**ELECTRICAL ENGINEERING (EE)**

**EE 2400. Circuits I.**
This course provides an introduction to the profession of Electrical Engineering and its specialties. Fundamental DC and sinusoidal steady-state circuit analysis techniques include Ohm's law, power, Kirchhoff's laws, and Thevenin and Norton equivalent circuits. Prerequisites: MATH 2471 with a grade of "C" or better.
**4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.**
**Grade Mode:** Standard Letter

**EE 2420. Digital Logic.**
An introduction to fundamental computer technologies, including Boolean logic design, logic circuits and devices, and basic computer hardware are studied. Laboratories provide hands-on experience with electricity, combinational and sequential digital circuits, and computer hardware. Prerequisite: CS 1428 with a grade of "C" or better.
**4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.**
**Course Attribute(s):** Lab Required
**Grade Mode:** Standard Letter

**EE 3340. Electromagnetics.**
Wave propagation, Maxwell's equations, transmission lines, wave guides, and antennas. Prerequisites: MATH 3373 and PHYS 2435 with grades of "C" or better. Co-requisite: EE 3300 or EE 3400.
**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**
**Grade Mode:** Standard Letter

**EE 3350. Electronics I.**
Analysis and design of active device equivalent circuits with emphasis on transistors, switching circuits, and operational amplifiers. Prerequisites: EE 3300 or EE 3400, all with a grade of "C" or better.
**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**
**Course Attribute(s):** Lab Required
**Grade Mode:** Standard Letter

**EE 3355. Solid State Devices.**
Semiconductor materials, principles of carrier motion, operating principles and circuit models for diodes, bipolar transistors and field-effect transistors. Introduction to integrated circuits. Prerequisites: EE 3300 or EE 3400 all with a grade of "C" or better.
**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**
**Course Attribute(s):** Lab Required
**Grade Mode:** Standard Letter

**EE 3370. Signals and Systems.**
Frequency domain representation of signals and systems and frequency domain concepts for circuit analysis and design. Transfer function and frequency response, Laplace and z-transforms, Fourier series, Fourier transform, and sampling. Prerequisites: EE 3300 or EE 3400, with a grade of "C" or better.
**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**
**Grade Mode:** Standard Letter

**EE 4321. Digital Systems Design Using HDL.**
This course will cover the design of digital systems using HDL including implementation of custom microprocessor and peripheral architectures. Prerequisite: EE 3420 with a grade of "C" or better.
**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**
**Grade Mode:** Standard Letter

**EE 4323. Digital Image Processing.**
This course provides the necessary fundamental techniques to analyze and process digital images. It covers principles, concepts, and techniques of digital image processing and computer vision. Prerequisites: CS 1428 and EE 3420, all with a grade of "C" or better.
**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**
**Grade Mode:** Standard Letter

**EE 4350. Electronics II.**
Analysis and design of integrated circuits, feedback, and frequency response. Prerequisites: EE 3350 with a grade of "C" or better.
**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**
**Course Attribute(s):** Lab Required
**Grade Mode:** Standard Letter

**EE 4351. Fundamentals of Electroceramics.**
Introduction to binary and ternary phase diagrams, non-centro-symmetric crystal structures and symmetry groups, nonlinear dielectrics (including ferroelectricity, piezoelectricity, pyroelectricity), nonlinear magnets, oxide wideband gap semiconductors, detectors and sensors, brief introduction to MEMS, radhard electronics, and spintronics technology. Research oriented labs related to materials processing, characterization, fabrication, and testing. Prerequisite: ENGR 2300 or equivalent with a grade of "D" or better; Co-requisite: EE 3355 with a grade of "D" or better, GPA of 2.25 or higher.
**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**
**Grade Mode:** Standard Letter

