequisite(s): Grade of C or better in ECE 225. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 341. Probability and Random Processes for Engineers. 3 hours.
Probability, random variables, discrete and continuous distributions, transformation of random variables, expectation, generating functions, statistical inference, hypothesis testing, estimation, random processes, stationarity, applications. Course Information: Credit is not given for ECE 341 if the student has credit for IE 342. Prerequisite(s): Grade of C or better in MATH 210.
ECE 340. Electronics II. 4 hours.
Differential amplifiers. Feedback amplifiers. Frequency response, stability and compensation of amplifiers. Circuit implementation of logic gates in various logic families. Bistable and memory circuits. Laboratory. Course Information: Prerequisite(s): ECE 340. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 346. Solid State Device Theory. 4 hours.
Introduction to semiconductors, Energy bands, Electron and hole transport mechanisms in semiconductor devices, recombination and generation, P-N Junctions. Intro to metal-oxide-semiconductor field effect transistors. Practical laboratory. Course Information: Prerequisite(s): MATH 220 and a grade of C or better in ECE 115 and a grade of C or better in PHYS 142. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 350. Principles of Automatic Control. 4 hours.
Transfer function; block diagrams; flow graphs; state space canonical forms; stability analysis; steady state and transient analysis; feedback control; continuous to discrete conversion; digital control. Course Information: Prerequisite(s): MATH 310 and grade of C or better in ECE 310. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 356. Computer Organization. 3 hours.
Software/hardware interaction in a computer. Compiler, assembler and linker, machine code. Clocking, datapath, control unit, ALU and memory design, cache memory, pipelining. Course Information: Credit is not given for ECE 356 if the student has credit for CS 261 or CS 262. Prerequisite(s): ECE 267.

ECE 367. Microprocessor-Based Design. 4 hours.
Microprocessor architecture; microprogrammed machines; programmer’s model; control signals and timing; system buses; parallel and serial interfacing; interrupt processing; I/O devices; memory devices; direct memory access; assembly language. Laboratory. Course Information: Prerequisite(s): ECE 267; and a grade of C or better in ECE 265 or a grade of C or better in CS 366. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 368. CAD-Based Digital Design. 4 hours.
Semi-complex circuit and system design techniques, data path control using FSMs, VHDL programming, circuit/system design projects using VHDL and CAD tools (VHDL Simulation, Circuit Synthesis). Course Information: Credit is not given for ECE 368 if the student has credit for CS 469. Laboratory. Prerequisite(s): ECE 366. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.

ECE 391. Electrical and Computer Engineering Practicum. 1 hour.
Provides students with the opportunity to apply the skills and knowledge gained in previous engineering courses within a professional, working environment. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. A maximum of 1 hour awarded toward degree requirements. Prerequisite(s): Approval of the Department.

ECE 392. Undergraduate Research. 1-5 hours.
Research under close supervision of a faculty member. Course Information: Satisfactory/Unsatisfactory grading only. Prerequisite(s): Consent of the instructor.

ECE 394. Special Topics in Electrical and Computer Engineering. 1-4 hours.
Multidisciplinary electrical and computer engineering topics at third-year level that vary from term to term depending on current student and instructor interests. Course Information: May be repeated if topics vary.

ECE 396. Senior Design I. 2 hours.
Introduction to the principles and practice of product design: specifications, evaluation of design alternatives, technical reports, and oral presentations. Independent design projects. Course Information: Prerequisite(s): ENGL 161; and ECE 225; and ECE 340 or ECE 346 or ECE 366. Open only to seniors.

ECE 397. Senior Design II. 2 hours.
Implement and test the group project designed in ECE 396; professional development; group presentations including participation at EXPO. Course Information: Prerequisite(s): ECE 396. Class Schedule Information: To be properly registered, students must enroll in one Lecture and one Laboratory.

ECE 407. Pattern Recognition I. 3 or 4 hours.
The design of automated systems for detection, recognition, classification and diagnosis. Parametric and nonparametric decision-making techniques. Applications in computerized medical and industrial image and waveform analysis. Course Information: Same as BME 407. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 341 or BME 339 or IE 342 or STAT 381.

ECE 410. Advanced Circuit Analysis. 3 or 4 hours.
Matrix algebra for network analysis, network parameters, macromodeling, high-frequency measurements, network functions and theorems. Topics in computer-aided analysis. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): MATH 310 and grade of C or better in ECE 310.

ECE 412. Introduction to Filter Synthesis. 3 or 4 hours.
Fundamentals of network synthesis, filter approximations and frequency transformations. Active filter synthesis using bi-linear and bi-quad circuits. Topics in computer-aided design. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade of C or better in ECE 310.

