SIU CARBONDALE Southern Illinois University

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Computer Engineering

Mission Statement

The mission of the School of Electrical, Computer, and Biomedical Engineering is to serve society as a center for learning and innovation in all major areas of electrical, computer, and biomedical engineering. The School accomplishes its mission by disseminating existing knowledge through teaching, creating new knowledge through research and publications, and by converting original ideas and concepts into new technologies. Through the integration of education and research, the School creates the academic environment necessary for training innovators and leaders for the future.

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

The fundamental goal of the undergraduate program in Computer Engineering is to offer a high-quality education, designed to achieve the following specific educational objectives:

Educational Objectives

Within a few years of graduation, Computer Engineering graduates are expected to attain:

1. Increasing responsibility beyond that in their entry-level description in job functions within Computer Engineering or related employment, and/or
2. Successful progress within graduate degree programs in Computer Engineering or other professional degrees such as other Engineering, Business, Law or Medicine, and
3. Continued successful professional development and adaptation to evolving technologies within their chosen field.

In the computer engineering curriculum the students can choose courses in:

1. **Computer Hardware Design**: Design and evaluation of integrated circuits, configurable hardware, embedded systems hardware, and computer architectures. Relevant courses: ECE 422, ECE 423, ECE 424, ECE 425, ECE 426, ECE 427, ECE 428, and ECE 429.
2. **Software Systems Software**: Algorithms and software development for digital integrated circuits, embedded systems software, microcontroller programming, multicore programming, machine learning and artificial intelligence, hardware-software codesign, and networks.

Employment opportunities exist within a wide range of organizations, such as computer, semiconductor, aviation, electronics, microelectronics, broadcasting, telecommunications, defense, automotive, manufacturing and electric power companies, state and federal agencies and laboratories. Employment opportunities cover the spectrum of engineering activities, ranging from research and development, to systems analysis, automation, manufacturing, customer service and support, marketing, and sales.

The undergraduate program in Computer Engineering is accredited by the Engineering Accreditation Commission of ABET, abet.org.

B.S. Computer Engineering Degree Requirements

Degree Requirements	Credit Hours	
University Core Curriculum Requirements		39
Foundation Skills		13
CMST 101	3	
ENGL 101, ENGL 102	6	
MATH 150 (3 credits out of 4)	3	
UNIV 101	1	
Disciplinary Studies		23
Fine Arts	3	
BIOL 202	2	
Humanities	6	
PHYS 205A	3	
PHYS 205B	3	
Social Science	6	
Integrative Studies (Multicultural/Diversity)		3
Requirements for Computer Engineering Major		87
Basic Science		
PHYS 255A, PHYS 255B	2	
Science Elective (with lab) [1]	4	
Mathematics		
MATH 150, (1 credit out of 4) MATH 250, MATH 251, MATH 305	11	
ECE Required Courses: ECE 222, ECE 235, ECE 235L, ECE 296, ECE 296L, ECE 315, ECE 321, ECE 321L, ECE 327, ECE 327L, ECE 329, ECE 329L, ECE 345, ECE 345L, ECE 355, ECE 355L, ECE 495C, ECE 495D		41
Technical Electives [2]		29

Degree Requirements		Credit Hours
ECE Technical Electives [3]	23	
General Technical Electives [4]	6	
Total		126

[1] For Science Elective choose from biological, chemical, or physical science (CHEM 200 + CHEM 201, PHYS 305 + PHYS 355, PHSL 201 + PHSL 208)

[2] At least 20 hours from the following list: ECE 411-435, two approved CS courses from CS 3XX or 4XX level (except CS 300, CS 393, or CS 493)

[3] Approved by the School. Approved ECE technical electives: ECE 3XX or 4XX level (except ECE 392, ECE 492 & ECE 493)

[4] Approved by the School. Approved General technical electives: ECE 3XX or ECE 4XX level (except ECE 493); CHEM 210; MATH 221, MATH 282, MATH 302, MATH 349, MATH 380, or MATH 4XX level (except MATH 411, MATH 412); CS 3XX or 4XX level (except CS 300, CS 393, or CS 493); ENGR 2XX, ENGR 3XX, 4XX (except ENGR 222, ENGR 296, ENGR 335), ENGR 3XXi (if not already counted toward the student's core requirement); BME 485; IMAE 470A

Students interested in meeting the requirements of both the Electrical Engineering and the Computer Engineering degree programs may ask the advisement office for a guide suggesting how one may complete both in a timely manner.

B.S. Computer Engineering - Cyber Systems and Security Engineering Specialization Degree Requirements

Degree Requirements		Credit Hours
University Core Curriculum Requirements		39
Foundation Skills	13	
CMST 101	3	
ENGL 101, ENGL 102	6	
MATH 150 (3 credits out of 4)	3	
UNIV 101	1	
Disciplinary Studies	23	
Fine Arts	3	
BIOL 202	2	
Humanities	6	

Degree Requirements		Credit Hours
PHYS 205A	3	
PHYS 205B	3	
Social Science	6	
Integrative Studies (Multicultural/Diversity)		3
Requirements for Computer Engineering Major		87
Basic Science		
PHYS 255A, PHYS 255B	2	
Science Elective (with lab) [1]	4	
Mathematics		
MATH 150 (1 credit out of 4) MATH 250, MATH 251, MATH 305	11	
ECE Required Courses: ECE 222, ECE 235, ECE 235L, ECE 296, ECE 296L, ECE 315, ECE 321, ECE 321L, ECE 327, ECE 327L, ECE 329, ECE 329L, ECE 345, ECE 345L, ECE 355, ECE 355L, ECE 495C, ECE 495D		41
Technical Electives [2]		29
ECE Technical Electives [3]	23	
General Technical Electives [4]	6	
Total		126

[1] *For Science Elective choose from biological, chemical, or physical science. (CHEM 200+201, PHYS 305+355, PHSL 201+208)*

[2] *At least 20 hours from the following list: ECE 411 -ECE 435, and two approved CS courses from CS 3XX or 4XX level (except CS 300, 393, or 493). One of the following courses: ECE 434, CS 410. Only one of those courses will count towards specialization. At least one course from the following list: ECE 418, ECE 433, CS 408, CS 409, ECE 503, ECE 518, ECE 519. At least two courses from the following list: ECE 412, ECE 422, ECE 424, ECE 431, CS 415. At least two courses from the following list: ECE 417, ECE 419, ECE 428, ECE 430, ECE 475, CS 413, ECE 517, ECE 541.*

[3] *Approved by the School. Approved ECE technical electives: ECE 3XX or 4XX level (except ECE 392, 492 & 493).*

