# ELECTRICAL AND COMPUTER ENGINEERING (ECE)

**ECE 0405 Electronic Materials** **3 Credits**
This course describes the properties and applications of certain materials used in the design and manufacture of electronic assemblies. Ceramics are often used as insulators, heat sinks, and substrates for interconnection structures. The course presents electrical, mechanical, and thermal properties of various ceramics, along with methods of fabricating and machining ceramic structures. Adhesives used to mount components and to replace mechanical fasteners such as screws and rivets provide connections that are stronger and take up less space. The course examines properties of adhesives such as epoxies, silicones, and cyanoacrylates under conditions of high temperature storage and humidity, along with methods of applications. Solders used to interconnect electronic components and assemblies are selected for temperature compatibility, mechanical properties, and reliability. The course emphasizes the new lead-free solder materials and presents the properties of plastic materials and the methods of forming plastic structures.

**ECE 0406 Advanced Digital Design** **3 Credits**
This course examines computer architecture implemented using a hardware design language and programmable logic devices. Students learn the VHDL hardware description language, and learn to use modern design, simulation, and synthesis software. Students design, verify, build and test digital logic circuits using industry standard development boards, and field programmable gate array (FPGA) technology.

**ECE 0411 Digital Signal Processing** **3 Credits**
Modern signal processing tools including vector spaces, bases and frames, operators, signal expansions and approximation, as well as classical signal processing tools including Fourier and z transforms, filtering and sampling, estimation, applications, and implementation.

**ECE 0415 Engineering Applications of Numerical Methods** **3 Credits**
This course provides students with the theoretical basis to proceed in future studies. Topics include root-finding, interpolation, linear algebraic systems, numerical integration, numerical solution of ordinary and partial differential equations, modeling, simulation, initial boundary value problems, and two point boundary value problems.

**ECE 0420 Readings in Electrical and Computer Engineering** **3 Credits**
Students formulate a project proposal, perform literature surveys, and learn the finer points of technical writing and presentation at the graduate level. The course requires a meta-paper written about the literature in the field. It emphasizes the basics of technical writing and research, and is organized to emphasize methods of the writing and the research process. Students learn to state a problem, the techniques of analysis, methods of investigation, and functional organization.

**ECE 0423 Thermal Management of Microdevices** **3 Credits**
This course addresses the thermal design in electronic assemblies which includes thermal characteristics, heat transfer mechanisms and thermal failure modes. Thermal design of electronic devices enables engineers to prevent heat-related failures, increase the life expectancy of the system, and reduce emitted noise and energy consumption. This course provides the required knowledge of heat transfer for such analysis and various options available for thermal management of electronics. This course also presents advanced methods of removing heat from electronic circuits, including heat pipes, liquid immersion and forced convection. Formerly ECE 0425.

**ECE 0431 Biomedical Signal Processing** **3 Credits**
This course presents an overview of different methods used in biomedical signal processing. Signals with bioelectric origin are given special attention and their properties and clinical significance are reviewed. In many cases, the methods used for processing and analyzing biomedical signals are derived from a modeling perspective based on statistical signal descriptions. The purpose of the signal processing methods ranges from reduction of noise and artifacts to extraction of clinically significant features. The course gives each participant the opportunity to study the performance of a method on real, biomedical signals.

**ECE 0432 Biomedical Imaging** **3 Credits**
**Prerequisite:** ECE 0431.
The course presents the fundamentals and applications of common medical imaging techniques, for example: x-ray imaging and computed tomography, nuclear medicine, magnetic resonance imaging, ultrasound, and optical imaging. In addition, as a basis for biomedical imaging, introductory material on general image formation concepts and characteristics are presented, including human visual perception and psychophysics.

**ECE 0433 Biomedical Visualization** **3 Credits**
An introduction to 3D biomedical visualization. Various technologies are introduced, include UltraSound, MRI, CAT scans, PET scans, etc. Students will learn about spatial data structures, computational geometry and solid modeling with applications in 3D molecular and anatomical modeling.