ECE 415. Image Analysis and Computer Vision I. 3 or 4 hours.
Image formation, geometry and stereo. Two-dimensional image analysis by fourier and other 2-D transforms. Image enhancement, color, image segmentation, compression, feature extraction, object recognition. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade of C or better in ECE 310.

ECE 417. Digital Signal Processing II. 0-5 hours.
Computer-aided design of digital filters; FFT algorithms and applications; multirate signal processing and wavelets; random signals and Wiener filtering; basics of 2-D DSP. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 317. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.
ECE 418. Statistical Digital Signal Processing. 3 or 4 hours.
Stochastic signal models, LMS identification, identification of signals from noise, Wiener filtering, blind separation of mixed signal, discrete Wavelet Transforms, compression and denoising, cepstral analysis. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 317 and ECE 341.

ECE 421. Introduction to Antennas and Wireless Propagation. 3 or 4 hours.
Potential, antenna parameters, radiation from linear wires and loops, impedance, arrays, communication links and path loss, tropospheric propagation, fading and diversity. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 225 and ECE 322.

ECE 423. Electromagnetic Compatibility. 0-5 hours.
EMC requirements for electronic systems. Nonideal behavior of components. Radiated and conducted emissions. Susceptibility. Coupling and shielding. Electrostatic discharge. System design for EMS. Course Information: Prerequisite(s): MATH 310 and ECE 322. To be properly registered, students must enroll in one Lecture-Discussion and one Laboratory.

ECE 424. RF and Microwave Engineering. 0-5 hours.
Transmission lines, Smith chart, strip, active RF devices and components, power amplifiers, voltage-controlled oscillators, mixers, wireless communication and radar systems, resonators, two-port parameters, power and energy considerations. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 225 and ECE 322. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 432. Digital Communications. 3 or 4 hours.
Source coding, quantization, signal representation, channel noise, optimum signal reception, digital modulation: ASK, PSK, FSK, MSK, M-ary modulation. Probability of error. Inter-symbol interference. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 310, ECE 311, and ECE 341.

ECE 434. Multimedia Systems. 3 or 4 hours.
Multimedia systems; compression standards; asynchronous transfer mode; Internet; wireless networks; television; videoconferencing; telephony; applications. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 310.

ECE 436. Computer Communication Networks II. 3 or 4 hours.
Explores integrated network architecture of service, control signaling and management, examples of high-speed LAN/WAN, next generation Internet and mobile wireless network. Course Information: 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Prerequisite(s): ECE 333.

ECE 437. Wireless Communications. 3 or 4 hours.
Cellular concept, frequency reuse, mobile radio propagation, channel fading, noise in analog communications, mobile radio channel equalization, multiple access techniques (FDMA, TDMA, CDMA), wireless networking. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 311 and ECE 341.

ECE 440. Nanoelectronics. 3 or 4 hours.
Wave-particle duality, Schrodinger equation, atomic orbitals, band theory of solids. Semiconductor and carbon nanoelectronic materials. Nanoscale device fabrication. Nanoelectromechanical systems. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 346; or consent of the instructor.

ECE 442. Power Semiconductor Devices and Integrated Circuits. 0-5 hours.
Encompasses fundamentals of primarily silicon based power semiconductors with regard to basic physical principles, breakdown mechanisms, high voltage bipolar and insulated gate devices, and basic packaging issues. Course Information: 4 undergraduate hours. 5 graduate hours. Credit is not given for ECE 442 if the student has credit for EECS 442. ECE 442 is a supplement for ECE 445 and ECE 545. Prerequisite(s): ECE 346. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

Analysis of different isolated and non-isolated power-converter topologies, understanding of power-converter components, switching schemes. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 342. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 448. Transistors. 3 or 4 hours.
Bipolar junction transistors, electronic processes in surface-controlled semiconductor and dielectric devices. Metal oxide semiconductor filed effect transistors, surface and interface effects, diode lasers, integrated optoelectronic devices. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 346.

ECE 449. Microdevices and Micromachining Technology. 0-5 hours.
Microfabrication techniques for microsensors, microstructures, and microdevices. Selected examples of physical/chemical sensors and actuators. Simulation experiments. Course Information: Same as ME 449. 4 undergraduate hours. 5 graduate hours. Laboratory. Prerequisite(s): ECE 347; or consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 451. Control Engineering. 3 or 4 hours.
Continuous-and discrete-time state-space models; solutions to state equations; stability; reachability/controllability, state feedback, tracking; observability, observers, output feedback; optimal control and estimation. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 350; and Grade of C or better in MATH 310.