**EE 4352. Introduction to VLSI Design.**
Analysis of design of CMOS integrated circuits. Introduction to CAD tools for VLSI design. Prerequisites: CS 2420 or EE 2420 and EE 3350, all with grades of "C" or better.
**3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.**
**Course Attribute(s):** Lab Required
**Grade Mode:** Standard Letter
Key concepts of advanced semiconductor technology including Moore's law, MOSFETs and CMOS, CMOS scaling, high K gate dielectrics, new channel materials replacing silicon, three dimensional device structures, compound semiconductor MESFET, HEMT, LED, Lasers and solar cells. Prerequisite: EE 3355 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 4354. Flexible Electronics.
This course will cover the materials systems, processes, device physics and applications of flexible electronics. The materials range from amorphous and nanocrystalline silicon, organic and polymeric semiconductors to solution cast films of carbon nanotubes. Real device discussions include high speed transistors, photovoltaics, flexible flat panel displays, medical image sensors, etc. Prerequisites: EE 3350 and EE 3355 and EE 4350, all with a grade of "C" or better, or permission of the instructor.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 4355. Analog and Mixed Signal Design.
Operational amplifier design applications, feedback, offset, stability, and compensation. Introduction to random signals, analog-to-digital converters, and digital-to-analog converters. Prerequisites: EE 3370 and EE 4350, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter

EE 4356. Power Electronics.
This course provides an introduction to power electronics and the use of such circuits for the control and conversion of electric power. Topics include semiconductor power devices and characteristics, DC-DC and multilevel converters, power inverters, and AC voltage controllers. Prerequisite: EE 4350 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 4358. Introduction to Microelectromechanical Systems.
This course will cover fabrication techniques for microelectromechanical devices and systems as well as provide an introduction to the design of micromechanical transducers. Co-requisite: MFGE 4392 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter

EE 4360. Linear Control Systems.
This course provides an introduction to linear continuous-time and discrete-time automatic control systems. Topics include time and frequency domain modeling and analysis, state variable analysis, feedback, transient and steady state response, stability, and sensitivity. Prerequisite: EE 3370 and MATH 3377, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 4362. Communication Networks.
Data communication concepts, protocols, algorithms, 7-layer OSI model, physical media, LAN architecture and components, Ethernet, FDDI, TCP/IP and related standards. Prerequisite: EE 2400 and EE 3420, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter

EE 4366. Introduction to Telecommunications.
Fundamentals of telecommunications, telephone networks, switching and transmission systems, circuit and packet switching, cell processing, and queuing theory and applications. Co-requisite: EE 4370 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 4368. Data Compression and Error Control Coding.
Introduction to information theory, information content of messages, entropy and source coding, data compression, channel capacity, data translation codes, and fundamentals of error correcting codes. Corequisite: EE 4370 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter
EE 4390. Electrical Engineering Design I.
This course is a team-based design of a system or component, which will include oral presentations and written reports. Prerequisites: EE 3350 and EE 3370 and EE 3420, all with a grade of "C" or better. Co-requisites: EE 4352 or EE 4370. (WI).
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required|Writing Intensive
Grade Mode: Standard Letter

EE 4391. Electrical Engineering Design II.
Advanced team-based design of a system or component, which will include oral presentations and written reports. (WI) Prerequisites: EE 4390 and EE 4352 or EE 4370, all with a grade of "C" or better.
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required|Writing Intensive
Grade Mode: Standard Letter

EE 4399A. Dynamic Data Acquisition and Analysis.
Methods for acquiring and analyzing dynamic (time-varying) data. Frequency domain analysis, analog-to-digital conversion, windowing, and digital filtering taught in the context of various industrial applications. Prerequisite: EE 3370 Signals and Systems.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

EE 4399B. Overview of Information Theory and Coding.
Fundamentals of Information Theory, Huffman coding, image encoding techniques, Hamming and BCH error control codes, Reed-Solomon coding, convolutional codes and the Viterbi decoding algorithm.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

This course teaches design and analysis of high-performance computer systems, focusing on quantitative analysis of the latest processors and compilers. Current processor architectures are surveyed for system design. Topics include instruction sets, parallelizing architectures, pipelining, I/O, memory and cache organization, parallel/vector processing, fast arithmetic units design, and implementation using HDL. Prerequisites: EE 3420 and CS 3339, all with a grade of "C" or better, or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course provides the necessary fundamental techniques to analyze and process digital images. It covers principles, concepts, and techniques of digital image processing and computer vision. Prerequisites: ED 3420 or CS 2308 with a grade of "C" or better, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course teaches development of embedded computing systems with strong resource constraints. Key concepts include managing constrained memory and processing speed limitations, and programming for soft and hard real-time constraints. Students will learn use of a Real-Time Operating System (RTOS). Prerequisites: EE 3420 and CS 3339, all with a grade of "C" or better, or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5350. Advanced Electronic Circuit Design.
This course includes low and high power RF amplifier design techniques, oscillators, FM demodulators, limiters, and mixer design. Additional topics include circuit design to minimize intermodulation and other forms of distortion, and RD and high-speed analog circuits with emphasis on digital-friendly applications. Prerequisite: EE 4350 with a grade of "C" or better, or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