[4] *Approved by the Department. Approved General technical electives: ECE 3XX or 4XX level (except ECE 493); CHEM 210; MATH 221, 282, 302, 349, 380, or 4XX level (except MATH 411, 412); CS 3XX or 4XX level (except CS 300, 393, or 493); ENGR 2XX, 3XX, 4XX (except ENGR 222, 296, 335), ENGR3XXi (if not already counted toward the student's core requirement); BME 485; IMAE 470A.*

Computer Engineering Courses

ECE222 - Introduction to Digital Computation Digital computation to solve basic problems in electrical and computer engineering. Analyzing problems, flowcharting, coding, executing, diagnosing, and verifying solutions. Programming in C++ language. Prerequisite: Mathematics 111 with a grade of C or better. Lab fee: $10 to help defray cost of equipment. Credit Hours: 3

ECE235 - Electric Circuits I Basic concepts: voltage, current, power, energy, Ohm's law and Kirchhoff's laws. Resistor circuits: Parallel and series resistors, nodal and mesh analysis; independent and dependent sources, Thevenin's theorem, Norton's theorem and superposition. RLC circuits: The voltage and current relationship in capacitors and inductors, natural and forced response of a first order, RL or RC, circuit. General case of RLC circuits. Sinusoidal steady state analysis: phasors and phasor diagrams, impedance, nodal and mesh equations in sinusoidal steady state. Operational Amplifiers and their applications, complex power. Students who have taken ENGR 335 cannot receive credit for this course. Prerequisite: MATH 250 with a minimum grade of C. Credit Hours: 3

ECE235L - Electric Circuits I Laboratory Use of Electronics equipment: Multimeter, power supply, breadboard, and oscilloscope. Ohm's Law and applications. Thevenin's Theorem and applications. Analysis of networks. First-order RL and RC circuits. Second-order RLC circuits. AC networks. Operational Amplifiers. Introduction to PSPICE and MATLAB with application to electric circuits. Prerequisite: MATH 250 with a minimum grade of C. Co-requisite: ECE 235. Lab fee: $55 to help defray cost of equipment. Credit Hours: 1

ECE296 - Introduction to Microcontrollers and Robotics Introduction to interpreted programming languages and programming principles. Introduction to programming microcontrollers. Covered materials will have an emphasis on their relationship to aspects of robotics. Co-requisite: ECE 296L. Prerequisite: ECE 222 with a grade of C or better. Credit Hours: 2

ECE296L - Introduction to Microcontrollers and Robotics Lab Hands-on application of micro-controllers for motor control, basic robotics, and data acquisition using various sensors. Application of an interpreted programming language and C++ to interact with various hardware. Hands-on application of programmable logic controllers and ladder logic. Prerequisite: ECE 222 with a grade of C or better. Co-requisite: ECE 296. Lab fee: $25 to help defray cost of software licenses and equipment. Credit Hours: 2

ECE315 - Mathematical Methods in ECE A four-part course designed to introduce all Electrical and Computer Engineering students to fundamental and advanced mathematical methods, through applications to engineering problems. Part A: Introduction to differential equations and applications to electric circuits, systems, and electromagnetic fields. Part B: applications of complex variables to electrical circuits, systems and electromagnetic fields. Part C: applications of linear algebra and matrix methods to electric circuits, systems and electromagnetic fields. Part D: Number systems. Boolean algebra. Probability, combinatorics and statistics with applications to ECE problems. Prerequisite: MATH 250 with a grade of C or better. Credit Hours: 4

ECE321 - Introduction to Software Engineering Introduction to tools, concepts, and techniques to develop complex software projects. The tools include object-oriented programming and advanced data structures. Concepts and techniques include introduction to principles of operating systems and introduction to software engineering, including requirements specifications, design methodology, and testing. Prerequisites: ECE 296 and ECE 296L with a grade of C or better. Credit Hours: 3

ECE321H - Introduction to Software Engineering University Honors (University Honors) Introduction to tools, concepts, and techniques to develop complex software projects. The tools include object-oriented programming and advanced data structures. Concepts and techniques include introduction to principles of operating systems and introduction to software engineering, including requirements specifications, design methodology, and testing. Prerequisites: ECE 296 and ECE 296L with grade C or better. Credit Hours: 3

ECE321L - Introduction to Software Engineering Lab Application development on Visual Studio or VScode. Prerequisite: ECE 296 and ECE 296L with a grade of C or better. Co-requisite: ECE 321 or ECE 321H allowed. Lab fee: $10 to help defray cost of equipment. Credit Hours: 1

ECE327 - Digital Circuit Design with HDL Discrete Mathematics including Boolean Algebra and Number Systems. Modular combinational and sequential circuit design. Arithmetic circuits. Programmable logic. Flip-flops, memory, shifters, counters. Finite State Machine Design. Synthesis and simulation with the Verilog Hardware Description Language (HDL). Prerequisite: ECE 222 with a grade of C or better. Concurrent enrollment required in ECE 327L. Credit Hours: 3

ECE327H - Digital Circuit Design with HDL (University Honors Program) Discrete Mathematics including Boolean Algebra and Number Systems. Modular combinational and sequential circuit design. Arithmetic circuits. Programmable logic. Flip-flops, memory, shifters, counters. Finite State Machine Design. Synthesis and simulation with the Verilog Hardware Description Language (HDL). Prerequisite: ECE 222 with a grade of C or better. Concurrent enrollment required in ECE 327L. Credit Hours: 3

ECE327L - Digital Circuit Design with HDL-Laboratory Implementation of digital combinational and sequential designs in hardware using SSI/MSI parts. Synthesis and simulation with the Verilog Hardware Description Language (HDL) using the Cadence SimVision and Cadence RTL Compiler CAD tools. Prerequisite: ECE 222 with a grade of C or better. Co-requisite: ECE 327 or ECE 327H. Lab fee: $60 to help defray cost of software licenses, equipment and consumable items. Credit Hours: 1

ECE329 - Computer Organization and Design Introduction to the design and organization of digital computers: data-path and control, hardwired and microprogrammed control, interrupts, memory organization concepts. An introduction to optimization issues. Design and implementation of simple computers with hardwired and microprogrammed control. Prerequisite: ECE 315 with a grade of C or better. Concurrent enrollment required in ECE 329L. Credit Hours: 3

ECE329H - Computer Organization and Design Honors (University Honors Program) Introduction to the design and organization of digital computers: data-path and control, hardwired and microprogrammed control, interrupts, memory organization concepts. An introduction to optimization issues. Design and implementation of simple computers with hardwired and microprogrammed control. Prerequisite: ECE 327 with a C or better. Concurrent enrollment allowed in ECE 329L. Credit Hours: 3