ECE 452. Robotics: Algorithms and Control. 3 or 4 hours.
Kinematic and dynamic modeling of robots; configuration space; motion planning algorithms; control of robots; sensors and perception; reasoning; mobile robots. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade of C or better in ECE 310; and MATH 310.

ECE 454. Mechatronic Embedded Systems Design. 0-5 hours.
Design and fabrication of scaled-down autonomous vehicles, from an embed system perspective; mechatronic components such as motors, microcontrollers, power supply, sensors, control algorithms, project oriented, culminating in racing competition. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 266 and ECE 310 and ECE 340; or consent of the instructor. Recommended Background: ECE 350 and ECE 412 and ECE 451. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.
ECE 458. Electromechanical Energy Conversion. 0-4 hours.
Electromagnetic forces and torque; magnetic circuits and transformers; DC machines; three-phase AC synchronous and induction machines; laboratory-demonstrations. Projects are required. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade of C or better in ECE 225. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 464. Testing and Reliability of Digital Systems. 3 or 4 hours.
Theory, practice and recent innovations in the testing and reliability of modern digital systems. Topics: fault modeling / simulation, automatic test pattern generation, built-in self-test, fault tolerance. Course Information: 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Prerequisite(s): CS 251; and ECE 366.

ECE 465. Digital Systems Design. 3 or 4 hours.
Switching algebra, combinational circuits, Mux, ROM, DCD, PLA-based designs, advanced combinational circuit minimization techniques, synchronous and asynchronous sequential circuit synthesis (minimization, hazards, races, state assignment) testing. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade C or better in PHYS 142; and ECE 366.

ECE 466. Computer Architecture. 3 or 4 hours.
Design principles of computer architecture. Topics include: instruction set architecture, pipelining, instruction-level parallelism, caches, main memory, and thread-level parallelism. Course Information: Same as CS 466. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 366 or CS 261.

ECE 467. Introduction to VLSI Design. 0-5 hours.
MOS, CMOS circuits VLSI technology, CMOS circuit characterization and evaluation. Static and dynamic MOS circuits, system design, faults, testing, and symbolic layout. Laboratory. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 340. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 468. Analog and Mixed - Signal Integrated Circuits. 0-5 hours.
Review of basic analog concepts; Sampling and mixed-signal interface circuits; analytical analysis and CAD-based design/simulation; emphasis on compact modeling, design tradeoffs, and intuitive design approaches. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 342. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 469. Hardware Description Language Based Digital and Computer System Design. 0-5 hours.
Hardware description language (HDL) introduction; digital system design including arithmetic circuit, datapath and control; basic processor architecture and design; use of CAD tools for simulation, synthesis, and verification. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 366; and ECE 465. Class Schedule Information: To be properly registered, students must enroll in one Lecture and one Laboratory.

ECE 491. Seminar. 1-4 hours.
Topics of mutual interest to a faculty member and a group of students. Offered as announced by department bulletin or the Timetable. Course Information: May be repeated. Prerequisite(s): Consent of the instructor.

ECE 493. Special Problems. 1-5 hours.
Special problems or reading by special arrangement with the faculty. Course Information: No graduation credit for students in the following: MS in Electrical and Computer Engineering or PhD in Electrical and Computer Engineering. Prerequisite(s): Consent of the instructor.

ECE 496. Undergraduate Senior Design Thesis I. 0-8 hours.
Introduction to engineering design and research methods: design tools, product conception and development, simulation, prototyping, technical reports and presentations, literature survey and undergraduate thesis. Course Information: Credit for ECE 496 only given to non-degree students. No graduation credit is given for ECE 496 to students enrolled in any degree program in Engineering. Extensive computer use required. Prerequisite(s): Consent of the instructor.

ECE 497. Undergraduate Senior Design Thesis II. 0-8 hours.
Introduction to engineering design and research methods: design tools, product conception and development, simulation, prototyping, technical reports and presentations, literature survey and undergraduate thesis. Course Information: Credit only given to non-degree students. No graduation credit given to students enrolled in Engineering. Extensive computer use required. Prerequisite(s): Consent of the instructor.

ECE 499. Professional Development Seminar. 0 hours.
Graduating seniors will be provided with information regarding future career paths and will provide information regarding the program to be used for assessment purposes. Course Information: Satisfactory/Unsatisfactory grading only. Prerequisite(s): Open only to seniors; and approval of the department. Must be taken in the student's last semester of study.