In this course students will learn key concepts and trends of advanced semiconductor device technology. Topics include Moore's law, MOSFET, CMOS and scaling, high-K gate dielectrics, new channel materials replacing silicon, three dimensional and compound semiconductor device structures. In addition students will be involved in laboratories and seminar presentations. Prerequisite: Instructor Approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5354. Flexible Electronics.
This course will cover the materials systems, processes, device physics and applications of flexible electronics. The materials range from amorphous and nanocrystalline silicon, organic and polymeric semiconductors to solution cast films of carbon nanotubes. Real device discussions include high speed transistors, photovoltaics, flexible flat-panel displays, medical image sensors, etc. Prerequisite: Instructor’s approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5390. Electrical Engineering Design I.
This course is a team-based design of a system or component, which will include oral presentations and written reports. Prerequisites: EE 3350 and EE 3370 and EE 3420, all with a grade of "C" or better. Co-requisites: EE 4352 or EE 4370. (WI).
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required|Writing Intensive
Grade Mode: Standard Letter

EE 5391. Electrical Engineering Design II.
Advanced team-based design of a system or component, which will include oral presentations and written reports. (WI) Prerequisites: EE 4390 and EE 4352 or EE 4370, all with a grade of "C" or better.
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required|Writing Intensive
Grade Mode: Standard Letter

EE 5399A. Dynamic Data Acquisition and Analysis.
Methods for acquiring and analyzing dynamic (time-varying) data. Frequency domain analysis, analog-to-digital conversion, windowing, and digital filtering taught in the context of various industrial applications. Prerequisite: EE 3370 Signals and Systems.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

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Fundamentals of Information Theory, Huffman coding, image encoding techniques, Hamming and BCH error control codes, Reed-Solomon coding, convolutional codes and the Viterbi decoding algorithm.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

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3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course teaches development of embedded computing systems with strong resource constraints. Key concepts include managing constrained memory and processing speed limitations, and programming for soft and hard real-time constraints. Students will learn use of a Real-Time Operating System (RTOS). Prerequisites: EE 3420 and CS 3339, all with a grade of "C" or better, or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5350. Advanced Electronic Circuit Design.
This course includes low and high power RF amplifier design techniques, oscillators, FM demodulators, limiters, and mixer design. Additional topics include circuit design to minimize intermodulation and other forms of distortion, and RD and high-speed analog circuits with emphasis on digital-friendly applications. Prerequisite: EE 4350 with a grade of "C" or better, or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