ECE329L - Computer Organization and Design Lab A sequence of labs for design and implementation of simple computers with hardwired and microprogrammed control. Prerequisite: ECE 315 with a grade of C or better. Concurrent enrollment in ECE 329 required. Lab fee: $50 to help defray cost of equipment and consumable items. Credit Hours: 1

ECE336 - Electric Circuits II Sinusoidal steady state power, three-phase circuits, magnetic circuits, mutual inductance, frequency response, Laplace transform and applications to circuits, Fourier series and Fourier transform, filter circuits, Two- and three-port networks. Use of Pspice. Prerequisite: ECE 235 with a minimum grade of C. Credit Hours: 3

ECE345 - Electronics Introduction to microelectronics, analog and digital systems, basic physics of semiconductors, diode models and circuits, bipolar junction transistors (BJTs) and BJT amplifier circuits, MOSFETs and MOSFET amplifier circuits, operational amplifiers (op-amps), op-amp circuits, non-ideal characteristics of the op-amp. Lecture. Prerequisites: ECE 235 and PHYS 205B with grades of C or better. Concurrent enrollment in ECE 345L allowed. Credit Hours: 3

ECE345H - Electronics-Honors (University Honors Program) Introduction to microelectronics, analog and digital systems, basic physics of semiconductors, diode models and circuits, bipolar junction transistors (BJTs) and BJT amplifier circuits, MOSFETs and MOSFET amplifier circuits, operational amplifiers (op-amps), op-amp circuits, non-ideal characteristics of the op-amp. Lecture. Prerequisite: ECE 235 and PHYS 205B with grades of C or better. Concurrent enrollment allowed in ECE 345L. Credit Hours: 3

ECE345L - Electronics Lab Introduction to microelectronics, analog and digital systems, basic physics of semiconductors, diode models and circuits, bipolar junction transistors (BJTs) and BJT amplifier circuits, MOSFETs and MOSFET amplifier circuits, operational amplifiers (op-amps), op-amp circuits, non-ideal characteristics of the op-amp. Laboratory. Prerequisite: ECE 235 and PHYS 205B with grades of C or

better. Co-requisite: ECE 345. Lab fee: $50 to help defray cost of equipment and consumable items. Credit Hours: 1

ECE351 - Probability and Statistical Analysis for Engineers Probability: Axioms of probability, discrete and continuous random variables, probability distributions, moments, correlation and covariance, conditional probabilities and densities, functions of random variables/vectors and their distributions, convergence of a sequence of random variables and limit theorems, and probabilistic models for BME applications. Statistical analysis: Parameter estimators, confidence intervals, hypothesis tests, regression and curve fitting, Monte Carlo estimation, and statistical analysis for BME applications. Prerequisite: MATH 305 with grade of C or better. Credit Hours: 3

ECE355 - Signals and Systems Signal and system classification, operations on signals, time-domain analysis, impulse response and stability, Fourier series and transform, application to communications, Laplace transform, application to linear circuits and systems, frequency response techniques, introduction to Matlab programming. Prerequisite: ECE 235 and MATH 305 (may be taken concurrently) with grades of C or better. Concurrent enrollment allowed in ECE 355L or BME 355L. Credit Hours: 3

ECE355H - Signals and Systems Honors (University Honors Program) Signal and system classification, operations on signals, time-domain analysis, impulse response and stability, Fourier series and transform, application to communications, Laplace transform, application to linear circuits and systems, frequency response techniques, introduction to discrete-time signals and systems, sampling, discrete and fast Fourier transforms. Lecture. Prerequisite: ECE 235, ECE 315 and MATH 250 with grades of C or better. Concurrent enrollment allowed in ECE 355L. Lab fee: $20 to help defray cost of software licenses and equipment. Credit Hours: 3

ECE355L - Signals and Systems Lab Introduction to Matlab programming, operations on signals, time-domain analysis, impulse response and stability, Fourier series and transform, Laplace transform, application to linear circuits and systems, frequency response techniques. Prerequisite: ECE 235 and MATH 305 (may be taken concurrently) with grades of C or better. Concurrent enrollment in ECE 355 or ECE 355H required. Restricted to enrollment in ECE program. Lab fee: $20 to help defray cost of software licenses and equipment. Credit Hours: 1

ECE356 - Linear Control Systems Introduction to signals, linear systems theory, the Laplace transform, modeling of dynamic systems and circuits, dynamic response, basic properties of feedback PID control, root-locus design method, and frequency-response design method. Prerequisites: ECE 235, ECE 315, ECE 355, and MATH 250. ECE 356L may also be taken concurrently. Credit Hours: 3

ECE356L - Systems and Control Laboratory Modeling and identification of linear time-invariant systems, understanding the effects of time delay, lead/lag controller design, PID control, controller implementation on digital computers all on a heat flow testbed. Prerequisite: ECE 356 with a C or better or concurrent enrollment. Lab fee: $20 to help defray cost of equipment. Credit Hours: 1

ECE361 - Introduction to Biomedical Engineering This course provides an introductory overview of current trends and principles of biomedical engineering. Application of engineering approaches to the analysis of biomedical systems. Principles, practice, and the role of biomedical engineers in science, engineering, healthcare, and commercialization of medical products. Professional moral and ethical issues in biomedical engineering. Prerequisite: ECE 296 with a grade of C or better or consent of instructor. Credit Hours: 3

ECE375 - Introduction to Electromagnetic Fields Elementary electromagnetic field theory; Static, quasi-static, and time-harmonic fields; Maxwell's equations in integral and differential forms; Force, energy and power; Plane waves; Transmission lines and materials; Engineering tools and applications. Prerequisites: ECE 235, MATH 251, and PHYS 205B with grades of C or better. Project fee to defray cost of software license: $90. Credit Hours: 3

ECE375H - Introduction to Electromagnetic Fields (University Honors Program) Elementary electromagnetic field theory; Static, quasi-static and time-harmonic fields; Transmission lines and materials; Smith charts; Maxwell's equations in integral and differential forms; Force, energy and power; Plane waves; Engineering tools and applications. Prerequisites: ECE 235, MATH 251 and PHYS 205B with grades of C or better. Project fee to defray cost of software license: $90. Credit Hours: 3

ECE385 - Electromechanical Energy Conversion & Power Systems Introduction to power systems. Three phase circuits. Power in single phase and three-phase circuits. Magnetic circuits, voltage induction, electromagnetic force. Power transformers. AC machines: synchronous machines; synchronous motors; induction motors. DC machines.. Prerequisite: ECE 235 with a grade of C or better. Concurrent enrollment allowed in ECE 385L. Credit Hours: 3

ECE385L - Electric Machines Lab Laboratory experiments to accompany the ECE 385 course. AC power measurements, power transformers, synchronous machine, induction machine, DC machine. Prerequisite: ECE 235 with a grade of C or better; co-requisite: ECE 385. Lab fee: $70 to help defray cost of equipment. Credit Hours: 1

ECE392 - Electrical Engineering Cooperative Education Supervised work experience in industry, government or in a professional organization. Students work with on-site supervisor and faculty adviser. Reports are required from the student and the employer. Hours do not count toward degree requirements. Mandatory Pass/Fail. Restricted to 2nd Year standing. Credit Hours: 1-6

ECE410 - Hardware Design and Architecture for AI Artificial intelligence (AI) is currently widely used in many advanced Machine learning (ML) applications. This course covers the fundamentals of design and implementation of hardware architectures for AI algorithms. Basic hardware building blocks will be introduced. It will also introduce the emerging memristor-crossbar array (MCA) as a computing platform for implementing neural network architectures. Students will gain hands-on experience through mixed-signal simulations and validation techniques. Prerequisites: ECE 327 and ECE 345 with grades of C or better. Project-based fee: $35 to help defray cost of software licenses and computers in the lab. Credit Hours: 3

ECE411 - Software Hardware Co-design for Deep Neural Networks Analysis of deep learning techniques such as deep feedforward networks, regularization, optimization algorithms, convolutional networks, and sequence modeling. Utilization of machine learning frameworks such as Tensorflow and Pytorch. Investigation of hardware architectures for machine learning applications such as GPUs, TPUs, and systolic arrays. Prerequisite: ECE 222 with a grade of C or better. Credit Hours: 3

ECE412 - Wireless Networks This undergraduate level course first introduces several widely adopted wireless communication technologies and then presents the concept, structure, and principles of ad hoc wireless networks. Novel applications in those networks will also be introduced. The coursework will include paper and literature reviews, presentations, assignments, and projects that will enable students to be familiar with ad hoc wireless networks. NS3 will be used for student projects in this course. Prerequisites: ECE 222 and ECE 355 with grades of C or better. Lab fee: $10 to help defray cost of equipment. Credit Hours: 3

ECE417 - Systems Modeling and Verification Principles of Model-Based Systems Engineering. Data modeling and rule modeling. Functional architecture. Behavioral models and executable models. Verification requirements. Requirements analysis. System test and evaluation. Process validation and verification. SysML graphical modeling language. Prerequisites: ECE 315 and ECE 327 with a grade of C or better. Credit Hours: 3. Credit Hours: 3

ECE418 - Hardware Security Introduction to hardware security. Hardware attacks. Trust and countermeasures on the electronic supply chain. Hardware IP piracy and reverse engineering. Attacks: Side channel, test-oriented, physical, PCB. Hardware security primitives. Hardware obfuscation. PCB authentication. Prerequisite: ECE 327 with a C or better. Credit Hours: 3. Credit Hours: 3

ECE419 - Systems Reliability Combinatorial aspects of system reliability. Parallel, standby, n-modular redundancy. Common cause failures. Information coding techniques. Reliability optimization and apportionment. Fault-tolerant computer design techniques. Prerequisites: ECE 315 and ECE 327 with a grade of C or better. Credit Hours: 3

ECE422 - Computer Network System Architecture Principles of Computer Networks. Protocols and system level implementations. Socket programming, router and switching fabric architecture, security and packet classification techniques, multimedia networking and QoS. Prerequisite: ECE 327. Lab fee: $10 to help defray cost of equipment. Credit Hours: 4

ECE423 - Digital VLSI Design Principles of the design and layout of Very Large Scale Integrated (VLSI) circuits concentrating on the CMOS technology. MOS transistor theory and the CMOS technology. Characterization and performance estimation of CMOS gates, CMOS gate and circuit design. Layout and simulation using CAD tools. CMOS design of datapath subsystems. Design of finite state machines. Examples of CMOS system designs. Laboratory experience in CMOS VLSI design. Lecture and Laboratory. Prerequisite: ECE 327 and 345. Lab fee: $35 to help defray cost of software licenses and equipment. Credit Hours: 4

ECE424 - Design of Embedded Systems Introduction of modern embedded system application, platform architecture and software development. Principles of embedded processor architecture, operating systems and networking connectivity. Design and optimize in terms of system power, security and performance. Lecture and laboratory. Prerequisites: ECE 296, ECE 296L, ECE 321 and ECE 329 with grades of C or better, or consent of instructor. Lab fee: $10 to help defray cost of equipment. Credit Hours: 4

ECE425 - VLSI Design and Test Automation Principles of the automated synthesis, verification, testing and layout of Very Large Scale Integrated (VLSI) circuits concentrating on the CMOS technology. Resource allocation and scheduling in high-level synthesis. Automation of the logic synthesis for combinational and sequential logic. The physical design automation cycle and CMOS technology considerations. Fault modeling and testing. Timing analysis. Laboratory experience using commercial tools for synthesis and layout. Prerequisite: ECE 327 with a grade of C- or better. Lab fee: $30 to help defray cost of software licenses and equipment. Credit Hours: 4

ECE426 - Implementation of VLSI Systems with HDL This course is dedicated for advanced Digital VLSI architecture and system implementation for high performance and low power digital signal processing applications. Application-specific processors and architectures to support real time processing of signal processing systems will be studied. Hands-on experience of using state-of-the-art CAD tools on designing such kind of VLSI architecture and systems. Upon completion of this course, students will entail large HDL-based implementation of a complete VLSI system. Prerequisite: ECE 327 with a grade of C or better. Lab fee: $35 to help defray cost of software licenses and equipment. Credit Hours: 4

ECE427 - Introduction to Integrated Interconnection Networks Role of interconnection networks. Specifications and constraints. Topology, routing, flow control, deadlock, livelock, arbitration, allocation. Prerequisite: ECE 329 with a grade of C or better. Credit Hours: 3

ECE428 - Programmable ASIC Design Principle and practice of designing and implementing Application-Specific Integrated Circuits (ASIC). Field Programmable Gate Arrays (FPGA). Timing analysis, timing closure and managing difference clock domains in ASIC design. Complex arithmetic circuits. Digital signal processing (DSP) circuits. FPGA microprocessors. Prerequisite: ECE 327 with a grade of C or better. Lab fee: $50 to help defray cost of equipment and consumable items. Credit Hours: 4

ECE429 - Computer Systems Architecture Principles of performance evaluation, processor microarchitecture, instruction-level parallelism, static and dynamic pipeline considerations. Superscalar processors. Multiprocessor systems. Memory hierarchy design, cache design. Mutual exclusion and synchronization mechanisms. Prerequisite: ECE 329 with a grade of C or better. Credit Hours: 3. Credit Hours: 3

ECE430 - Principles of Systems Programming Introduction to concepts, techniques and tools to develop complex software to manage hardware resources. Operating system modules and interfaces, kernel development, process scheduling, dynamic memory control, device drivers. Design methodologies to meet system requirements specifications. Prerequisite: ECE 321 with a grade of C or better. Lab fee: $20 to help defray cost of equipment. Credit Hours: 4

ECE431 - Cloud Computing Cloud computing has evolved as a widely accepted and adopted computing model recently. This undergraduate course introduces the concepts, basic principles, overall structures, and key technologies of cloud computing, as well as several popular cloud computing services offered by major IT companies. In addition to the general cloud computing, the course is also featured by the introduction of MapReduce and Hadoop, which are the most popular programming model and platform for processing large amounts of data in parallel on cluster machines, respectively. The course work will include paper and literature review, presentations, assignments, and projects that will enable students

to learn and use state-of-art cloud computing technologies and products. Amazon EC2 and Hadopp will be used for course projects, through which students will gain experience on how to deploy or build applications over computing clusters. Prerequisite: ECE 329 with a minimum grade of C or instructor consensus. Lab fee: $10 to help defray cost of equipment. Credit Hours: 3

ECE432 - Programming for Multi-Core Processors Multi-core architecture, threads, thread execution models, thread priority and scheduling, concurrency, multi-threaded programming models, synchronization, performance measurement and local balance, software tools for multi-threaded programming. Restricted to ECE students or consent of advisor. Prerequisite: ECE 222 with a grade of C or better. Lab fee: $20 to help defray cost of equipment. Credit Hours: 3

ECE433 - Network System Security Principles, design, and implementation of network systems security. Network security basics (computer networks and network security module), packet sniffing and spoofing, network security systems (firewall, virtual private network, and instruction detection systems), security tools (AES, Hash, RSA, and public key infrastructure), and advanced topics such as bitcoin and block chain. Prerequisite: ECE 315 or equivalent with a grade of C or better. Credit Hours: 3. Credit Hours: 3

ECE434 - Computer Systems Security Principles of computer systems security. Vulnerabilities, attacks and defenses, cryptographic primitives, authentication, digital signature, access control. Software systems security: buffer overflow, virus, SQL injection. Networking security: denial of service attack, firewall and IDS, Wi-fi security. Hardware systems security: secure processing and secure co-processor. Cloud, edge and IoT security. Prerequisite: ECE 315 with a C or better and consent of instructor. Credit Hours: 3

ECE435 - Data Analysis in Engineering with R R programming language: Vectors, Matrices, Lists, Data Frames, Factors, Tables. Review of machine learning techniques: Numerical Regression, Logistic Regression, k-Nearest Neighbors, Decision Trees. ROC curves. Various application case studies. Prerequisite: ECE 315 or equivalent with a grade of C or better. Credit Hours: 3

ECE438 - Medical Instrumentation: Application and Design (Same as BME 438) This course introduces ECE undergraduate students to the field of medical instrumentation. Medical instrumentation is the application of advanced engineering technology to problems in biology and medicine. The course focuses on fundamentals of instrumentation systems, sensors, amplifiers, and signal precondition. In addition, the course also includes design and applications of medical instrumentation, biopotential measurement, biomedical signal processing, and other related topics. Prerequisite: MATH 305 and ECE 355 with a grade of C or better, or consent of instructor. Restricted to enrollment in ECE programs. Project-based fee: $45 to help defray cost of software licenses and equipment. Credit Hours: 3

ECE440 - CMOS Radio-Frequency Integrated Circuit Design Introduction of RF IC, passive RLC Networks, passive IC components, MOS Transistors, distributed systems, Smith Chart and S-Parameters, introduction to Band-width estimation, biasing and voltage reference, basic High Frequency Amplifiers, introduction to: noise in RF IC, Low Noise Amplifiers, Power Amplifiers, Phase-Locked Loops and Oscillators. Lecture and laboratory. Prerequisite: ECE 345, ECE 375 or equivalent. Lab fee: $35 to defray the cost of software licenses and equipment. Credit Hours: 4

ECE441 - Photonics and Devices Ray optics, wave optics, beam optics, polarization of light, Fourier optics, fiber optics, electro-optics, nonlinear optical media, acousto-optics, and photonic switching. Prerequisite: ECE 375 with a grade of C or better. Lab fee: $50 to help defray the cost of consumable items as well as maintaining or replacing the existing equipment. Credit Hours: 4. Credit Hours: 4

ECE442 - Bioelectronics and Biosensors (Same as BME 418) The sources of electrical signals in biological systems. Methods and types of sensors for sensing bioelectrical signals, including amperometric, potentiometric, piezo-electric, impedance, and FET based biosensors. Interface between biosensors and electronics for sensor signal condition and data acquisition. Precision electronics for biosensor signal acquisition, including potentiostat, current, charge, capacitance and impedance sensing circuit, lock-in amplifier. Prerequisite: BME 337 or ECE 345 with a grade of C or better. Credit Hours: 3. Credit Hours: 3

ECE444 - Introduction to Computer Vision (Same as BME 444) Introduction to computer vision, computer vision applications, image fundamentals and image formation, image filtering, deep learning for computer vision, computer recognition and detection, 3D computer vision, motion and video. Prerequisite:

ECE 315 and ECE 355 with a minimum grade of C- or consent of instructor. Credit Hours: 3. Credit Hours: 3

ECE446 - Electronic Circuit Design Analysis and design of electronic circuits, both discrete and integrated. Computer-aided circuit design and analysis. Design of amplifier and filter circuits. Circuit stability analysis and frequency compensation techniques. Prerequisite: ECE 345 and ECE 355 with a grade of C or better or concurrent enrollment. Lab fee: $10 to help defray cost of software licenses and equipment. Credit Hours: 4

ECE447 - Semiconductor Devices Semiconductor industry and Moore's law. Review of quantum mechanics of atoms. From atoms to crystals: energy bands, effective mass and density-of-states. Semiconductor statistics. Carrier transport phenomena. PN junctions. Schottky junctions. Bipolar junction transistors (BJTs). MOSFETs: capacitance-voltage and current-voltage characteristics, threshold voltage, scaling and short-channel effects, SPICE models. CMOS process integration. Basic optoelectronic devices: LEDs and solar cells. Lecture and laboratory. Prerequisite: ECE 345 or equivalent. Lab fee: $25 to help defray cost of software licenses. Credit Hours: 4

ECE448 - Optical Imaging and Photonics (Same as BME 448) Geometrical optics, including refraction and reflection; Physical optics, including interference, diffraction, and polarization; Optical aberrations, including causes and effects; Fourier optics, with applications to imaging; Light sources, including LEDs and lasers; Photodetectors, including photodiodes and image sensors; Lens systems; Microscopes. Prerequisites: ECE 355, MATH 251, and PHYS 205B with a grade of C or better. Lab fee: $125 to help defray the cost of equipment, supplies, and software packages. Credit Hours: 4. Credit Hours: 4

ECE449 - VLSI Material and Device Characterization Materials for modern VLSI: semiconductor crystals, tubular and monolayer materials, organic materials, heterostructures, wafers and notations. Nanoscale fabrication processes: IC production flow, selective doping, nanolithography, etching, contacts and interconnects, spontaneous formation and ordering of nanostructures, fabrication of MEMS/NEMS systems, IC assembly and packaging. VLSI device characterization: electrical CV and IV profiling, defect characterization using DLTS, carrier mobility and lifetime measurements, optical microscopy and spectroscopy, particle beam and X-ray techniques. Reliability of devices and ICs: harsh environments, hot carriers, NBTI, electromigration, electrostatic discharge, IC power dissipation and cooling. Prerequisite: ECE 447 or ECE 423 or PHYS 425 with a grade of C or better or instructor consent. Credit Hours: 3

ECE451 - Biomedical Optics (Same as BME 431) Fundamental theories of light, including the wave theory of light and the particle theory of light; Fundamental interactions between light and matter, including reflection, refraction, absorption, scattering, fluorescence, and polarization; Biology of cells and tissues; Tissue optical properties; Tissue-targeted contrast agents; Coherence and interference; Light transport in turbid media; Diagnostic applications of light, including microscopy, spectroscopy, fluorescence imaging, fluorescence-lifetime imaging, optical coherence tomography, diffuse optical tomography, and/or biosensors; Therapeutic applications of light, including photodynamic therapy, photothermal therapy, and/or laser ablation. Prerequisites: ECE 355, MATH 251, and PHYS 205B with a grade of C or better. Credit Hours: 3. Credit Hours: 3

ECE453 - Image Sensors (Same as BME 453) Fundamentals of semiconductor physics, including the use of doping and biasing to control electronic potentials in devices; Fundamentals of integrated circuits, including the design and fabrication of diodes, transistors, and interconnects; Fundamental interactions between light and matter, including reflection, refraction, and absorption; Structure and operating modes of photodiodes; Architectures and operating principles for charge coupled device (CCD) image sensors and complementary metal-oxide-semiconductor (CMOS) image sensors; Performance metrics for image sensors, including the noise floor, the full-well capacity, the quantum efficiency, and fixed pattern noise; Construction of color image sensors; Signal processing for image sensors, including color interpolation and color correction. Prerequisite: ECE 355 and PHYS 205B with a grade of C or better.. Credit Hours: 3

ECE456 - Mechatronics and Embedded Control Components of mechatronics systems, mathematical modeling, system identification, numerical tools for design and analysis, single-loop controller design, embedded systems, data acquisition and signal conditioning, sensors, actuators, networked control. This course includes lab session. Prerequisite: ECE 315 and ECE 356. Lab fee: $35. Credit Hours: 4

ECE457 - Computational Electronics Elements of computational science/engineering. High-performance clusters and software tools for HPCs. Essential numerical methods. Fundamental physics

and modeling of charge transport in semiconductor VLSI devices. Numerical solution of Poisson equation. Numerical solution of carrier continuity equations and terminal currents in semiconductor devices. Numerical solution of the Schrodinger equation. Electronic bandstructure calculations using the tight-binding formalism. Introduction to NEGF formalism. Commercial and non-commercial semiconductor device modeling tools. Prerequisite: ECE 447 or PHYS 425 with a grade of C or better or instructor consent. Project-based fee: $25 to help defray cost of software licenses. Credit Hours: 3

ECE458 - Digital Image Processing I Basic concepts, scope and examples of digital image processing, digital image fundamentals, image sampling and quantization, an image model, relationship between pixels, enhancement in the spatial domain, enhancement in the frequency domain, image segmentation, basics of color image processing. Prerequisite: ECE 355 with a grade of C- or consent of instructor. Project-based fee: $30 to help defray cost of software licenses and equipment. Credit Hours: 3. Credit Hours: 3

ECE459 - Biomedical Microelectromechanical Systems (Same as BME 419) The course is designed to introduce students with fundamentals of MEMS and its applications. The emphasis will be on physical principle in sensors and corresponding fabrication techniques, with supplemental discussion of the state-of-art applications in industry and research. Students will learn to analyze and design systems by solving regular homework problems and active participation during lectures and in-class examples. Topics: Introduction of MEMS, fundamentals of microfabrication and nanofabrication, fundamentals of physics in sensors, a case study of electrostatic sensing, microfluidics and biomedical applications, projects. Prerequisites: MATH 251, PHYS 205A, PHYS 205B, ECE 235 each with a grade of C or better. Project-based fee: $50 to help defray cost of equipment and commodities. Credit Hours: 3

ECE460 - Principles of Biomedical Engineering Principles of biomechanics, biomaterials, electrophysiology, modeling, instrumentation, biosignal processing, medical imaging, and biomedical optics. Not for credit towards the BS in Electrical or in Computer Engineering. Prerequisite: MATH 250 with a grade of C or better or consent of instructor. Credit Hours: 2

ECE466 - Modern Control Systems Introduction to analysis of linear dynamical systems in time and frequency. Review of linear algebra and solutions of linear differential equations. State space representations, state transition matrix, and stability. Design and synthesis of controllers for linear systems. Prerequisites: ECE 355 and ECE 356. Credit Hours: 3

ECE467 - Introduction to Biomedical Imaging (Same as BME 467) Principles associated with x-ray imaging, computed tomography, ultrasound, magnetic resonance imaging, and optical imaging. Image quality. Image reconstruction. Prerequisite: MATH 305 and ECE 355 with a grade of C- or better, or consent of instructor. Project-based fee: $30 to help defray cost of software licenses and equipment. Credit Hours: 3. Credit Hours: 3

ECE468A - Digital Signal Processing This course introduces undergraduate students to the field of digital signal processing, which is an area of science and engineering that has developed rapidly. The course topics include discrete-time signals and systems analysis, z-transform, discrete Fourier transform, fast Fourier transform algorithms, digital filter design, and other related topics. Prerequisite: ECE 355 with a grade of C or better, or consent of instructor. Lab fee: $20 to help defray cost of software licenses and equipment. Credit Hours: 3

ECE469 - Introduction to Machine Learning for Engineering Applications Basic machine learning concepts: Model selection, feature scaling, bias-variance trade-off, regularization, Performance metrics and validation techniques, Probability and statistics review. Supervised learning: Linear/non-linear regression and logistic regression, Generalized linear models, Generative learning models, Bayes decision theory, Naive Bayes classifier, Nearest neighbor classifiers, Hidden-Markov models, Support vector machines, Kernel methods, Bagging, Boosting. Unsupervised Learning: Clustering: K-means, Expectation-maximization, Anomaly detection, Dimensionality Reduction: Principal components analysis, transform techniques. Basics of reinforcement learning and deep learning. Restricted to 4th Year or graduate standing. Credit Hours: 3. Credit Hours: 3

ECE470 - Fundamentals of Neural Networks in Data Science (Same as BME 470) Anatomy and physiology of the cerebral cortex, Feed-forward Networks, Multilayer Perceptrons, Recurrent Networks, Hopfield Networks, Selforganizing Networks, Convolutional Neural Network, Applications to pattern

recognition, robotics, image processing, and speech processing. Prerequisite: MATH 305 or ECE 315 or BME 351 with a C or better or consent of instructor. Credit Hours: 3. Credit Hours: 3

ECE471 - Wireless Communication Systems This course covers fundamentals of wireless communication systems. Topics include wireless system architectures, channel modeling, introduction to cellular systems, digital modulation and multiple-access techniques, introduction to multiantenna techniques, performance analysis, wireless physical layer security, future trends in wireless communications. Prerequisites: ECE 315 and ECE 355 with grades of C or better or consent of instructor. Project-based fee: $20 to help defray cost of software licenses. Credit Hours: 3. Credit Hours: 3

ECE472 - Antennas I Analysis, design, fabrication, measurement and CAD applied to basic antenna types. Fundamental parameters. Friis transmission equation. Impedance and pattern measurements. Resonant microstrip and wire antennas. Arrays and line sources. Lecture and Laboratory. Prerequisite: ECE 375. Lab fee: $120 to help defray cost of software licenses. Credit Hours: 4

ECE474 - Speech Processing This course introduces students to the rapidly developing field of speech processing. Fundamentals of speech production system, acoustic theory, signal analysis of speech, speech coding, speech synthesizing, and speech recognition algorithms. Prerequisites: MATH 250 and ECE 355 with grades of C or better or consent of instructor. Credit Hours: 3

ECE475 - Cyber Security for Digital Health This course introduces students to cyber security for digital health applications. Introduction to cyber security and cyber-attack surface, cyber security for electronic health records, cyber security for medical information, security and identity based on characteristics of face recognition and fingerprint recognition, cyber security for networked medical devices and healthcare facilities, cyber security for wearable or implantable devices. Prerequisite: MATH 251 with a minimum grade of C- or consent of instructor. Credit Hours: 3

ECE476 - Introduction to Information Theory and Channel Coding Entropy and Mutual Information. Channel Capacity. Gaussian Channel. Linear Block Codes. Convolutional Codes. Advance Channel Coding Techniques. Prerequisite: ECE 315 and ECE 355. Credit Hours: 3

ECE477 - Fields and Waves I Transmission lines for communications. Guided wave principles and resonators. Applications in electronics, optoelectronics and photonics. Principles of radiation. Solution techniques for Laplace's equation and one-dimensional wave equation. Prerequisite: ECE 375 with a grade of C or better. Credit Hours: 3

ECE478 - Principles of Communication Systems This course covers principles of communication systems. Topics include representation of signals and systems, amplitude modulation, angle modulation, probability theory and random processes for communication system designs, transition from analog to digital and pulse code/delta modulation, baseband digital transmission, digital band-pass transmission techniques, introduction to information theory and coding, wireless channel modeling, cellular systems and performance analysis. Lectures and laboratory projects. Prerequisites: ECE 315 and ECE 355 or consent of instructor. Credit Hours: 4

ECE479 - Microwave Engineering I Electromagnetic theory, analysis, design, fabrication, measurement and CAD applied to passive networks at microwave frequencies. Topics include: Transmission lines, Waveguides, Impedance matching, Tuning, Resonators, Scattering parameters, the Smith Chart. Lecture and Laboratory. Prerequisite: ECE 375. Lab fee: $100 to help defray cost of software licenses. Credit Hours: 4

ECE481 - Wind and Solar Energy Power Systems This course introduces students to wind and solar energy power systems. Planning of wind generation; and operation of wind generators, mechanical and electrical design, power conditioning, control and protection. Planning, operation and design of electric solar plants; power conditioning, control and protection. Prerequisite: ECE 385 with a grade of C or higher. Credit Hours: 3

ECE482 - Power Electronics This course offers a comprehensive overview of power electronics devices and circuits, covering both foundational and advanced concepts. The primary objective is to equip students with design methodologies and analytical tools crucial for the efficient conditioning and management of electrical power. Topics include semiconductor power materials and devices, power converters, converter dynamics and control, and switched mode power supply, and their mathematical

modeling. Real-world applications in clean energy, electrification, electric vehicles, computing, display, and solid-state lighting will be covered. Fabrication and packaging of power electronics modules will also be discussed. Students will also engage in hands-on design projects using industry-standard TCAD software. Prerequisite: ECE 345 with a grade of C or better, or instructor consent. Project/design fee: $65 to help defray cost of software licenses Credit Hours: 3

ECE483 - Electric Drive Systems Course content is roughly 1/3 power electronics, 1/3 applied control and 1/3 electric machinery and focuses on analysis, simulation, and control design of electric drive based speed, torque, and position control systems. Advanced topics depending on the semester are taught. Prerequisite: ECE 356 and ECE 385 with a grade of C or better. Lab fee: $65 to help defray cost of software licenses and equipment. Credit Hours: 3

ECE484 - Electric and Hybrid Vehicles This course provides a comprehensive overview of modern all electric vehicles. It also touches on hybrid and plug-in hybrid vehicles. Topics include design analysis of vehicle components, trends in state-of-the-art power electronics materials, devices, and converters, battery and energy storage technologies, and the interaction of vehicles with the power grid. Key technical aspects with appropriate level of mathematical formulations and engineering design guidelines will be discussed. Essential features of autonomous driving system architecture and the associated hardware and software requirements will also be covered. System-level design may be considered using industry-standard TCAD design software. Prerequisite: ECE 345 with a grade of C or better, or instructor consent. Project/design fee: $65 to help defray cost of software licenses. Credit Hours: 3

ECE486 - Clean Electric Energy History and future of energy resources and their use as a component of electrical systems. Fossil fuels and renewable energy sources. Environmental and economical impacts of various energy sources. Electric energy generating plants and distributed generation. Design of hybrid renewable energy systems. Prerequisite: ECE 385 with a grade of C or better, or consent of instructor. Credit Hours: 3. Credit Hours: 3

ECE487 - Power Systems Analysis Modeling and analysis of electric power systems. Topics covered: AC power, generators, power transformers, transmission line parameters and steady state operation, computation of power flows. The course uses power system analysis software. Prerequisite: ECE 385 with a grade of C or better, or consent of instructor. Credit Hours: 3. Credit Hours: 3

ECE488 - Power System Engineering The course covers topics involving the design and operation of a power system. Topics: symmetrical and unsymmetrical power system faults, power system protection design, transient stability of power generators, power system economic operation, power system control, transient operation of transmission lines. The course uses power system software. Lecture. Prerequisite: ECE 487 with a grade of C or better. Credit Hours: 3

ECE489 - Electric Power Distribution Design of primary and secondary distribution networks. Load characteristics. Voltage regulation. Metering techniques and systems. Protection of distribution systems. Special topics related to power distribution. Prerequisite: ECE 235 with a grade of C or better. Credit Hours: 3

ECE492 - Special Studies in Electrical Engineering Individual projects and problems selected by student or instructor. Open to 4th Year students only. Not for graduate credit. Special approval needed from the instructor. Credit Hours: 1-6

ECE493 - Special Topics in Electrical Engineering Lectures on topics of special interest to students in various areas of electrical engineering. Designed to test new and experimental courses in electrical engineering. Special approval needed from the instructor. Credit Hours: 1-4

ECE494 - Diagnostic Ultrasound Diagnostic ultrasound is an ultrasound-based biomedical imaging technique used to visualize muscles, tissue, and many internal organs, to capture their size, structure and any pathological lesions. This course is an introduction to the principles and applications of biomedical ultrasound. This course will focus on fundamentals of acoustic theory, principles of ultrasonic detection and imaging, design and use of currently available tools for performance evaluation of diagnostic devices, and biological effects of ultrasound. Prerequisite: MATH 305 and ECE 355 with a grade of C or consent of instructor. Restricted to enrollment in ECE programs. Lab fee: $30 to help defray cost of equipment, supplies, and software licenses. Credit Hours: 3

ECE495C - Computer Engineering Capstone Design I Capstone Design part 1. Preparation for professional computer engineering practice with a major design experience based on earlier coursework, incorporating appropriate engineering standards and multiple constraints. Includes aspects of project development and design within a team such as communicating, documenting, establishing goals, planning tasks, meeting deadlines, analyzing risk, and fulfilling responsibilities professionally and ethically. Not for graduate credit. Prerequisites: ECE 296, ECE 321, ECE 329, ECE 345, ECE 355 with grades of C or better. Restricted to 4th Year standing in Computer Engineering. Lab fee: $50 to help defray cost of software licenses, equipment and consumable items. Credit Hours: 3

ECE495D - Electrical and Computer Engineering Capstone Design II Capstone Design part 2. Continuation of a major design experience based on earlier coursework, incorporating appropriate engineering standards and multiple constraints. Team approach in engineering projects. Work plan/time scheduling. Design options & cost-benefit analysis. Development of the final decision. Team coordination & documentation of team member efforts, design stages, team communication, and team decision making processes. Implementation of the design (if the project warrants). Evaluation of the final product. Written, oral, and poster presentation of final design. Not for graduate credit. Prerequisite: ECE 495C or ECE 495E or BME 495A with a C or better. Lab fee: $50 to help defray cost of software licenses, equipment and consumable items. Credit Hours: 3

ECE495E - Electrical Engineering Capstone Design I Capstone Design part 1. Preparation for professional electrical engineering practice with a major design experience based on earlier coursework, incorporating appropriate engineering standards and multiple constraints. Includes aspects of project development and design within a team such as communicating, establishing goals, planning tasks, meeting deadlines, analyzing risk, and fulfilling responsibilities professionally and ethically. Not for graduate credit. Prerequisites: ECE 296, ECE 327, ECE 345, ECE 355, ECE 375 with grades of C or better. Restricted to 4th Year standing in Electrical Engineering. Lab fee: $50 to help defray cost of software licenses, equipment, and consumable items. Credit Hours: 3

ECE496A - Honors in Electrical and Computer Engineering-Honors Reading Must be taken during the last two years of the undergraduate's career. Special approval needed from the department. Credit Hours: 3

ECE496B - Honors in Electrical and Computer Engineering-Honors Supervised Research Must be taken during the last two years of the undergraduate's career. Research culminating in an honors thesis for the University Honors Program. Prerequisite: ECE 496A or consent of department. Credit Hours: 3

Computer Engineering Faculty

Ahmed, Shaikh, Professor, Ph.D., Arizona State University, 2005.

Anagnostoupoulos, Iraklis, Associate Professor, Ph.D., National Technical University of Athens, 2014.

Aruma Baduge, **Gayan,** Associate Professor, Ph.D., University of Alberta, 2013, 2016.

Asrari, Arash, Assistant Professor, Ph.D., University of Central Florida, 2015.

Chen, Ying, Associate Professor, Ph.D., Duke University, 2007.

Kagaris, Dimitrios N., Professor, Ph.D., Dartmouth College, 1994.

Komaee, Arash, Associate Professor, Ph.D., University of Maryland, College Park, 2008.

Lu, Chao, Assistant Professor, Ph.D., Purdue University, 2012.

Phegley, James, Senior Lecturer, Ph.D., Southern Illinois University, 2001.

Qin, Jun, Associate Professor, Ph.D., Duke University, 2008.

Sayeh, Mohammad, Professor, Ph.D., Oklahoma State University, 1985.

Tragoudas, Spyros, Professor and Director, Ph.D., University of Texas, Dallas, 1991.

Wang, Haibo, Professor, Ph.D., University of Arizona, 2002.

Weng, Ning, Associate Professor, Ph.D., University of Massachusetts, 2005.

Emeriti Faculty

Botros, Nazeih, Professor, Emeritus, Ph.D., University of Oklahoma, 1985.
Brown, David P., Professor, Emeritus, Ph.D., Michigan State University, 1961.
Daneshdoost, Morteza, Professor, Emeritus, Ph.D., Drexel University, 1984.
Gupta, Lalit, Professor, Emeritus, Ph.D., Southern Methodist University, 1986.
Harackiewicz, Frances J., Professor, Emerita, University of Massachusetts at Amherst, 1990.
Hatziadoniu, C., Professor, Emeritus, Ph.D., West Virginia University, 1988.
Galanos, Glafkos, Professor, Emeritus, University of Manchester, England, 1970.
Osborne, William P., Professor, Emeritus, Ph.D., New Mexico State University, 1970.
Pourboghrat, Farzad, Professor, Emeritus, Ph.D., University of Iowa, 1984.
Smith, James G., Professor, Emeritus, Ph.D., University of Missouri at Rolla, 1967.
Viswanathan, R., Professor, Emeritus, Ph.D., Southern Methodist University, 1983.

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