**ECE 0435 Microelectronics** **3 Credits**
This course considers the methods of interconnecting electronic components at very high circuit densities and describes methods of designing and fabricating multilayer printed circuit boards, co-fired multilayer ceramic substrates, and multilayer thin film substrates in detail. It discusses the methods of depositing thick and thin film materials, along with their properties, and analyzes these structures and compares them for thermal management, high frequency capability, characteristic impedance, cross-coupling of signals, and cost. The course also includes techniques for mounting components to these boards, including wire bonding, flip chip, and tape automated bonding.

**ECE 0440 Computer Graphics** **3 Credits**
This course supports the visualization and computer systems domain with computer gaming applications. It is an introduction to GUI and game design and computer graphics concepts. Topics include human-computer interfaces using the AWT; applied geometry; homogeneous coordinate transforms.

**ECE 0441 Computer Systems Architecture** **3 Credits**
An investigation into computer architectures (past, present and future). We will explore various hardware and software techniques designed to maximize parallelism and improve performance. Front-end design (branch prediction, instruction fetch, trace caches), HW/SW techniques of parallelism, Memory system design (caching, prefetching), Technology issues (low power, scaling, reliability, nanotechnology), multiprocessors. Class will include a mix of lectures and discussions on assigned readings of recent publications. Students will be responsible for leading and participating in these discussions. A course project exploring a particular topic in depth will be required.

**ECE 0448 Embedded Microcontrollers** **3 Credits**
Introduction to embedded microcontrollers in electronic and electromechanical systems. Hardware and software design techniques are explored for user and system interfaces, data acquisition and control. These tools are used to develop software code for practical applications such as motor speed control and voltage regulation for power supplies.

**ECE 0448L Embedded Microcontrollers Lab** **1 Credit**
**Fee:** $80 Engineering Lab Fee
This laboratory covers the basic operation and applications of a microprocessor. Students learn to program a microprocessor to control applications such as motor speed by the use of an emulator connected to a PC. They design a circuit using a microprocessor for a specific application and write a program to control the circuit. On completion of the program, they use the emulator to program an actual microprocessor for use in their circuit.

**ECE 0451 Nanoelectronics I** **3 Credits**
Building on the two introductory courses in nanotechnology, this course is the first of two that describe how nanotechnology can be integrated into the electronics industry. The unique electrical, mechanical, and optical properties of structures in the nanometer range and how they may be applied to electronics products are discussed. Principles of electronic materials, semiconductor devices, and microfabrication techniques will be extended to the nanoscale. Students will increase their knowledge of electronic structure, quantum mechanics, and the behavior of optoelectronic and low-dimensional systems. Students make extensive use of the available literature to seek out potential applications of nanotechnology.

**ECE 0455 Sensor Design and Application** **3 Credits**
This course covers the design, fabrication, and properties of sensors intended to measure a variety of parameters, such as stress, temperature, differential pressure, and acceleration. Sensors of different types are used in a wide range of equipment, especially automated equipment, to detect changes in state and to provide the signals necessary to control various functions. Sensors are generally connected to electronics systems that process and distribute the signals. The support electronics must identify the signal, separate it from noise and other interference, and direct it to the appropriate point. These support electronics are a critical part of the sensor technology; students discuss their design and packaging in detail.

**ECE 0457 Advanced Linear Systems** **3 Credits**
Modeling and analysis of linear systems. Introduction to linear algebra with emphasis on matrices, linear transformations on a vector space, and matrix formulation of linear differential and difference equations. State variable analysis of advanced linear systems. Transform methods using complex variable theory, and time-domain methods including numerical algorithms.

**ECE 0460 Network Programming** **3 Credits**
This course covers principles of networking and network programming. Topics include OSI layers, elementary queuing theory, protocol analysis, multi-threading, command-line interpreters, and monitors. Students write a distributed computing system and check their performance predictions with experiments.

**ECE 0461 Green Power Generation** **3 Credits**
This course compares various methods of green power generation including solar power, wind power, water power, and several others. This course covers how power is generated from these sources, the startup costs, the efficiency, and the practicality. These methods are compared to the present most common method of using oil and gas to heat water into steam to turn turbines. The student does not necessarily need a background in engineering and any necessary background material will be covered to the understanding of all.

**ECE 0470 Network Embedded Systems** **3 Credits**
This course covers distributed development - connecting peripherals to networks via Java. Plug-and-play paradigm is used to add services on the fly. Students learn about the following topics: multicast and unicast protocols, service leasing, lookup services, remote events, sharing data between distributed processes, and distributed transactions. The course also covers interfacing hardware (sensors, robotics, etc.) to the Web.

**ECE 0477 Power Security and Reliability** **3 Credits**
**Prerequisite:** ECE 0495.
This course focuses on Power System Protection and Relaying to allow the design of robust and reliable power systems. After reviewing the need for protection of power system elements (motors, generators, transformers, and transmission/distribution lines), the course: Explores developments in the creation of smarter, more flexible protective systems based on advances in the computational power of digital devices and the capabilities of communication systems that can be applied within the power grid, Examines the regulations related to power system protection and how they impact the way protective relaying systems are designed, applied, set, and monitored, Considers the evaluation of protective systems during system disturbances and describes the tools available for analysis, Addresses the benefits and problems associated with applying microprocessor-based devices in protection schemes' Contains an expanded discussion of internal protection requirements at dispersed generation facilities. MatLab is used to solve homework problems and do team design projects.

**ECE 0478 Electromagnetic Compatibility** **3 Credits**
This course presents design techniques to minimize electromagnetic interference (EMI) from or to it. The various sources of Radio-frequency emissions from electronic systems, coupling paths for the transfer of undesired electromagnetic energy will be introduced. Electromagnetic Compatibility (EMC) requirements for electronic products will be presented along with techniques to measure EMI. High speed digital signal transmission integrity related issues and methods to overcome signal integrity will be introduced. Techniques to minimize conducted and radiated Emissions through filtering and grounding will be presented. System design for EMC will be presented.

**ECE 0479 Communication Systems** **3 Credits**
This course focuses on analog and digital communication systems and the effects of noise on those systems. It includes analog modulation and demodulation techniques (amplitude, frequency, and phase modulation) and digital modulation and demodulation techniques (ASK, FSK, PSK, PCM, and delta modulation). It discusses performance analysis of analog and digital communication systems under noise with applications of probability theory to the analysis. It discusses information measure, source coding, error correcting codes and Spread spectrum systems.

**ECE 0480 Wireless Systems I** **3 Credits**
The applications of wireless communication are expanding rapidly - from cellular phones to wireless internet to household appliances - and involve many disciplines other than microwave transmission. This course covers several aspects of wireless communication, including antenna design, FCC regulations, and multi-channel transmission protocols. In addition, it discusses modern design approaches such as Bluetooth. Students learn how analog and digital signals are coded. The course also discusses transmission during interference and EMI/RFI as well as fiber optics communication.

**ECE 0483 Independent Study** **3 Credits**
Students pursue special topics, projects, and/or readings in selected areas. Students must meet with the instructor to discuss the proposed topic of study.

**ECE 0495 Power Generation and Distribution** **3 Credits**
This course considers the generation and distribution of electrical power to large areas. Three-phase networks are described in detail, including both generators and loads. Methods of modeling distribution systems by per-unit parameters are covered, along with power factor correction methods. Fault detection and lightning protection methods are also described. Some economic aspects of power generation and distribution are presented.

**ECE 0496 Fault Analysis in Power Systems** **3 Credits**
**Prerequisite:** ECE 0495.
This course covers three types of faults in electrical power grids: open lines, lines shorted to ground, and lines shorted to each other. Methods of locating faults are covered, along with an analysis of the effects. Methods of protection and fault isolation are also covered.

**ECE 0505 Advanced Power Electronics** **3 Credits**
This course considers the design and application of electronic circuits related to power generation and conversion including inverters, power supplies, and motor controls. Topics include AC-DC, DC-DC, DC-AC, AC-AC converters, resonant converters, and the designof magnetic components. Models of electric motors and generators are presented to facilitate the design of controls for these structures.

**ECE 0508 Engineering Entrepreneurship** **3 Credits**
Designed specifically for engineers and scientists having a passion for technological innovation, this popular interdisciplinary course focuses on the roles of inventors and founders in successful high-tech ventures. By providing knowledge and skills important to the creation and leadership of such startups, the course aims to train the founders and leaders of tomorrow's high-tech companies. This course makes use of case-studies and active learning to engage the students in venture creation. Guest lectures enable industry experts to share their insights for venture formation.

**ECE 0510L Product Design Laboratory** **1 Credit**
**Fee:** $80 Engineering Lab Fee
**Prerequisite:** ECE 0405.
This laboratory course provides hands-on experience in measuring and analyzing the electrical and mechanical properties of materials used in the design of electronic products. It also covers thermal analysis and methods of removing the heat from electronic circuits. Experiential learning includes measurement of temperature coefficient of expansion, measurement of thermal resistance, measurement of tensile strength, measurement of material hardness, temperature measurement of electronic components, Peltier effect (thermoelectric coolers), heat pipes, convection cooling (fins and air flow), and heat flow across a bonding interface such as solder or epoxy.

**ECE 0520L System Design Lab** **1 Credit**
**Fee:** $80 Engineering Lab Fee
**Corequisite:** ECE 0455.
This laboratory provides students with an understanding of sensors and non-linear control systems. Experiments include temperature sensors such as thermocouples, thermistors, and infrared, motion sensors, strain gauges, nonlinear servos, and computer analysis of nonlinear systems.

**ECE 0550 Thesis I** **3 Credits**
**Prerequisite:** ECE 0420.
The master's thesis tests students' abilities to formulate a problem, solve it, and communicate the results. The thesis is supervised on an individual basis. A thesis involves the ability to gather information, examine it critically, think creatively, organize effectively, and write convincingly; it is a project that permits students to demonstrate skills that are basic to academic and industry work. The student must also submit a paper for possible inclusion in a refereed journal appropriate to the topic.

**ECE 0551 Thesis II** **3 Credits**
**Prerequisite:** ECE 0550.
The master's thesis tests students' abilities to formulate a problem, solve it, and communicate the results. The thesis is supervised on an individual basis. A thesis involves the ability to gather information, examine it critically, think creatively, organize effectively, and write convincingly; it is a project that permits students to demonstrate skills that are basic to academic and industry work. The student must also submit a paper for possible inclusion in a refereed journal appropriate to the topic.

**ECE 0591 Capstone Professional Project I** **3 Credits**
**Prerequisites:** Completion of 9 credits in the MS ECE program.
In these two semester capstone courses, students form teams, perform a technical study, and design, develop, and test electrical and computer systems based on their customer's requirements. The results of these projects provide a library of case studies, designs, development techniques, and project management skills that are of interest to local industry professionals. A capstone prospectus must be developed at the beginning of the capstone sequence.

**ECE 0592 Capstone Professional Project II** **3 Credits**
**Prerequisite:** ECE 0591.
In these two semester capstone courses, students form teams, perform a technical study, and design, develop, and test electrical and computer systems based on their customer's requirements. The results of these projects provide a library of case studies, designs, development techniques, and project management skills that are of interest to local industry professionals. A capstone prospectus must be developed at the beginning of the capstone sequence.