In this course students will learn key concepts and trends of advanced semiconductor device technology. Topics include Moore's law, MOSFET, CMOS and scaling, high-K gate dielectrics, new channel materials replacing silicon, three dimensional and compound semiconductor device structures. In addition students will be involved in laboratories and seminar presentations. Prerequisite: Instructor Approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5354. Flexible Electronics.
This course will cover the materials systems, processes, device physics and applications of flexible electronics. The materials range from amorphous and nanocrystalline silicon, organic and polymeric semiconductors to solution cast films of carbon nanotubes. Real device discussions include high speed transistors, photovoltaics, flexible flat-panel displays, medical image sensors, etc. Prerequisite: Instructor’s approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
EE 5355. Electronic Materials and Devices.
This course covers theoretical concepts applicable to the understanding of unique properties exhibited by electronic materials, especially by dielectrics, oxide semiconductors, ferroelectrics, pyroelectrics, piezoelectrics, magnetic, and multifunctional and multiferroic materials. The various microelectronic devices and modern novel technologies based on these materials are emphasized. Prerequisite: EE 3350 with a grade of "B" or better, or equivalent, with a grade of "B" or better, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5360. Thin Film Technology.
This course covers the theoretical and practical aspects of thin film technology in modern devices. The design and fabrication of thin film heterostructures is discussed. Growth and nucleation of epitaxial thin films with diverse properties and devices with combined properties will be emphasized. Prerequisite: EE 3350 with a grade of "B" or better, or equivalent, with a grade of "B" or better, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5372. Advanced Networking.
This course develops important theoretical and application topics related to advanced networking. Theoretical topics are introduced using mathematical treatments, including queueing theory and some random processes. The course includes applications of these topics to communications networks, and focuses on architectures, applications and technologies which affect modern computer and data networks. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5374. Introduction to Wireless Communication.
This course teaches principles and practices in designing and analyzing cellular and other wireless communication systems. Topics include RF propagation modeling, fast and slow fading, modulation, demodulation, coding, and multiple access techniques. Prerequisite: EE 4370 with a grade of "C" or better. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5375. Smart Grid: an Application Development Platform.
In this course, students will learn how to develop real applications for the smart grid and model its performance with simulations and stochastic models. Topics include energy informatics, smart metering, home energy management, demand response, load disaggregation and APIs/OpenData. The mathematical tools used include: Optimization/Control, Machine Learning and Stochastic Processes. Prerequisites: EE 3370 or EE 4340 or approval of instructor.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course develops the theory and applications of random processes using mathematical treatments, including elementary discrete and continuous time linear systems theory, elementary probability, and transform theory. Topics include applications of random processes to information and communication theory, estimation and detection, control, signal processing, and stochastic systems theory. Prerequisite: ENGR 5310 with a grade of "C" or better, or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5385. Optoelectronic Devices.
This course introduces the student to the concepts, physical operations, and design criteria of state-of-the-art optoelectronic devices and systems used in research, technology, medicine, communication, and other modern applications. Prerequisites: EE 3355 or EE 4350, or equivalent, with a grade of "C" or better; or approval of instructor. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5398A. Antenna Theory, Design and Applications.
This course covers the basic theory, design and applications of antennas. The topics include antenna radiation, fundamental parameters of antennas, linear wire antennas, loop antennas, antenna arrays, long-periodic antennas, horn antennas, microstrip antennas and modern nano-antennas. Restricted to students enrolled in the MS Engineering program. Prerequisite: EE 3340 or EE 3370 (or an equivalent) with a grade of "C" or better, or Instructor's approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing Topics
Grade Mode: Standard Letter

EE 5398B. Electronic Materials and Beyond for Sustainable Energy.
This course covers the basic science and technology for sustainable energy from the view of materials, where electronic materials are highly emphasized. The topics include solar cells, thermoelectrics, batteries, supercapacitors, artificial photosynthesis, fuel cells, biomass and nuclear energy. Restricted to students enrolled in MS Engineering program. Prerequisite: EE 3355 or equivalent, with a grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing Topics
Grade Mode: Standard Letter

EE 5398C. Multimedia Signal Processing.
This course covers theory and applications of digital signal processing to multimedia signals, including speech, audio, image, and video. Key concepts and algorithms are discussed first, followed by a review of relevant industry standards. Hardware architectures and real-time implementation concepts appropriate for multimedia signals are also included. Restricted to students enrolled in MS Engineering program. Prerequisites: EE 3370 (or equivalent) and EE 4377 or EE 4323 (or an equivalent), all with a grade of "C" or better; or Instructor's approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing Topics
Grade Mode: Standard Letter
EE 5398D. Electroceramics.
This course covers binary and ternary phase diagrams, non-centrosymmetric crystal structures and symmetry groups, nonlinear dielectrics (ferroelectricity, piezoelectricity, pyroelectricity), nonlinear magnetics, oxide wideband gap semiconductors, detectors and sensors, introduction to MEMS, radhard electronics, and spintronics technology. Labs and additional research-oriented instruction are related to materials processing, characterization, fabrication, and testing. Restricted to students enrolled in the MS Engineering program. Prerequisite: EE 3355 with a grade of "B" or better, or Instructor’s Approval.
3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter